Textbook of
Complete Denture
PROSTHODONTICS

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To
My beloved parents
D.K Lakshman Gowda
Seetha Lakshman

Foreword

I have carefully gone through the text, arrangement of the illustrations and the language in the text and feel that this book entitled *Textbook of Complete Denture Prosthodontics* would prove to be a trendsetter in Prosthodontics for reasons of clarity of basic sciences, which constitute biological foundation. It is truly heartening to observe that the living character of the foundation has received major consideration in treatment approach. Topic wise arrangement of the text and inclusion of treatment approach to miscellaneous atypical conditions has been done thoughtfully. I feel that this book will be of great use to both undergraduate and postgraduate students in Prosthodontics. In addition, consideration for inclusion of laboratory procedures in Prosthodontics will definitely aid organization of mind for planning treatment.

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Preface

I have made this humble effort of writing this book *Textbook of Complete Denture Prosthodontics* with an aim to provide the basic knowledge of complete denture prosthodontics to the learners of the art and science of prosthodontics. This accomplishment of mine also attempts at avoiding the dependence of learners on foreign books taking the cost factor into consideration. However, I have avoided compromising on the quality by providing the scientific basis of complete denture treatment with emphasis on laboratory procedures, which is very essential for the success of the treatment. A number of photographs and illustrations have been included so that not much is left to the fate of imagination. As with all textbooks, even this attempt of mine may have shortcomings, which I would like to overcome in the subsequent editions through your valuable suggestions.

Sarandha D.L

Acknowledgements

I invoke **God, the almighty,** and bow down in reverence to my **Alma Mater "Sri Manjunatheshwara College of Dental Sciences and Hospital", Dharwad.**

My heart felt gratitude to my **parents** for all my achievements. I appreciate the moral support, encouragement and prayers of my parents and **sister Nathali.**

I am highly indebted to **Dr Sri Veerendra Heggade**, Dharmadhikari of Dharmasthala and Chairman of Sri Dharmasthala Manjunatheshwara College of Dental Sciences and Hospital, Dharwad for providing me an opportunity to study in his esteemed institution.

My sincere gratitude to my teacher, guide and professional idol **Dr Subhash M Joshi** MDS for teaching me the finest art of Prosthodontic treatment based on biologic principles rather than a mechanical approach. His encouraging attitude, an eye to see the positive aspect of my work before a healthy criticism and faith in my ability has helped me inculcate confidence in my academic career. I immensely thank him for taking personal interest in this endeavor in spite of his other professional commitments.

I take this opportunity to thank **all my teachers at SDM College of Dental Sciences, Dharwad** for laying a strong foundation to my professional achievements with a special note of thanks to my Principal, **Dr C. Bhasker Rao** MDS, and postgraduate teachers **Dr Narendra P Patil** MDS **, Dr Ramesh Nadiger** MDS**, Dr Jagdeesh** MDS**, Dr Sunil Kumar** MDS **and Dr Lekha** MDS. **Dr Sunil Kumar's** thoughtfulness to correct the chapter on Implants is sincerely appreciated.

A very special note of appreciation and gratitude to **Dr Zakir Hussain** MDS for his contribution towards this task and helping me in every stage during the preparation of this book.

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The invaluable assistance of my colleagues and friends **Dr Prafulla Thumati, Moumita, Jayanti, Dr Ghanshyam Jinka, Dr Umapathi, Dr Bharath Shetty, Dr Sajjad Salam, Dr Wilma Fernandez, Dr Deepti Sinha, Dr Jatin Agarwal, Dr Sathyabodh Guttal and Dr Sudhindra Kulkarni** are sincerely appreciated.

This task would not have been possible without the sincere efforts of **Mr. Srinath of Guru Communications**. His patience and timely help is sincerely appreciated.

A very special note of thanks to **all my students** for being my source of inspiration **and my patients** for being the source of my practical experience.

Sincere gratitude to **Jaypee Brothers Medical Publishers (P) Ltd, New Delhi** for considering publishing this book. A very special note of thanks to Mr Manjunath Hegde for being the coordinator on behalf of the publisher and for his valuable suggestions.

Last but not the least, I thank all those who have contributed through their prayers and good wishes.

Contents

CHAPTER 1

Human Masticatory Apparatus: Transition from Dentulous to Edentulous State

INTRODUCTION

The masticatory apparatus comprises of teeth, periodontal tissues, oral mucosa, salivary glands, neuromuscular system, jawbones, tongue and temporomandibular joints. The gradual transition from dentulous to edentulous state has important implications in prosthodontic treatment, which includes the treatment choice, clinical procedures and the prognosis. Some of the age-related changes that affect the orofacial structures might be physiologically normal, however treatment should be rendered to the elderly people with an awareness of biologic factors since the adaptive mechanism and tissue regenerative potentials are usually significantly lowered. Hence, they require a different approach, modified treatment planning and knowledge of how the tissue changes associated with senescence affect oral health.

DENTAL TISSUE

As age advances, the wear of enamel accentuates giving the occlusal surfaces of a flat appearance. The gradual change in the quantity and quality of dentine due to formation of secondary dentine result in teeth that are more yellow and with decreased translucency. There is a significant increase in the thickness of cementum on the root. In addition, *gingival recession* as age advances, contributes to the discoloration and root caries. Teeth also show signs of root resorption, which may be a result of local injuries and mechanical stresses. With increasing age the volume of pulp decreases as a result of continuous apposition of dentin. This is associated with *fibrosis of the pulp tissue* and reduced vascularization. Tooth wear is a major problem in the older patients. The causes are *attrition, abrasion and erosion. Attrition* is the gradual loss of tooth substance due to mechanical action on the tooth as in para functional habits like bruxism/increased occlusal forces. *Abrasion* is usually caused by friction from a foreign body, independent of occlusion between teeth. *Erosion* is defined as the loss of hard tooth substance due to chemical process not involving bacteria, for example, the intake of acidic beverages.

Generally restorative and prosthetic treatment of worn dentitions is difficult to create sufficient retention for the partial prosthesis due to decrease in the size of the teeth and continued ill effects on the prosthesis. It may also be difficult to completely eliminate the factors causing wear of teeth.

PERIODONTAL TISSUES

The periodontium consists of the supporting tissues of the tooth, comprising the gingiva, periodontal attachment, alveolar bone and cementum. The structure of the periodontium becomes more irregular with age and deposition of cementum, which continues throughout life. One of the main reasons for complete edentulism is periodontal disease. *Periodontitis* is a slow progressive disease, which results in pocket formation due to loss of periodontal attachments, gingival recession and exposure of the root surface, increased tooth mobility and ultimate loss of the affected teeth. This sequence is not a result of age but of chronic disease state within the supporting structure of the tooth. Early sequential loss of teeth because of periodontal disease may, however, cause irregular resorption of bony ridge, which may compromise the stability of denture.

ORAL MUCOSA

The oral mucosa comprises three broad categories: (1) *Masticatory mucosa,* which is keratinized or para keratinized and covers the palatal vault and the attached gingiva. (2) *Lining mucosa*, which is nonkeratinized and comprises the mobile lining tissues within the mouth, including the cheeks, the floor of the mouth, ventral surface of the tongue and the soft palate.(3) *Specialized mucosa* which covers the lips and dorsum of the tongue.

The oral tissues like other tissues in the body change as an individual grows older. The oral mucosa of the aged is friable and easily injured. The mucosa in the elderly person is generally thin and tightly stretched and it blanches easily. Aging produces changes in the blood vessels, particularly atherosclerotic changes. Oral varicosities are often noted on the undersurface of the

tongue and in the floor of the mouth. The incidence of oral cancer is associated with aging patients, which accounts for approximately 4 percent of all cancers. Here the mucosa should be carefully examined and critically evaluated. When the mucosa lacks adequate keratinization, the protective capacity provided by the keratinized layer is reduced and the patient is prone to suffer from chemical, bacterial and mechanical irritations. The capacity of the prosthesis to initiate mechanical irritations in these patients is, therefore, a significant problem in patient management. The mucosa presenting heavy layers of thick keratin should be closely and continuously examined. The level of pain threshold of soft tissue changes markedly after the menopausal period and male climacteric. Hence, denture tolerance as a consequence, is markedly reduced.

SALIVARY GLANDS

Sufficient amount of saliva is necessary for the maintenance of oral health and comfort. In this respect, saliva is particularly important in wearers of removable dentures to protect the oral mucosa from mechanical irritation and infections and to achieve retention in complete dentures. The normal unstimulated salivary flow rate is 0.38 ± 0.21 ml/min. Impaired salivary secretion or xerostomia is likely, if the unstimulated flow rate is less than 0.12 ml/min. Of the whole unstimulated saliva, 40 percent is derived from the submandibular glands and 8 percent from mucosal glands. The normal stimulated salivary flow rate is less than 0.60 ml/min of the whole stimulated saliva and 50 to 65 percent is derived from the parotid glands.

In major salivary glands of humans, fat accumulation occurs predominantly as progressive infiltration, which increases with age. These adipose cells may gradually encroach on the parenchyma extending inwards from the periphery of the lobules replacing the entire lobule with adipose tissue. There is an age-related increase in the amount and density of the fibrous skeletal component both around the ducts and in the septa which thus, appears widened intralobularly so that the acini becomes more widely spaced. The masticatory function stimulates salivary flow. Hence, decreased masticatory function will cause oral dryness and reduced salivary flow because of atrophy of salivary glands and reduced synthesis and secretion of saliva. Thus, appropriate masticatory function is important for proper maintenance of the salivary flow and overall quality of life for the elderly. The diminished function of the glands also results in physiochemical changes in the saliva, which shows a decrease in ptyalin content and an increase in mucous content.

Reduced salivary flow contributes to dry and inelastic oral mucosa, cracked lips, fissuring of tongue and oral mucosa, sore spots under the denture, poor retention of denture and difficulty in swallowing. Due to lowered ptyalin content of saliva, digestion of cooked starch is remarkably reduced. *Xerostomia* also affects oral hygiene and adherence of food particles to tissues predisposing it to infection.

NEUROMUSCULAR SYSTEM

As age advances there is a decrease in the speed with which muscle tension can be developed and released and in the muscle power by which work can be performed. There is reduction in the fiber muscle mass. Furthermore a slowly progressive degeneration of the muscles is a feature of the aging process consistent with long contraction of tissues and slowly contracting muscles.

JAW BONES

In elderly subjects, the bone formation activity is decreased in relation to bone resorption activity in the jawbones. The cortical porosity of the mandible also increases. Changes are characterized by *altered anatomy with a shift in the origin of mentalis, buccinator, mylohyoid and genioglossus muscles* that assume superior position along with *mental foramen* in the mandible. The degenerative changes in the blood vessels cause decreased blood supply to the bones. The mandibular blood supply becomes merely extra-osseous via the plexus of vessel formed by the facial, buccal and lingual arteries.

TEMPOROMANDIBULAR JOINTS

With advancing age the joint tends to lose its ability to withstand degenerative changes and shows progressive change comparable to those seen in osteoarthritis. These changes vary from slight fraying of the articular surfaces to cleft formation between the bundles of fibrous tissue of which the articular surfaces and the disc are composed. The severities of changes are related to advancing age and are more intense. When there is loss of posterior part of the dentition, mandibular condyle itself undergoes gradual reduction in size and the articular surface becomes flattened with advancing age. Temporomandibular disorders include a number of clinical problems that involves the masticatory musculature, temporomandibular joints and associated structures. Temporomandibular disorders indicate a deviation from normal function that may be the cause or the consequence of changes or disorders of one or more components of the masticatory apparatus.

TONGUE

Taste buds, which are responsible for taste perception, reside predominantly in the papillae of the tongue, although smaller populations are also present in the epithelia of the soft palate and the larynx. There is a tendency for the taste buds to diminish in number in old age. "Bald tongue", one in which the filiform papillae are atrophic is a common finding in elderly people. "Caviare tongue" is the term applicant to the nodular enlargement of the large veins underneath the surface of the tongue. This is very common in patients over 60 years of age.

The main risk factors are irreversibility of caries and periodontal diseases which, if not controlled, lead to tooth loss, resorption of the residual ridge, destabilized occlusal conditions and impaired masticatory ability. Following prosthetic treatment acceptable function of the masticatory apparatus can often be maintained.

SELF-HELP QUESTIONS

1. Define attrition, abrasion and erosion of teeth.
2. What are the features of periodontitis?
3. What are the ill effects of reduction in keratinized layer of oral mucosa?
4. What is the normal unstimulated salivary flow rate?
5. What is xerostomia?
6. What are the consequences of xerostomia?
7. What is bald tongue?
8. What is caviare tongue?
9. What is macroglossia?
10. Mention the causes of xerostomia.

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CHAPTER 2

Anatomical Landmarks of Significance in Complete Denture Treatment

INTRODUCTION

It is quite essential to have knowledge of the tissues that support the maxillary and the mandibular dentures. These tissues also help the dentures in obtaining their retention and stability. There are certain tissue areas or regions in the maxillary and mandibular edentulous foundations, which are better suited to bear the stresses due to mastication, and are called as *stress bearing areas.* While there are other tissue areas which are not quite suited to take up these stresses, either due to their anatomy or due to the structures that lie beneath them and are called *stress relief areas.* The structures which limit the extension of the maxillary and mandibular complete dentures are called *border-limiting areas.*

The mucous membrane that lines the oral cavity varies in character in different zones and denture border depends on the function of the different zones. The sub-mucosa, which is a connective tissue, attaches the mucosa to the underlying structures. The submucosa varies in composition depending on whether the mucosa is firmly or loosely attached to the bony structure and whether there is muscle tissue between itself and the underlying bone. The blood vessels present in the submucosa supply blood to the edentulous foundation and the nerves innervate it.

A detailed description of the mucosa and the submucosa is beyond the scope of this book. However the microscopic and macroscopic structures of the maxillary and mandibular edentulous foundations relevant to complete denture treatment will be discussed, as it would give a better understanding of the oral anatomy which would act as positive guides to successful complete denture treatment.

STRUCTURES RELATED TO THE MAXILLARY AND MANDIBULAR EDENTULOUS FOUNDATION

These structures can be divided into two categories:

1. **Supporting structures:** These are the structures that support the denture
2. **Border limiting structures**: These are the structures that limit the border extent of the maxillary denture.

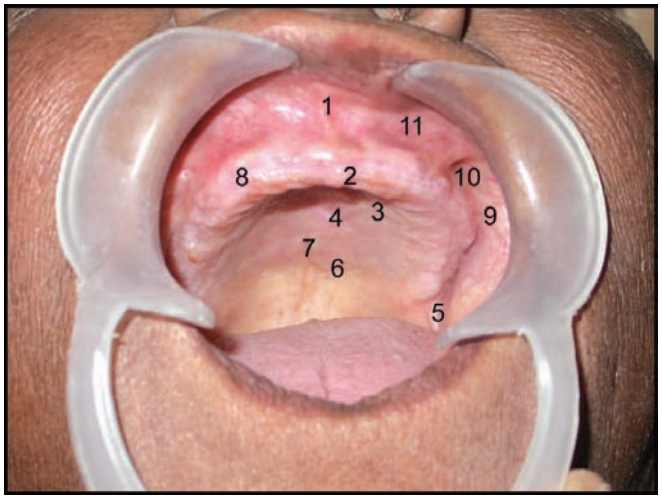

FIGURE 2.1: Anatomical landmarks in maxillary edentulous foundation. (1) Labial frenum, (2) Incisive papilla, (3) Palatal rugae, (4) Midpalatine raphe, (5) Hamular notch, (6) Posterior palatal seal area, (7) Fovea palatinae, (8) Residual alveolar ridge, (9) Buccal sulcus, (10) Buccal frenum, (11) Labial sulcus

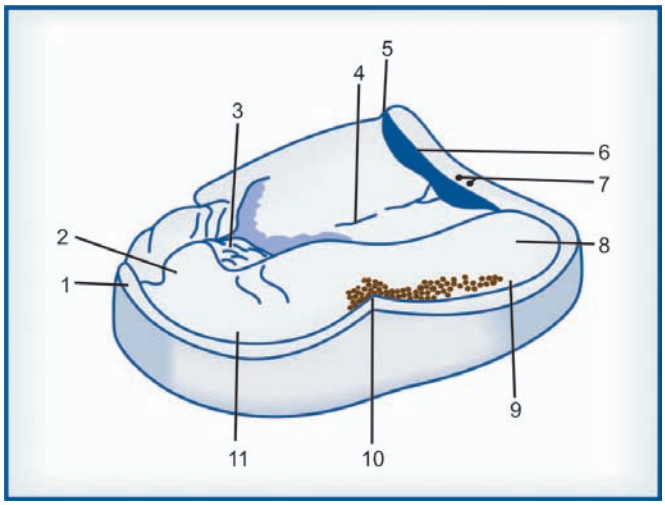

FIGURE 2.2: Anatomical landmarks in maxillary edentulous cast. (1) Labial frenum, (2) Incisive papilla, (3) Palatal rughae, (4) Midpalatine raphe, (5) Hamular notch, (6) Posterior palatal seal area, (7) Fovea palatinae, (8) Residual alveolar ridge, (9) Buccal sulcus, (10) Buccal frenum, (11) Labial sulcus

Supporting Structures in the Maxillary Edentulous Foundation

The Residual Alveolar Ridge (Figs 2.1 and 2.2)

It is covered with thick mucous membrane made up of stratified squamous epithelium, which is keratinized. It is attached to the underlying bone by the sub-mucosal layer, which is devoid of fat or glandular cells and

characterized by dense collagenous fibers that provides adequate resiliency. The underlying bone has a thick cortical covering and together with the mucosa and submucosa can provide excellent support and withstand masticatory forces. The firm attachment of the mucous membrane decreases as it passes from the crest to the slopes of the ridge. The keratinization of the epithelium reduces and the submucosa contains loose connective tissue though the underlying bone is still cortical. The slopes of the ridges do help in the stability of the denture during function. Hence, some of the stress does get transmitted through the slopes. The maxillary residual alveolar ridge may be, therefore, termed as *primary stress bearing area.*

Incisive Papilla (Figs 2.1 and 2.2)

It is a pad of fibrous connective tissue anteriorly overlying the incisive foramen. The submucosa in this region contains the nasopalatine nerves and vessels.

Significance

- A stable landmark is related to the incisive foramen through which the neurovascular bundle emerge and lies on the surface of the bone.
- It is a biometric guide giving information about location of maxillary canines (a perpendicular line drawn posterior to the center of the incisive papilla to sagittal plane passes through the canines).
- It is a biometric guide giving information on positional relation of central incisors, which are about 8-10 mm anterior to the incisive papilla.

Clinical consideration: During the impression procedure, care should be taken not to compress the papilla. This is one of the *relief areas* of the maxillary edentulous foundation. Hence the incisive papilla should be relieved. Compression of blood vessels leads to obliteration of the lumen which would deprive nutrition to the tissues leading to break down of the tissues. Pressure on the nerve causes parasthesia in the region of the upper lip.

Palatal Rugae (Figs 2.1 and 2.2)

They are the raised areas of dense connective tissue radiating from the median suture in the anterior 1/3rd of the palate. They contain the same epithelium (keratinized) as the crest of the alveolar ridge. The submucosa differs in that it contains adipose tissue. These tissues can withstand stresses unless they are very flabby. They help in the stabilization of the maxillary denture during function.

Significances

- It is concerned with phonetics.
- It increases the surface area of the foundation and thus, supplements the values of retention.
- It is denture-stabilizing area in the maxillary foundation.

Midpalatine Raphe or Median Raphe (Figs 2.1 and 2.2)

It is an area extending from the incisive papilla to the distal end of the hard palate along the sutural joint.

Significance

- The area of sutural joint is covered by firmly adherent mucous membrane to the underlying bone with little submucosal tissue. There is, therefore, no resiliency in this region and stress cannot be applied in this region. This is a stress relief area in the maxillary edentulous foundation and consideration is needed for stability of maxillary denture.
- The median fusion of two maxillary processes and two horizontal plates of palatine bone form this sutural joint.
- The function of sutural joint is growth. Sometimes there is overgrowth of the bone at the sutural joint resulting in torus palatinus.

Clinical consideration: During final impression procedure the raphae is relieved in order to create equilibrium between the resilient and non-resilient tissue supports.

Maxillary Tuberosity (Figs 2.1 and 2.2)

This is the distal most part of the residual alveolar ridge and presents the hard tissue landmark. The underlying bone in this area could be irregular and cause soreness due to pressure of the denture base.

Significance

- The last posterior tooth should not be placed on the tuberosity.

- There is sometimes vertical and lateral growth of the tuberosity and the area assumes importance when the maxillary antrum extends laterally with undercuts in the tuberosity region.
- To prevent oro-antral fistula, it is important to have an occlusal radiograph before surgical resection of the tuberosity.
- The undercuts lateral to the tuberosity can be used for the retention of the denture.
- In case of severe undercuts at the tuberosity region, the undercut on the preferential chewing side should be reduced.

Fovea Palatinae (Figs 2.1 and 2.2)

- Usually they are two in number on either side of the midline.
- They are remnants of the coalesance of the ducts.
- They indicate the vicinity of the posterior palatal seal area.
- It has no clinical significance.

Border Limiting Structures in the Maxillary Edentulous Foundation

Labial Frenum (Figs 2.1 and 2.2)

- Appears as a fold of mucous membrane extending from the mucous lining of the lip to/ towards the crest of the residual alveolar ridge on the labial surface.
- It is sickle shaped and may be single or multiple.
- It may be narrow or broad.
- It contains no muscle fibers.
- Attachment is of three types:
  1. Close to the ridge.
  2. Average.
  3. Away from the crest of the ridge.

Clinical considerations

- Sufficient allowance should be created during final impression procedure and in the completed prosthesis because over riding the function of the frenum will cause pain and dislodgement of the denture.
- During the impression making procedure, the lip should be stretched horizontally outwards for the proper recording of the frenum.
- If frenum is attached close to the crest, frenectomy should be done. Failure to do so will lead to the denture border being placed on the hard tissue which will cause decreased effect of border seal.

Labial Vestibule (Figs 2.1 and 2.2)

It extends on either side of the midline from labial frenum anteriorly to the buccal frenum posteriorly. It is bounded laterally by the labial mucosa and medially by the maxillary residual alveolar ridge. Reflection of the mucous membrane superiorly marks the height. The area of mucous membrane reflection has no muscle attachment. This area is covered by non-keratinized epithelium with large amount of loose areolar tissue present in the submucosa. Due to this, the tissue in this region is movable which can easily lead to the overextension and hence the denture might cause soreness of the tissue.

Clinical consideration: For effective border contact between denture and tissue, the vestibule should be suitably filled with impression material.

Buccal Frenum (Figs 2.1 and 2.2)

Appears as a single fold or multiple folds of mucous membrane reflection area to or towards the slope or crest of residual alveolar ridge.

Significance

- Levator anguli oris (caninus muscle) lies beneath it and is hence influenced by other muscles of facial expression.

Clinical significance

- During final impression procedure and in the final prosthesis, sufficient allowance should be created for the movement of frenum because overriding the function of the frenum will cause pain and dislodgement of the denture.
- During the impression procedure, the cheek should be reflected laterally and posteriorly.
- If frenum is attached close to the crest of the ridge, frenectomy should be done.

Buccal Vestibule (Figs 2.1 and 2.2)

It is bounded anteriorly by the buccal frenum, laterally by the buccal mucosa and medially by the residual alveolar ridge. The mucosa and submucosa in this region are the same as in the labial vestibule.

Clinical considerations

- During the impression procedure the vestibule should be suitably filled with impression material for proper border contact between denture and the tissue.
- When the denture flange properly occupies the vestibular space that is distal and lateral to the alveolar tubercules, the stability and retention of the maxillary denture is greatly enhanced.
- The buccal flange borders depend upon movement of the ramus of the mandible at the distal end of the buccal vestibule and hence the patient should move the mandible in a lateral and protrusive relation to make sure that the coronoid process does not interfere with these functions.
- To effectively record the maxillary buccal sulcus, the mouth should be half way closed because wide opening of the mouth narrows the space and does not allow proper contouring of the sulcus.

Hamular Notch (Figs 2.1 and 2.2)

It is a narrow cleft of loose connective tissue, which is approximately 2 mm in extent antero-posteriorly. This structure is bounded by the maxillary tuberosity anteriorly and the pterygoid hamulus posteriorly and marks the postero-lateral limit of the upper denture. The submucosa in this region is thick and made up of loose areolar tissue. A seal can be obtained by utilizing this area as it can be displaced to a certain extent without trauma.

Significance

- Constitutes the lateral boundary of the posterior palatal seal area in the maxillary foundation.
- The pterygomandibular raphe attaches to the hamulus.

Clinical considerations: The denture should not extend beyond the hamular notch, failure of which will result in:

1. Restricted pterygomandibular raphe movement.
2. When mouth is wide open, the denture dislodges.
3. Pterygomandibular raphe may be sandwiched below the denture.

Posterior Palatal Seal Area (Figs 2.1 and 2.2)

This landmark presents the three-dimensional seal area, which supplements values of retention of maxillary denture.

- Anterior limit consists of as much resilient area as palpated by the T-burnisher because of histological contents.
- The hamular notch area reveals lateral limit.
- The line of minimal function reveals posterior limit.
- Superior-inferior limit is revealed by the resiliency of the tissues that can be compressed within physiologic limits.

Significance

- It improves the retention by more than 10 times.
- Instills confidence in a patient to wear and retain maxillary denture.
- Helps in warding off the gagging reflex.
- Reduces the learning period of wearing denture.
- The percentage linear shrinkage does not change its dimension.

Supporting Structures of Mandibular Edentulous Foundation

The Residual Alveolar Ridge (Figs 2.3 and 2.4)

The support for the lower denture is provided by the mandibular residual alveolar ridge and the soft tissue covering it. In most cases, the type of bone present at the crest of the lower edentulous foundation is cancellous as compared to the bone present at the surface of the slopes of the residual alveolar ridge which is cortical. Therefore, in spite of the submucosa having fibrous connective tissue at the crest, this area cannot bear the masticatory stress. Hence, the crest of the mandibular edentulous foundation is termed as the *stress relief area.*

Buccal Shelf Area (Figs 2.3 and 2.4)

This is an area of compact bone that is bounded laterally by the external oblique ridge and medially by the crest

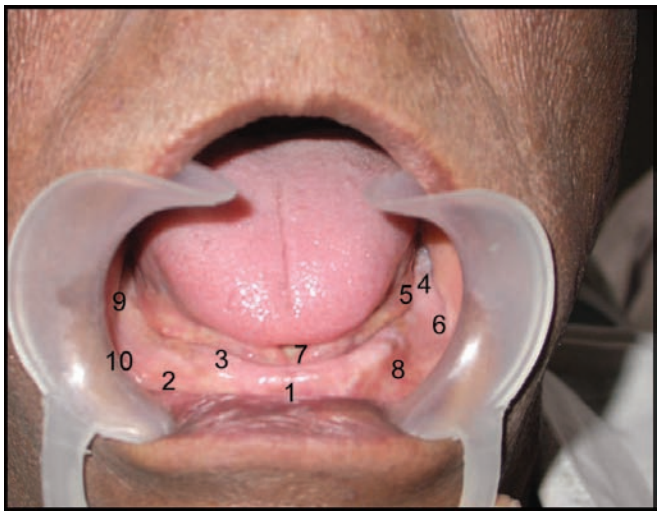

FIGURE 2.3: Anatomical landmarks in mandibular edentulous foundation. (1) Labial frenum, (2) Labial sulcus, (3) Residual alveolar ridge, (4) Retromolar pad, (5) Distolingual sulcus, (6) Buccal shelf area, (7) Lingual frenum, (8) Buccal frenum, (9) Masseteric notch, (10) Buccal sulcus

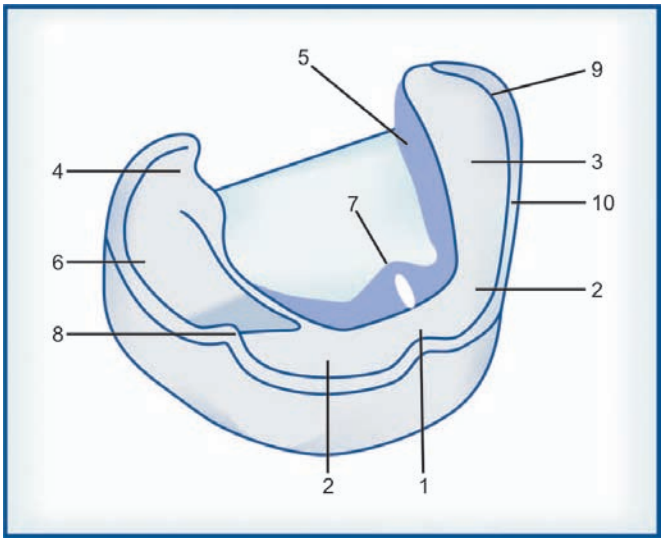

FIGURE 2.4: Anatomical landmarks in mandibular edentulous cast. (1) Labial frenum, (2) Labial sulcus, (3) Residual alveolar ridge, (4) Retromolar pad, (5) Distolingual sulcus, (6) Buccal shelf area, (7) Lingual frenum, (8) Buccal frenum, (9) Masseteric notch, (10) Buccal sulcus

of the mandibular ridge. Here, the mucosa is less keratinized than the mucosa covering the crest of the ridge. The submucosa contains fibers of the buccinator muscle.

Significance

- It presents the area of compact bone, which by virtue of its disposition is horizontal and therefore, best suited to receive masticatory stresses in the vertical direction.
- It is the *primary stress bearing area* in the mandibular foundation.

Reason

- It is horizontal and made up of dense cortical bone
- The soft tissue and muscle attachment do not restrict coverage and extension of mandibular base
- The dense closely placed trabeculae are arranged parallel.

Clinical considerations: It is not advisable to extend the impression beyond the external oblique ridge. Failures may ocur due to inadequate selection and no modification of impression trays.

Genial Tubercle (Figs 2.3 and 2.4)

It is usually seen below the crest of the ridge.

Significance

- In a severely resorbed ridge, it is seen above the residual alveolar ridge and hence, it should be relieved.
- The mucosa covering the genial tubercle is thin and tightly adherent to the underlying bone.

Clinical consideration: It should be relieved with a spacer, failure of which leads to ulceration.

Border Limiting Structures in Mandibular Edentulous Foundation

Labial Frenum (Figs 2.3 and 2.4)

It is the fold of mucous membrane extending from the mucous lining of the mucous membrane of the lips to/towards the crest of the residual alveolar ridge on the labial surface.

Clinical considerations

- During the impression procedure, the lip has to be reflected anteriorly and horizontally.
- During impression procedure and in final prosthesis allowance should be made in the form of a notch to prevent over-riding of function, which may result in laceration of the tissue.

Labial Vestibule (Figs 2.3 and 2.4)

It is bounded anteriorly by the labial frenum, posteriorly by the buccal frenum, laterally by the labial mucosa and medially by residual alveolar ridge. The mucosa in this region has a thin and a non-keratinized epithelium and the submucosa has loose connective tissue fibers and elastic fibers.

Clinical considerations: For effective border contact between the denture and tissue, the vestibule should be suitably filled with impression material during the impression procedure.

Buccal Frenum (Figs 2.3 and 2.4)

It is the fold of mucous membrane extending from the mucous membrane of the buccal mucosa to / towards the crest of the residual alveolar ridge on the buccal surface. It may be single or multiple.

Significance: The depressor anguli oris muscle underlines it.

Clinical consideration: During the impression procedure and final prosthesis, sufficient allowance should be made to prevent overriding of function of frenum, which may result in laceration.

Buccal Vestibule (Figs 2.3 and 2.4)

It is bounded anteriorly by the buccal frenum, posteriorly by the massetric notch area, medially by residual alveolar ridge and laterally by buccal mucosa. The mucosa of the buccal vestibule is the same as the labial vestibule with the submucosa containing loose connective tissue fibers mixed with elastic fibers.

Significance

- It is an area of esthetic consideration.
- The buccal flange covers about 5 mm or more of fibers of buccinator in this area. It runs in a horizontal manner in the anteroposterior direction and hence is not a dislodging factor.

Clinical consideration: This space constitutes an area to be suitably filled by impression material during impression procedure.

Masseteric Notch Area (Figs 2.3 and 2.4)

It is immediately lateral to the retromolar pad and continues anteriorly to buccal vestibular sulcus.

Significance: It is an area where the masseter muscle in function (anterior fibers) may push against the distal part of the buccinator muscle

Clinical consideration

- It is due to the contraction of the masseter that a depression is formed at the distobuccal corner of the retromolar area.
- When the mouth is opened widely the borders in this area cut into the tissue, so it should be recorded with the mouth slightly opened.
- During impression procedure in the area of masseteric notch, downward pressure is applied and the patient is asked to close the mouth against the pressure. Over extension of the denture causes:
  1. Dislodgement of the denture.
  2. Laceration.

Retromolar Pad (Figs 2.3 and 2.4)

It is a pear shaped body at the distal end of the residual alveolar ridge. It is also known as the *retromolar triangle.*

Significance

- Represents distal limit of the mandibular denture.
- It has muscular and tendenous elements lying underneath.
  1. Fibers of temporalis
  2. Fibers of masseter
  3. Fibers of buccinator
  4. Fibers of the superior constrictor muscles of pharynx
  5. Tendinous mandibular raphe

  Because of muscular tendenous elements, the area should not be subjected to pressure effect.

Clinical considerations

- Helps in maintaining the occlusal plane.
  - Divide the retromolar pad into anterior 2/3rd and posterior 1/3rd
  - Posterior height of occlusal rims should not cross the anterior 2/3rd

- Helps in arranging the mandibular posterior teeth.
  - Draw a line from the highest point in the canine region to the apex of the retro molar triangle extending it to the land area of the cast, which is called the *mean crestal line.* The central fossa of all posterior teeth should lie on the mean crestal line.
- Teeth should not be placed on the retromolar pad because of its inclined plane, which will act as a dislodging factor with the forces being inclined anteriorly.

Lingual Frenum (Figs 2.3 and 2.4)

It is the muco buccal fold that joins the alveolar mucosa to the tongue.

Significance: It overlies the genioglossus muscle, which takes origin from the superior genial spine on the mandible.

Clinical consideration

- Sufficient allowance should be given in the impression and the final denture to prevent overriding of function of the frenum.
- During impression procedure, the patient should touch the tip of the tongue to the incisive papilla region.

Sublingual Crescent Area (Figs 2.3 and 2.4)

The anterior portion of the lingual sulcus is commonly called the sublingual crescent area. It is the part of the floor of the mouth covering the sublingual gland.

Significance: It has specialized innervations.

Clinical consideration: Over extension of the denture in this area causes burning sensation.

Retromylohyoid Space (Figs 2.3 and 2.4)

It is located posterior to the mylohyoid ridge and bounded posteriorly by the fibers of the superior constrictor of pharynx.

Significance

- The distolingual portion of the flange is influenced by the glossopalatine and superior constrictor muscle.
- It constitutes the most important bracing potential in the mandibular foundation.

Clinical consideration: Even in the poorer of the poor conditions, this has to be recorded very critically for stability of mandibular denture.

Successful accomplishment of the complete denture treatment constitutes a joint responsibility of both the operator and the patient by way of correctly participating in the treatment procedures. It is imperative that apart from the knowledge of all the factors of anatomical and physiological relevance in treatment procedures, execution of the factors, digital dexterity and communication skills of the operator are of paramount importance. Thus, the diagnosis and clinical acumen of the operator constitute important considerations in the application of above knowledge.

SELF-HELP QUESTIONS

1. What are the anatomical landmarks of significance in maxillary edentulous foundation?
2. Mention the anatomical landmarks of significance in mandibular edentulous foundation?
3. Why are incisive papilla and midpalatine raphe referred to as the "stress relief areas?"
4. Which are the primary and secondary stress bearing areas in the maxillary edentulous foundation?
5. What is the significance of posterior palatal seal area?
6. What is the consequence of bilateral severe undercuts in the distobuccal sulcus and what is the preprosthetic consideration?
7. Why should an allowance be created in the complete denture at the labial and buccal frenum areas?
8. Which muscle underlies the buccal frenum?
9. Is it necessary to relieve the greater palatine foramen area?
10. Why is buccal shelf area referred to as the primary stress bearing area?
11. What are the contents of the retromolar pad?
12. What is the procedure to record the maxillary and mandibular labial frenum?

13. What is the procedure to record the maxillary and mandibular buccal frenum?
14. Why is crest of the mandibular edentulous ridge considered the "stress relief area?"
15. Mention the clinical significance of retromolar pad.
16. What is mean crestal line?
17. Describe the anatomy of posterior palatal seal area.
18. What is the significance of fovea palatine?

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CHAPTER 3

Residual Ridge Resorption

INTRODUCTION

Residual ridge is the term used to describe the clinical alveolar ridge after healing of bone and soft tissues following extractions. *Residual ridge resorption* is a term used for the diminishing quantity and quality of residual ridge after teeth are extracted. It is a *chronic, progressive* and *irreversible process* with the rate being fastest in the first 6 months after extraction. Although the phenomenon "residual ridge resorption" is easily observed clinically after tooth extraction, the sequence of biologic changes is not very well understood. In 1979, Atwood postulated that there are four major etiologic factors that cause residual ridge resorption: *anatomic, prosthetic, metabolic* and *functional.* The description in this chapter will be based on these four factors.

A basic concept of bone structure and its functional elements must be clear before bone resorption can be understood. The structural elements of bone are: *(a) osteocytes found in bone, (b) intercellular substance or bone matrix consisting of fibrils and calcified cementing substance, (c) osteoblasts, (d) osteoclasts.*

a. **Osteocytes:** These are cells responsible for metabolic activity of bone.
b. **Calcified cementing substance:** The calcified cementing substance consists mainly of polymerized glycoprotein. Mineral salts namely calcium carbonate and phosphates are bound to these protein substances.
c. **Osteoblasts:** Osteoblasts, by their function of forming and calcifying the intercellular substance, are the active bone forming cells. The osteoblasts surround the bone in a continuous layer. In the course of bone formation, some osteoblasts get engulfed in the intercellular substance and become osteocytes.
d. **Osteoclasts:** Osteoclasts are the cellular components of bone that are responsible for bone resorption. Bone resorption always requires the simultaneous elimination of the organic and inorganic components of the intercellular substance.

Alveolar bone has two structural characteristics. A hard compact outer layer is superimposed on a spongy somewhat resilient substructure. A healthy and thoroughly healed alveolar process has a layer of wear resistant compact bone of varying thickness. Beneath the compact bone is the spongy bone. The spaces between the trabeculae communicate throughout the spongy bone. Bone is constantly undergoing changes in response to replacement and functional demands.

CLINICAL FACTORS RELATED TO RATE OF RESORPTION OF RESIDUAL RIDGES

Anatomic Factors

When we clinically examine a completely edentulous foundation, we tend to gauge the residual ridge on the basis of it being high/low, broad/narrow, rounded/spiny, covered by thick/thin mucoperiosteum. Although the broad, high ridge may have greater potential bone loss, the rate of vertical bone loss may actually be slower than that of a narrow ridge because there is more bone to be resorbed per unit of time and because the rate of resorption also depends on the density of the bone. Theoretically, the denser bone is said to have slower rate of resorption, merely because there is more bone to be resorbed per unit of time.

Metabolic Factors

Metabolic disturbance is attributed to both nutritional disturbances and hormonal causative factors. General body metabolism is the net sum of all building up (*anabolism*) and the tearing down (*catabolism*) going on in the body. Anabolism exceeds catabolism during growth and convalescence, levels off during most of the adult life and is exceeded by catabolism during disease and senescence.

Hormonal Factors

Pituitary Glands and Hypophysis

The hypophysis is the master gland of the endocrine system. The control of the hypophysis over the endocrine system is complex and problems of dysfunction require the analysis of an endocrinologist. Such findings are of importance to the dentist because they involve the general health of the patient, which is reflected in the oral cavity.

Thyroid Glands

They are responsible for the regulation of the rate of metabolism. Hyperthyroidism increases the metabolic rate leading to negative nitrogen balance. Such a balance is equivalent to protein deficiency, which can be a direct cause of osteoporosis. Thyroxin also has a direct influence on the kidneys, causing an increased excretion of calcium and phosphorus. This depletion of calcium and phosphorus results in decreased bone apposition and increased osteoclastic activity.

Parathyroid Glands

Parathormone maintains blood calcium by mobilizing it from the bones through osteoclastic activity.

Islets of Langerhans

The failure of these glands to produce sufficient insulin for proper utilization of glucose causes diabetes mellitus. The syndrome of poor healing, low tissue tolerance and rapid resorption of bone is associated with the diabetic patient. In the absence of insulin, a relative nitrogen starvation occurs from increased gluconeogenesis with the amino acids being diverted from protein synthesis. A diabetic controlled by either insulin or diet is not affected by this mechanism. Since perfect control is rarely possible, a word of caution and explanation to diabetic patients is necessary so that they can appreciate their prosthetic difficulties.

Suprarenal Glands

The adrenal cortex produces steroid hormones called corticoids. Cortisone and related steroids are antianabolic. It may induce the formation of glucose from carbohydrates and may increase the calcium loss by direct effect on calcium excretion. The prolonged use and administration of such steroids are considered very dangerous to bone tissue. However, one of the beneficial effects of corticoids is to control the defense mechanism of inflammation.

Gonads

In general, the sex hormone (*androgens and estrogens*) promotes a protein anabolic action on all tissues including bone. A moderate amount of osteoporosis accompanies senescence because of the increased catabolic action reflected by atrophic and degenerative changes throughout the body. The ageing person produces decreased amount of androgens and estrogens, which results in faulty protein metabolism for tissue repair. The bone matrix suffers and normal bone loss cannot be compensated.

Dietary Factors

Food is classified as proteins, carbohydrates, fats, vitamins and inorganic elements.

Protein

Protein is necessary to build and maintain tissue and to supply energy. The synthesis of osteoid tissue in protein-starved people is compromised and calcification is decreased since the protein matrix is embarrassed. Protein may not be available because of inadequate intake, improper assimilation or excessive loss as in nephrosis or because it is utilized as calorie requirements because of hyperthyroidism/ uncontrolled diabetes. Inadequate incorporation of protein in diet (3 ounces/ day) will cause slow growth of bone. Bone apposition cannot keep up with normal osteoclastic activity and a negative bone factor exists.

Vitamins

The action of vitamins in many respects is said to be same as that of hormones. The relationship of vitamins and hormones can be explained on the basis that the endocrine glands produce intrinsic hormones and the vitamins are extrinsic hormones.

Vitamin A: A deficiency of vitamin A may result in poor development and calcification of bone. Prolonged deficiency of vitamin A causes renal damage by hornification of tubules, which then lose the capacity to reabsorb phosphorus. The imbalance of the calcium: phosphorus ratio leads to osteoporosis.

Vitamin B complex: The total effect of vitamin B complex is of a regulatory nature. Hypovitaminosis B results in loss of appetite, dietary insufficiency, increase in nervous

irritability resulting in lowered resistance to stress and emotional tension. The total well being of the individual is impaired.

Vitamin C: Lack of vitamin causes decalcification of the bone and has been held responsible for diffuse alveolar atrophy. The apposition of new bone slows down dramatically because osteoblastic activity is impaired. The collagen content of bones is also reduced in vitamin deficiency. The periosteum thickness and the cells appear immature and resemble fibroblasts. This condition may make the periosteum easily prone to injury by the denture base. Osteophytes appear as a result of avitaminosis C. The rapid loss of bone and the increased inflammation of the mucoperiosteum cause the development of these bony outgrowths.

Vitamin D: It is necessary for the calcium phosphorus balance to remain within tolerable limits. Vitamin D would be unnecessary if the exact required ratio of calcium and phosphorus were available in the diet. When bone loses its ability to calcify the matrix, administration of vitamin D will cause calcification and denser bone. Moderate overdosage causes excessively mineralized bone, but gross overdosage causes bone resorption. Many drugs act as vitamin antagonists. These drugs act largely on vitamin C and B complex and their excessive use may cause a marked vitamin deficiency. Some of the common vitamin inhibitors are nicotine, alcohol, barbiturates, morphine, some of the sulfa drugs and some of the antibiotics such as streptomycin and penicillin.

Carbohydrates (Starch and Sugars)

They provide the chief source of energy. They are related only indirectly to bone resorption through association with diabetes and by substitution for more favorable foods.

Fats and Organic Substances

They are those, which yield heat and energy and only secondarily build/repair tissue.

Inorganic Elements

Calcium salts (calcium carbonate and calcium phosphate) form the rigid supporting structure of bones. Phosphorus in the form of calcium and magnesium phosphate, gives hardness to bone. Abnormalities of the calcium phosphorus elements of the blood stream may be associated with alveolar resorption or rarefaction.

The body requires 0.7 gm of calcium/day, which can be obtained from 1 quart of milk. Other sources of calcium are dairy products, spinach, oranges, celery, chard, carrots and lettuce. The phosphorus need is about 1.5 to 3 gm daily dependent upon the form. Dry beans, milk, cheese, leafy vegetables, celery and carrots may fulfill these requirements.

Edentulous patients should follow a prescribed dietary regimen. This diet should be low in carbohydrates and high in protein intake. The diet should include at least a quart of milk or substitute dairy products, vegetables, fruits and a multiple vitamin supplement.

Functional

Bone is generally thought of as a hard substance because of its rigidity, when in reality it is one of the most plastic tissues of the body, e.g. a blood vessel impinging on bone will form a groove. Bone is constantly undergoing changes in response to replacements and functional demands. *Wolff's law* postulates that all changes in the function of bone are attended by definite alterations in its internal structure. Forces within physiologic limits of bone are beneficial in their massaging effect. On the other hand, increased or sustained pressure, through its disturbance to the circulatory system, produces bone resorption. The amount and frequency of stress and its distribution and direction are important factors in treatment planning. Although the total amount of the necessary masticatory stress cannot be diminished, increasing tissue coverage and decreasing the length and width of the occlusal table may lessen the load/unit area. The frequency of stress application modifies the reaction of alveolar bone to external forces. Constant pressure on bone causes resorption, while intermittent forces favor bone formation. Since recurrent forces over short intervals of time have essentially the same resorbing effect

as constant pressure, a rest period between meals is beneficial. For this reason, the patient should be warned that gum chewing has a destructive effect on the bone.

Bruxism is an expression of nervous tension, which manifests itself as gnashing, grinding or clenching of the teeth while the patient is asleep or awake. Since most denture patients do grind their teeth in sleep, the dentures should not be worn during this period. Thus the supporting structures are afforded the rest period essential to the maintenance of the alveolar bone. While grinding of the teeth when the patient is awake may be a habit of tension, it may also be caused due to lack of interocclusal distance.

The principal concern should be in the pattern and position of the posterior teeth. There are two mandibular movements associated with mastication: a closing/cutting movement and a lateral or grinding movement. A sharp cusp will penetrate a bolus of food with less force than a flat occlusal form. However, a law of physics explains that forces applied to an inclined plane produce a resultant force or vector perpendicular or right angles to the plane. Applying this principle to occlusal form, the resultant force of the steep incline of high cusps would produce a lateral force, which might cause alveolar resorption.

Stress distribution favorable to healthy alveolar bone maintenance is dependent principally upon bilateral balanced occlusion. Balanced occlusion is that arrangement of the teeth, which will permit the necessary mandibular movements with out tending to dislodge the denture or traumatize the supporting structure.

Prosthetic Factors

Prosthetic factors are extremely difficult to evaluate because of the tremendous number of variables including the anatomic, metabolic and functional factors. The rate of change is under the influence of the remaining functional stimuli, the altered blood supply and the body chemistry as affected by nutritional, hormonal and emotional factors. Fundamentally the wearing of a denture is physiologically incompatible with the function of the ridge tissues because pressure is directed on to the bone through vascular tissue by the denture. If the mechanical factors designed into the denture by the impressions, jaw relation records and occlusion are controlled, so that pressure remains within tissue tolerance, the denture base will not contribute to a rapid bone resorption. If the action of the base is favorably controlled in its adaptation to the tissues and its directed force, it could provide stimuli that retard resorptive processes. Often, a new technique, a new impression material, new denture base or a new form of teeth has been heralded as the answer to the problem of ridge resorption.

The prosthetic factors contributing to ridge resorption/ summary of causes of atrophy in jaw bones:

1. Excessive stress resulting from artificial environment.
2. Abuse of the tissue from lack of rest.
3. Long, continued use of ill-fitting dentures.
4. Reduced area of coverage of the foundation resulting in increased load per unit area.
5. Faulty impression procedures, employing compressive forces.
6. Error in relating maxillae to cranial landmarks.
7. Lack of freeway space due to increased vertical dimension of occlusion.
8. Incorrect centric relation record.
9. Faults in selection and placement of posterior teeth.
10. Lack of balance in posterior occlusion.
11. Non-correction of occlusal errors caused due to processing technique and factor of tissue resiliency.
12. Use of non-rigid material with high flexure for denture base.
13. Non-observance of biological principles of stress reduction.
14. Patients with dysfunction state of TMJ resulting in instability of dentures.
15. Age changes in senility.

PROSTHODONTIC MANAGEMENT OF PATIENTS HAVING ATROPHIED FOUNDATION

Conventional Approach

1. Thorough clinical examination
2. Communication– geriatric problems

3. Improving stress potential– systematic and local
4. Proprioceptive exercise
5. Clinical procedures
   a. Impressions
   b. Jaw relations
   c. Selection and arrangement
6. Laboratory procedure

Thorough Clinical Examination

It should be done on the basis of the general information regarding the medical health status, previous denture treatment, temporomandibular joint status and evaluation of supporting and surrounding tissue.

Communication

It involves prosthodontic service of giving complete information on expectations, use, care and maintenance of dentures after carefully examining the patient. Conditions complicating the treatment with geriatric problems need greater understanding.

Improving Stress Potential

The principle is not to treat the jaw but the patient as a whole.

Systematic approach: Enquiry into food habit and dietary intake will reveal the nutritional status of the patient. When combined with clinical findings, it will help dentist in prescribing the nutritional regime which may include prescriptions on vitamin products, hematinics in therapeutic dose, proteins to improve, repair and maintenance of tissues, neurotropic agents to improve neuromuscular co-ordination, dietary calcium for balancing osteoporotic changes, drugs to correct anaemic conditions and vitamins with hormonal inclusions to treat geriatric problems.

Local approach: This consists of warm saline mouth rinses, application of astringent lotions and gum massage.

Proprioception

Proprioception has a reference to learning to effect relaxation of facial muscles and perform the horizontal movements and vertical movements under control to facilitate jaw relation recording procedures. This will be referred to as including patient in the treatment.

Clinical Procedures

Minimal pressure impression should be made in order to reduce the stress on the underlying ridge. The impression should cover maximum denture bearing surface within physiologic limits. Rigid denture base material should be used. The jaw relation should be accurately recorded with special emphasis on creating adequate freeway space (2-3mm). Teeth with shallow cuspal inclines should be selected. The teeth should be arranged in the neutral zone where the forces from the tongue and the cheek muscles are in equilibrium. There should be simultaneous contact of maxillary and mandibular teeth both in centric and eccentric relations. Post denture insertion instructions should be administered with sufficient emphasis on tissue rest.

Laboratory Procedures

- Laboratory remount followed by clinical remount
- Selective grinding
- Preservation of face bow record.

Prosthodontic management problems are mostly considered from physiological, psychological, social and functional needs of a geriatric edentulous patient. Stability and retention qualities suffer greatly in these patients. The problem becomes much worse when the patients expectations run high because of lack of patient education and motivation. The patient fails to realize that a dentist does not create the problem of his foundation but the patient himself has created the same out of neglect. Patient should not expect miracles from prosthodontic treatment. For above reasons the treatment should be guided by understanding various problems before giving solutions to overcome the same.

SELF-HELP QUESTIONS

1. Define residual ridge.
2. What is residual ridge resorption?
3. Mention the four major etiologic factors that cause residual ridge resorption.

4. What relevance does dietary intake have on residual ridge resorption?
5. How is hyperthyroidism a contributing factor in residual ridge resorption?
6. What is the need to provide rest to bone tissue?
7. What is Wolff's law?
8. How can residual ridge resorption be managed by prosthodontic measures?
9. What role does nutritional deficiency play in residual ridge resorption?

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CHAPTER 4

Evaluation of the Patient, Diagnosis, Treatment Plan and Prognosis for Complete Denture Treatment

INTRODUCTION

Evaluating the patient for proper diagnosis, prognosis and appropriate treatment plan is the first step in complete denture treatment. It is, therefore, very important for the student to know the meaning of these terms before evaluating the patient:

1. **Examination**: It is an enquiry, scrutiny or investigation carried out for the purpose of diagnosis.
2. **Diagnosis**: 'Dia'–apart 'Gnosis'–knowledge.
   It is the critical or scientific evaluation of existing conditions, which is made towards the end of the examination. Diagnosis, being a continuous procedure, is not accomplished in a short time.
3. **Prognosis:** Denture prognosis is a judgment or opinion of the prospects for success or otherwise in the fabrication and usefulness of the dentures. This opinion is given in advance of treatment.
4. **Treatment plan**: It refers to the systematic or step-by-step sequence of procedures planned for the treatment of a patient.

HISTORY AND EXAMINATION

Personal Data

- Patient's name
- Age/sex
- Address
- Occupation
- Outpatient number
- Telephone number.

Relevance of Patient's Name

The importance of addressing the patient by name is to develop a good rapport with the patient.

Relevance of Age of the Patient

Until the fourth decade of life, there is resiliency of the tissues, which is capable of rapid repair. After the fifth decade of life, there is slow growth and repair and the oral tissues do not readily accept a new environment as the accommodation factor is reduced in advancing age. Edentulous patients, who then reduce their food intake due to lack of teeth, are deprived of adequate nutrition. Above the age of 40, osteoporotic changes are also a common finding.

Relevance of the Sex Factor of the Patient

Cosmetics and esthetics would be much more important in females. Younger males though would be conscious, they may grow indifferent to looks as they age and are more interested in the comfort and efficiency of mastication of the dentures. Also during menopausal state, there would be intolerance to treatment and burning of mouth, vague pains and psychological disturbances.

Relevance of Factor of Occupation of the Patient

Occupation indicates the type of work carried out by the patient and his/her surroundings at the work place. It also tells us about the patient's social status in the society and the importance the patient would have of the dentures, in its esthetic value and the implications on oral health. The financial status of the patient can also be evaluated.

Relevance of Address and Telephone Number

It is for the purpose of communication.

Systematic Status

Medical History

An accurate history must be obtained and conditions linked to complete denture treatment must be noted to arrive at a particular treatment plan and care of the dentures thereafter.

Conditions that may affect complete denture therapy include:

Arthritis:

- Temporomandibular joint may be involved.
- Occlusal changes may have to be made from time to time.
- In case of involvement of finger joints, there may be decreased dexterity to maintain denture hygiene. In such cases the use of sodium perborate solution for cleaning the dentures is mandatory due to its ability to liberate nascent oxygen thereby detaching the plaque.

Diabetes:

- There may be wasting of tissues.
- Patients need functional rest to the tissues; therefore, they can be advised less time of wear.
- In severe diabetes, acetone is secreted in the mouth, which leads to poor fit of the denture. Hence, the patients are advised to reduce the time of wear of denture.
- Stresses on the edentulous foundation would have to be controlled because of lowered tissue potential and instructions on eating habits and changes in lifestyle would have to be advised. Patients would have to consume protein diet to allow for recuperation of tissues.
- Diet rich in vitamin B and vitamin C would have to be recommended. Calcium will have to be supplemented in the diet regime.
- A physician should also be consulted for appropriate control of blood sugar level.
- The condition indicates careful consideration of impression procedure, teeth selection and type of occlusion.

Anaemia

- Soft tissue overlying bone becomes fragile with possibility of enhanced bone loss.
- Decrease in bearing capacity of foundation tissue.
- Decrease in healing capacity.
- Advice patient for heamogram, with main emphasis to improve blood picture through administration of haematinic principle.

Radium Treatment

- In patients who have received radiotherapy, osteoradionecrosis and necrosis of the soft tissues is of common occurrence. This would imply the treatment is contraindicated or if required, posterior occlusion would have to be such that there is reduced stress. For example, flat occlusal table.
- Xerostomia can also occur due to radiotherapy. Hence, sialogouges and use of denture adhesives may have to be considered.

Neuromuscular Disorders

It is commonly seen in Parkinsonism, Bell's palsy, Tic doloreaux etc.

- It implies that these conditions be improved by advocating neurotropics because the patient's neuromuscular coordination would enable the proper recording of jaw relations.
- Vit-B_6 and vit-B_{12} should be administered.
- It should be remembered that medication by physicians for varying medical conditions does effect volume changes in soft tissues.
- Secretory activity is reduced affecting the defense mechanism of oral tissues.

Cardiovascular Disease

- Patient should be given early morning appointments inorder to avoid the tissue changes that occur due to medication during the later part of the day.
- The duration of each appointment should be short inorder to reduce the stressfull condition.

DENTAL HISTORY

A. *Reasons for loss of teeth* should be ascertained such as
   - Periodontal disease
   - Caries of teeth or
   - Any other causes.

B. *Previous denture experience* should be recorded in patient's own words:
   - Reasons why the patient needs new prosthodontic treatment should be noted. This is normally referred to as chief complaint or patient's chief requirement because the new treatment will have very important bearing on this.
   - Previous denture experience could be noted in terms of number, duration of time, information on esthetics, phonetics, mastication, retention, vertical dimension of occlusion and centric relation should be noted down. Similarly repairs that has been carried out earlier would include:
     a. Repair to a denture

b. Rebasing
c. Relining

- Old dentures should be evaluated as excellent, good or unsatisfactory and the patient should be encouraged to discuss what he/she should expect from new dentures in relation to esthetics, efficiency and comfort. This basis has its ultimate reflection on the mental attitude of the patient.

The **mental attitude** of the patient has been classified by MM House into four categories. They are:

- Philosophical
- Exacting
- Hysterical
- Indifferent

Philosophical patient: They are easy going, co-operative, well adjusted to life and they understand and accept advice. They do not imagine or anticipate any particular difficulty. They are co-operative on their part and will make positive effort towards attaining success. This category of patients desire treatment for maintenance of health and constitute the best category towards acceptance of treatment.

Exacting patients: They are above average in intelligence, often dissatisfied with past treatment and are over concerned with functional aspects of treatment. They do not readily accept advice. They are of demanding type. They need to be explained about details of treatment procedures as they often expect rewards at no additional cost. They often become the operator's greatest support once they are satisfied.

Hysterical patients: These patients have a negative attitude, emotionally unsteady, apprehensive and excited and will show unnecessary fear for dental service and may be mentally impaired. They accept treatment out of helplessness with no application of mind. Treatment easily discourages them if they suffer failure.

Indifferent patient: These patients show least concern and often go without dentures for years. They have no desire to wear dentures and do not care much about the need for dentures and function. They do not show any concern towards the instructions given.

C. The operator should know what the patient expects from the dentures. The operator should know whether the patient:

- Understands limitations of treatment
- Functions
- Esthetics

The patient should understand the use, probable difficulties and success of the treatment. Any information given after the insertion of dentures would not be accepted by the patient and may be considered as an excuse by the dentist to the poor quality of treatment.

CLINICAL EXAMINATION

Extra-oral Examination

a. Face Form: Ovoid/Tapering/Square (Fig. 4.1)
Square: If the biangular width is equal to the bizygomatic width.
Tapering: If the biangular width is lesser than the bizygomatic width.
Ovoid: If the bizygomatic width is lesser than the biangular width

b. Face profile: Normognathic/prognathic/retrognathic (Fig. 4.2)

c. Symmetry: Symmetrical/asymmetrical

d. Facial height: Decreased/normal/increased

e. Facial muscle tone: Normal/flabby/spastic

f. Color of hair: Black/brown/grey/white

g. Color of eyes: Black/brown/white/grey

h. Complexion: Dark/fair/medium/ruddy

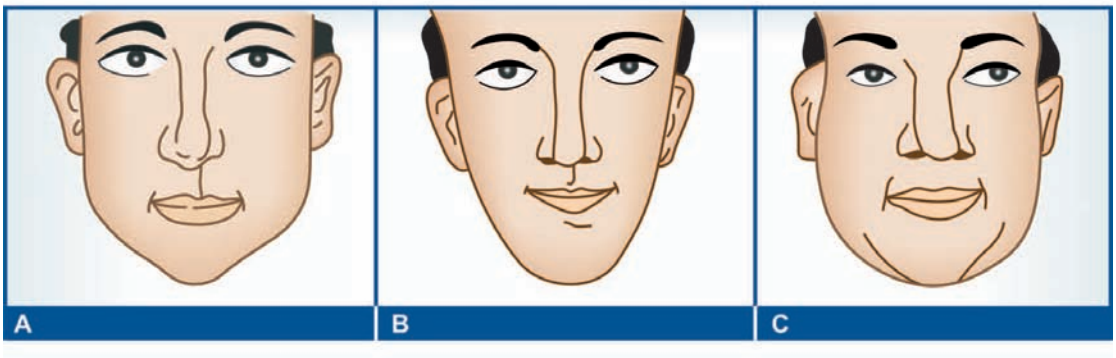
i. Lips

- **Thickness:** Thick/average/thin
- **Length:** Short/average/long
  Thick lips—Support becomes a problem.
  Short lips—Active, teeth become visible even with slight movement.
- **Average**—Exposure of teeth is subtle.

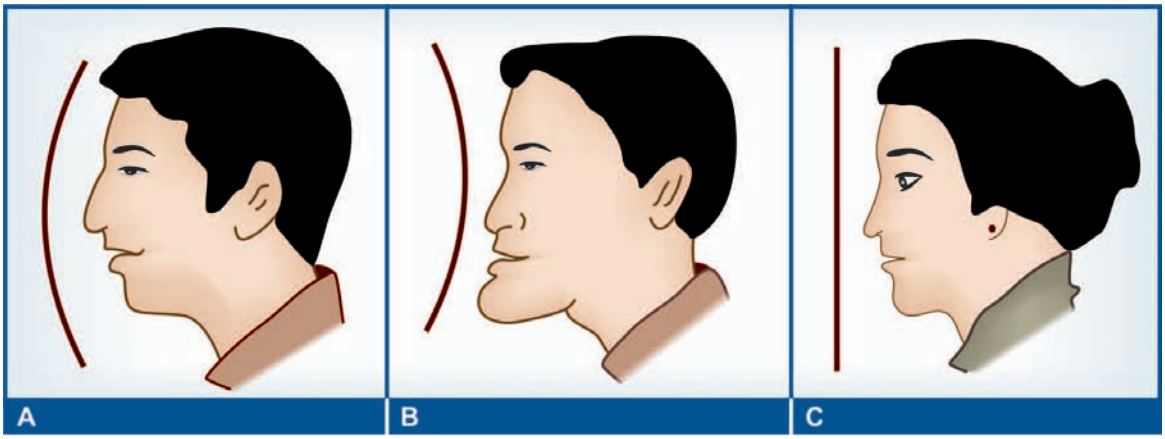
Examination of the face is done primarily for the selection and arrangement of anterior teeth.

j. Temporomandibular joint (TMJ)

- Complaints of pain, subluxation, crepitus or a combination of two or three can be encountered. These could be encountered due to severe



FIGURES 4.1A to C: Face forms: (A) Square, (B) Tapering, (C) Ovoid



FIGURES 4.2A to C: Face profile: (A) Convex, (B) Concave, (C) Straight

discrepancy of vertical dimension of occlusion, loss of teeth or loss of posterior stops, which causes the load to shift anteriorly.

- TMJ dysfunction could lead to instability of the dentures.
- Tension and pull created by the condyle due to loss of posterior stops could lead to spasm. Anti inflammatory analgesics need to be administered.

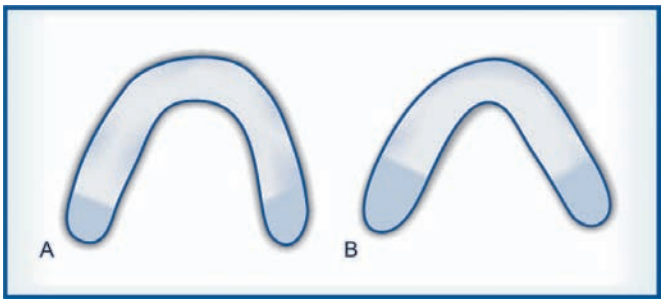
Examination of TMJ

1. The bulk of index finger is placed in the external auditory meatus and equal pressure is applied while instructing the patient to open the mouth. If pain is felt,it indicates abnormal condition
2. Auscultation.

Intraoral Examination

a. Arch form: U shaped/V shaped (Fig. 4.3)

b. Residual ridge form: (Fig. 4.4)

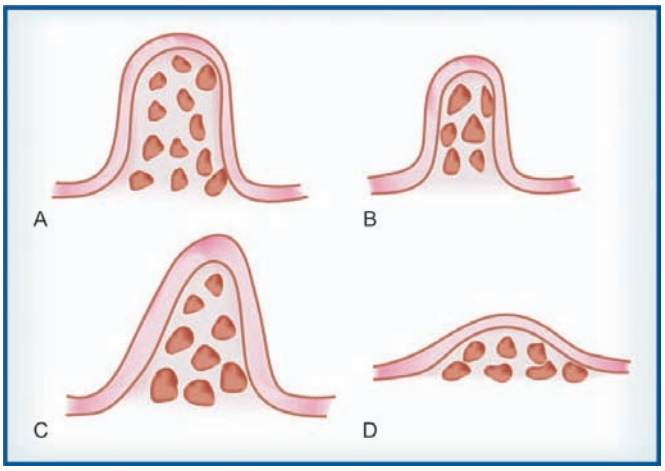


FIGURES 4.3A and B: Arch form: (A) U shaped, (B) V shaped

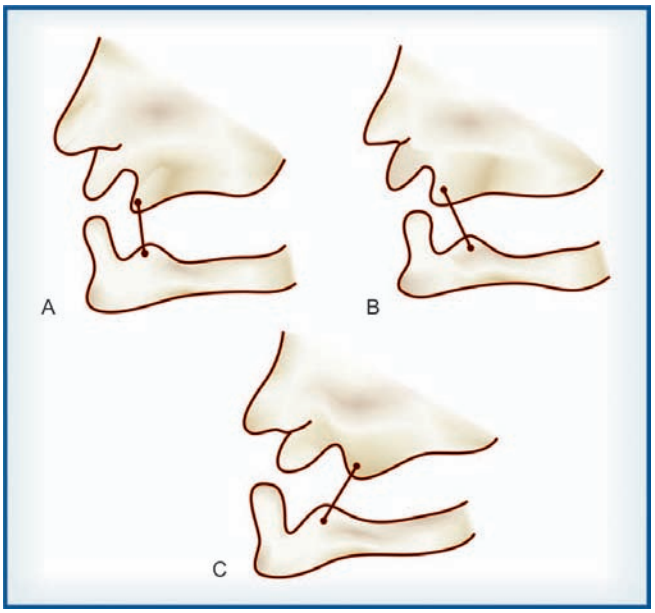
- High well rounded
- Low well rounded
- Knife-edge
- Flat
- Depressed

c. Residual ridge relation (Fig. 4.5):

- Normognathic
- Prognathic
- Retrognathic



FIGURES 4.4A to D: Residual ridge form: (A) High well-rounded, (B) Low well-rounded, (C) Knife edge, (D) Flat

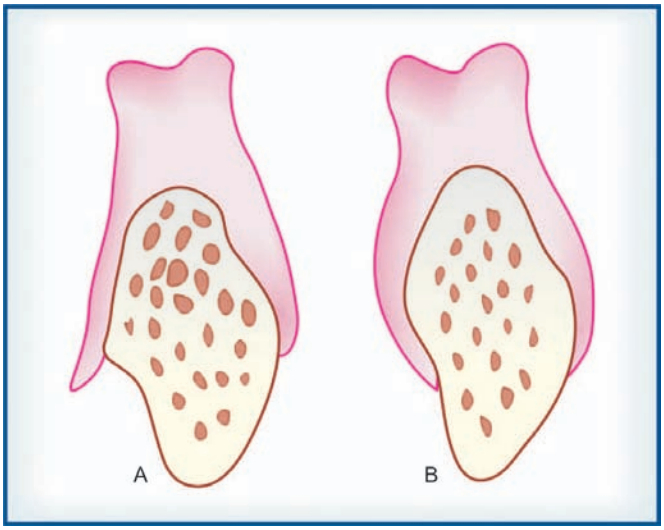


FIGURES 4.5A to C: Residual ridge relation: (A) Normognathic, (B) Retrognathic, (C) Prognathic

d. Interarch distance:

1. Adequate**:** Normal—16 mm–20 mm
2. Inadequate: It will cause mechanical interference leading to biological damage.
3. Excessive: It may be due to increased resorption of residual alveolar ridge. It results in increased leverage arm which implies damaging force on the support.

e. **Undercut location:** The favorable undercuts should be detected that aid in retention and the unfavorable undercuts should be planned for surgical correction (Fig. 4.6).



FIGURES 4.6A and B: Relation of the denture to the undercut in mandibular alveolar ridge: (A) Unfavorable undercut, (B) Favorable undercut

f. Bony irregularities location: The irregularity should be palpated and the blanching of tissue over it is examined. Radiographic examination will be an additional aid in differentiating the irregularity caused by bone and any residual tooth structure. Surgical correction should precede any prosthodontic treatment (Fig. 4.7).

g. Retained root pieces: It can be confirmed by radiographic examination followed by surgical removal.

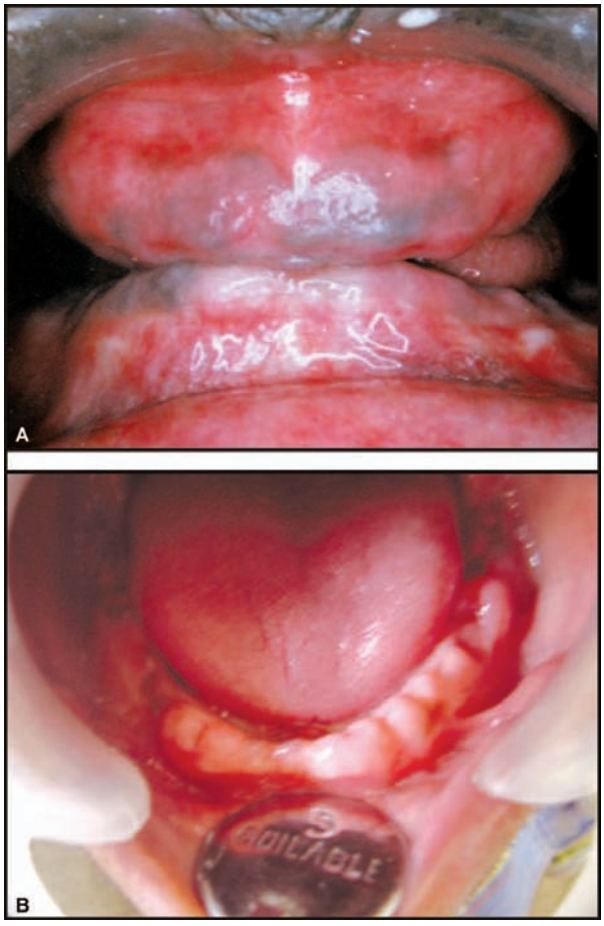
h. Mucosa

- Resilient: Ideal requirement
- Hard/Unyielding: Unequilibrium of support
- Inflamed: Very fragile
- Hyperplastic/Displacable: Surgical treatment for elimination of hyperplastic tissue/astringent containing tannic acid
- Other abnormalities.

i. Vault of the palate (Figs 4.8 and 4.9): It may be 'V' shaped or 'U' shaped. It could be either high vault or flat vault. The 'U' shaped palate is suitable in reference to retention and stability while the 'V' shaped palate causes deflective forces.

Junction of hard and soft palate may be classified as class I, class II or class III (Fig. 4.10).

- **Class I:** The hard and the soft palate are at the same level. The implication of a class I soft palate



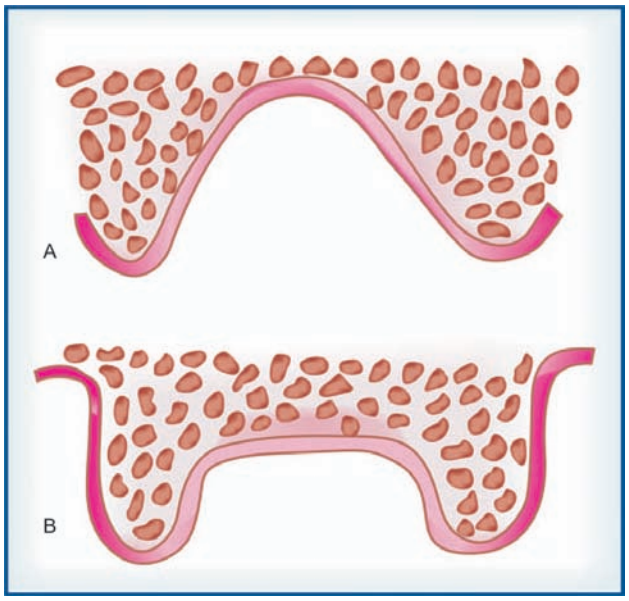
FIGURES 4.7A and B: Alveolar ridge indicated for alveoloplasty: (A) Excessive height of anterior region of the alveolar ridge, (B) Irregularity of the alveolar ridge

is that the posterior extent of the denture is not critical.

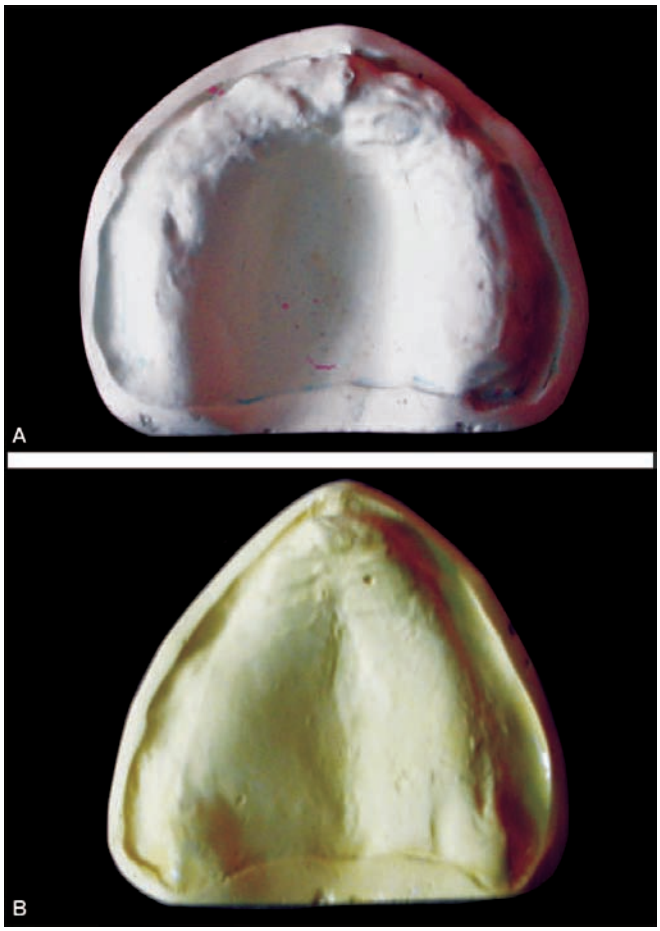
- **Class II:** The soft palate gradually slopes from the hard palate. Overextension of the posterior limit of the denture can be tolerated to some extent.
- **Class III:** The soft palate abruptly slopes from the hard palate. If the posterior limit overrides the function, it would lead to respiratory difficulty and gagging reflex. Hence, the posterior limit of maxillary denture remains very critical.

j. Maxillary tuberosity

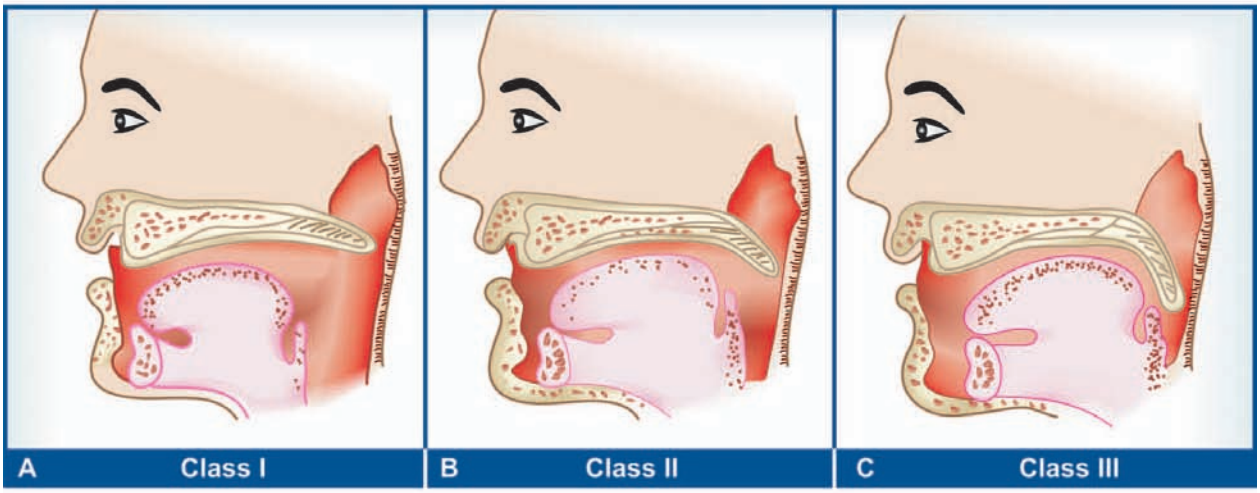
- Normal/enlarged/pendulous: Occlusal radiograph of the tuberosities should be taken to see proximity to maxillary antrum, if resection of tuberosity is required. In case of bilateral undercuts, preference of the patient to the chewing side is



FIGURES 4.8A and B: Form of palatal vault: (A) High vault, (B) Flat vault



FIGURES 4.9A and B: (A) U shaped arch with deep vault palate, (B) V shaped palate with flat vault palate



FIGURES 4.10A to C: Junction of hard and soft palate

noted and the undercut on that side is reduced. Surgical template should be made before reduction.

k. Saliva:

Quantity	*Quality*
Scanty	Serous/thin
Abundant	Mucous/thick
Normal	Mixed

The blunt end of an instrument is dipped in the pool of saliva and raised. If it sticks to the instrument in a ropy form, it is mucous. If it does not stick, then it is serous. In mixed type of saliva, it adheres to the tip of the instrument in a ropy form to some extent and then breaks.

Thick mucous saliva causes surface deficiency. It affects adhesion, cohesion and surface tension. In case of abundant and thick mucous saliva, antisialogogus can be advocated/ mouth can be washed with solution of sodium bicarbonate that will reduce salivary secretion into the mouth.

l. Tongue size: Normal/abnormal or large

The lingual flange of the lower denture should be physiologically contoured. If the flange is kept short, the tongue may be pinched between the tissue of the lingual side and the denture.

The distal limit of the maxillary denture should be made to flush with the vibrating line (physiological contouring). If it is not done, it may lead to gagging reflex and abrasion of the tongue.

m. Frenal attachment: Maxillary/ mandibular

1. Normal
2. Close to the crest
3. Broad

Adequate allowance has to be given for the function of the frenum. Failure to do so will lead to ulcer formation at the base of the frenum, which is very painful. If the frenum attachment is close to the crest of the ridge, it has to be treated surgically because the denture periphery placed on hard bone will affect peripheral seal. Over reduction of the denture base in the area of the frenum can weaken the denture.

Radiographic Examination

Orthopantomogram (OPG)

Orthopantomogram is very important in prosthodontics. It gives an idea of compact bone and the trabecular pattern. It also helps in spotting pathological areas and retained root stumps.

- A radiographic picture depicting dense bone with compact trabeculae and a few medullary spaces with a well-defined cortex is considered a good foundation.
- Cancellous bone can react favorably if the stress is kept within physiological limits. If trabeculae and medullary spaces are evenly distributed, the radiograph picture is lighter. Cortex, though well defined, could be lighter in contrast.

CASE RECORD

Student/Operator Name — Patient No.
Patient's Name — Sex — Age.
Address — Telephone
Occupation — Registration No.

I. Chief Complaint

What is your problem and why do you seek treatment?

a. Lost all teeth and need dentures
b. Old dentures are unsatisfactory/ill fitting
c. Old dentures worn out/broken/lost.
d. Any other

II. History of Present Illness

1. How long have you been without natural teeth?
   Upper
   Lower
2. Primary reason for the loss of the teeth:
   a. Gum disease: Loosened/mobile teeth
   b. Dental caries
   c. Any others
3. Previous denture experience and its duration
4. Why do you mainly require dentures?
   a) Mastication b) Esthetics
   c) Phonetics d) On other's suggestion

III. Evaluation of Systemic Status/General Health:

1. General constitution-Robust/Average/Frail
2. Past medical history:
   i. Any major illness?

Diabetes	Anemia
Tuberculosis	Bleeding disorders
Cardiovascular diseases	Asthma
Neurological disorder	Jaundice
Palsy	Radiotherapy
Epilepsy	Drug history
Allergy	Any other

   ii. Present medical history or H/o hospitalization

IV. Personal History:

1. Oral hygiene habits: Methods
   Frequency
2. Other habits
   Smoking / Pan / Tobacco chewing / Betal nut / Alcohol / Clenching / Bruxism / any other

V. Socio-psychological Status

1. Family status.
2. Educational Status
3. Mental attitude: Philosophical Exacting
   Hysterical Indifferent
4. What patient expects?
   Understand limitation
   Function
   Esthetics

CLINICAL EXAMINATION

A. Extraoral Examination Face

1. Form: Ovoid/Tapering/Square
2. Profile: Normognathic/Prognathic/Retrognathic
3. Symmetry: Symmetrical/Asymmetrical
4. Facial height: Decreased/Normal/Increased
5. Facial muscle tone: Normal/Flabby/Spastic
6. Complexion: Dark/Fair/Medium
7. Lips: Thick/Average/Thin
8. Length: Short/Average/Long
9. T.M.J. Examination: a. Normal b. Pain or tenderness, c. Clicking d. Movements-Normal/Deviated/Restricted
10. Lymph node (Submandibular, Submental, Cervical, Preauricular, Mastoid Examination: Palpable / Non-palpable, Tender / Non-Tender, Movable / Fixed

B. Intraoral Examination:

I. Evaluation of Residual Ridges
   1. Arch form: Maxillary: U shaped / V shaped / Combination / Square
      Mandibular: U shaped / V Shaped / Combination / Square
   2. Residual ridge form
      a. High well rounded
      b. Low well rounded
      c. Knife edge
      d. Flat/ Depressed
      Maxillary: Anterior, Posterior
      Mandibular: Anterior, Posterior
   3. Ridge relation: Normognathic/Prognathic/Retrognathic/Cross arch
   4. Interarch distance: mm (Normal 16-20 mm) (Adequate / Inadequate / Excessive)
   5. Under cut location: Upper Anterior Lower Anterior
      Upper Posterior Lower Posterior
   6. Bony irregularities location
   7. Retained root pieces.
   8. Mucosa: Well Keratinised/Smooth/Firm/Loose/Abnormal (Details):
      Resilient
      Hard unyielding
      Inflamed
      Hyperplastic or dysplastic
      Other mucosal abnormalities
   9. Special features (If any) (Condition of the maxillary tuberosities, Mylohyoid ridge, etc)
   10. Maxillary tuberosity: Normal/Enlarged/Pendulous

II. Lip Mucosa: Normal/ Abnormal

III. Cheek Mucosa: Normal/Abnormal

IV. Floor of the Mouth
   a. Lingual frenum: Normal/Prominent/Absent/tongue-tie
   b. Genial tubercles: Not seen/Prominent
   c. Plica: Not seen/Prominent

V. Tongue:
   a. Mucosa: Normal / Abnormal
   b. Size: Normal / Hypertrophy / Atrophic
   c. Gag reflex: Normal / Exaggerated

VI. Palate
   a. Incisive papilla: Normal / Prominent
   b. Rugae: Normal / Prominent
   c. Mucosa: Normal / Abnormal
   d. Compressibility
      Median area: Rigid / Compressible
      Lateral area: Rigid / Compressible
   e. Palatal vault: V Shaped / U Shaped / Flat
   f. Junction of hard and soft palate: Class I / Class II / Class III
   g. Posterior palatal seal area: Compressible / Non-compressible

VII. Vestibule: Upper: Labial – Shallow / Deep
Buccal – Shallow / Deep
Lower: Labial – Shallow / Deep
Buccal – Shallow / Deep
Lingual – Shallow / Deep

VIII. Frenal Attachments: Maxillary Mandibular
   a. Number
   b. Normal
   c. Close to crest
   d. Broad
   e. Prominent Freni

IX. Saliva:

Quality	Quantity
1. Serous or Thin	1. Scanty
2. Mucous or Thick	2. Abundant
3. Mixed	3. Normal

X. Observation of any other relevant findings:

XI. Remarks on the existing dentures:
   1. Cleanliness
   2. Vertical Dimension of occlusion
   3. Extension of denture base
   4. Stability
   5. Condition of the teeth
   6. Esthetics
   7. Condition of denture base
   8. Centric relation
   9. Retention
   10. Phonetics

XII. Special investigations:
   a. Radiographs
   b. Diagnostic casts
   c. Others

Prognosis
Treatment plan
   a. Motivation / Patient Education
   b. Surgical / Non Surgical preparation of tissues / Systemic / Local treatment

c. Clinical Steps and Laboratory Procedures Material and Technique Used

No.	Step	Material	Date	Sign
1.	Primary impression Upper Lower			
2.	Diagnostic / Primary cast preparation			
3.	Custom tray preparation			
4.	Final Impression Upper Lower			
5.	Preparation of stone cast (Working cast)			
6.	Preparation of Wax occlusion rims			
7.	Jaw relation record			
8.	Transfer of sealed Jaw relation record on to the articulator			
9.	Selection of teeth			
10.	Teeth arrangement			
11.	Try-in and verification of jaw relation record			
12.	Preparation of mould, wax elimination and processing			
13.	Trimming, recovery of the denture, finishing and polishing			
14.	Denture insertion			
15.	Recall checkup			

Accomplishment: Satisfactory / Unsatisfactory

Patient's Signature

Staff Incharge Signature HOD Signature

- Poor quality of foundation is revealed by radiolucent non-cortical bone, which is poor in organic salts. There is no definite cortex, margins are thin and these patients invariably suffer from discomfort and excessive resorption.

For the benefit of the students a model examination chart has been given on page 30.

SELF-HELP QUESTIONS

1. Define diagnosis, examination, prognosis and treatment plan.
2. What is the treatment plan for complete edentulous diabetic patients?
3. What is the preprosthetic treatment consideration for complete edentulous patient with anemia?

4. What is the absolute contraindication for complete denture treatment?
5. Why should early morning and short appointments be planned for cardiovascular complete denture patients?
6. What implication will neuromuscular disorders have on complete denture fabrication procedure?
7. Classify mental attitude according to M.M. House.
8. Classify face form by Leon Williams.
9. What relevance does different residual ridge forms have in success of complete denture treatment?
10. Classify junction of hard and soft palate and mention its relevance in complete denture treatment.
11. How do you check for the quality of saliva?
12. What is the significance of radiographs in complete denture treatment?
13. Mention the sialogogues and antisialogogues.

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CHAPTER 5

Preprosthetic Surgery

INTRODUCTION

The preprosthetic surgery is an important procedure done prior to prosthetic replacements in compromised condition of the hard and the soft tissues supporting the complete denture

AIMS

1. To facilitate retention and stability of the denture.
2. To improve the condition of the supporting tissues.

SCOPE

The scope of preprosthetic surgery includes the following:

1. Ridge preservation procedures as a preventive measure
2. Corrective or recontouring procedures of the defects and abnormalities.
3. Ridge extension procedures
   a. Relative methods, e.g. sulcus extension (vestibuloplasties)
   b. Absolute methods, e.g. ridge augmentation methods
4. Reconstruction methods like correction of abnormal ridge relationships.
5. Provision of accessory aids
   a. Creating favourable undercuts
   b. Dental implants
   c. Onlay denture
6. Modified denture construction procedures e.g. immediate denture where construction of the denture precedes surgery.

INDICATIONS

Indications for preprosthetic surgery in hard tissue defects like:

1. Knife edge margins of alveolar ridge
2. Presence of any bony spicules
3. Presence of any root stumps or cysts
4. Presence of exotosis (bony overgrowth) occurs in maxilla in palate.
5. Presence of tori-mandible is commonly involved in the lingual aspect.

Indications for preprosthetic surgery in soft tissue defects like:

1. Bulbous maxillary tuberosity with normal underlying bone.
2. Alteration of muscle attachment e.g. Mylohyoid muscle attachment forms the floor of the mouth. Geniohyoid and genioglossus which are attached to genial tubercles.

Requirements of an ideal ridge:

1. No evidence of intraoral or extraoral pathologic conditions.
2. Proper jaw relationship in the anteroposterior, transverse and vertical dimensions.
3. Alveolar processes that are as large as possible and of the proper configuration (the ideal shape of the alveolar process is a broad U-shaped ridge with vertical components as parallel as possible).
4. No bony or soft tissue protuberances or undercuts.
5. Adequate attached keratinized mucosa in the primary denture bearing area.
6. Adequate vestibular depth.
7. Adequate form and tissue coverage for possible implant placement.
8. Have no muscle fibers or frena that mobilize the prosthesis.
9. Have no neoplastic lesions.

The various types of preprosthetic surgeries are:

1. Ridge preservation
2. Ridge augmentation
3. Ridge extension

RIDGE PRESERVATION PROCEDURE

Hard Tissue Abnormalities

Alveoloplasty

It is a plastic surgical recontouring procedure that is done on alveolar ridge to obtain a proper foundation and stability of a denture. Simplest forms of alveoplasty consist of compression of lateral walls of extraction socket after simple tooth removal. In many cases of simple tooth extraction digital compressions of extraction site adequately contours the underlying bone provided, there are no gross irregularities of bone in the area after extraction.

Alveoplasty in case of multiple teeth extraction is done in two stages:

a. Immediately after extraction or
b. After a certain level of healing has taken place

Simple Procedure

A conservative alveoplasty in combination with multiple extractions is carried out after all the teeth in the arch have been removed.

After local anesthesia is administered, reflect a proper mucoperiosteal flap exposing the bony protruberance. A mucoperiosteal incision is given along the crest of the ridge with adequate extensions anterior and posterior to the area to be exposed. Flap reflection allows adequate visualization and access to the alveolar ridge. If adequate exposure is not obtained, small vertical releasing incisions should be given. The objectives of mucoperiosteal flap reflection are to allow for adequate visualization and access to the bony structures that require recontouring and to protect soft tissues adjacent to this area during the procedure. Depending on the degree of irregularity of the alveolar ridge area, recontouring can be accomplished with a bone rongeur, a bone file or a bone bur in a handpiece alone or in combination. In any case copious saline irrigation should be used throughout the recontouring procedure. After recontouring, the flap should be reapproximated by digital pressure and the ridge palpated to ensure that all irregularities have been removed. After copious irrigation the edges of the flap can be trimmed to remove excess tissue and sutured with interrupted or continuous sutures.

Dean's Intraseptal Procedure (Fig. 5.1)

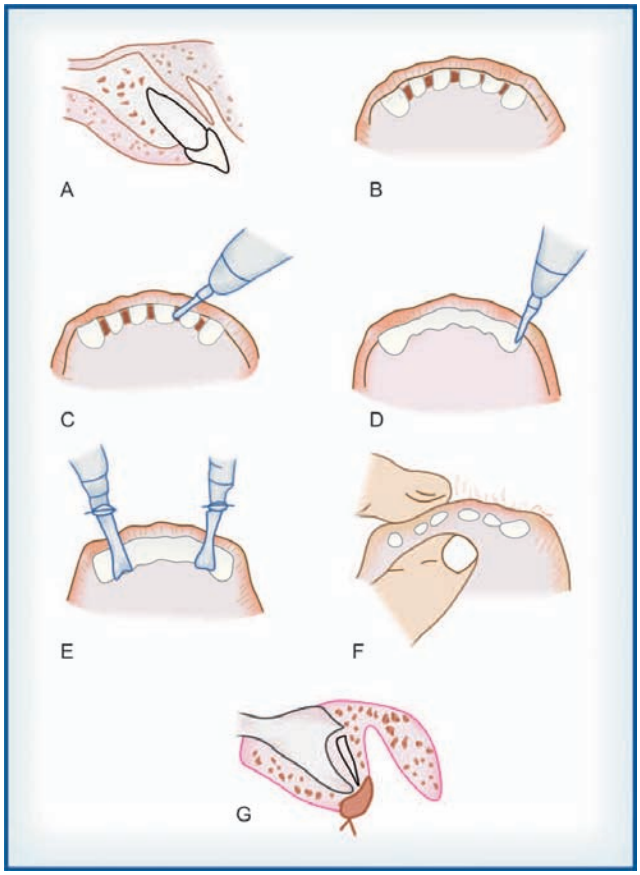
It is done at the time of extraction. This technique is best used in an area where the ridge is of relatively regular contour and height but presents an undercut at the depth of the labial vestibule because of the configuration of the alveolar ridge.

After exposure of the crest of the alveolar ridge by reflection of the mucoperiostium, a small rongeur can be used to remove the intraseptal segment of the alveolar bone. After adequate bone removal has been accomplished digital pressure should be sufficient to fracture the labial cortical plate of the alveolar ridge inward to approximate the palatal or lingual plate area more closely. Digital pressure on the labial aspect of the ridge is necessary to determine when the bony cut is complete and to ensure that the mucosa is not damaged.

After positioning the labial cortical plate any residual bony irregularities can be contoured using a bone file and the alveolar mucosa can be re-approximated with interrupted or continuous sutures.

Advantages:

- Labial prominence of the alveolar ridge can be reduced without significantly reducing the height of the ridge in this area.
- The periosteal attachment to the underlying bone can also be maintained, thus reducing postoperative bone resorption and remodeling.



FIGURES 5.1A to G: Dean's intraseptal (intercortical) alveoloplasty. (A) Pre-extraction, (B) Post extraction, (C) Bur used to remove interdental base, (D) Smoothening, (E,F) Compression of cortices, (G) Primary closure

Maxillary Tuberosity Reduction

Horizontal and/or vertical excess of the maxillary tuberosity may be a result of excess bone, an increase in the thickness of soft tissue overlying the bone or both. Recontouring of the maxillary tuberosity area may be necessary to remove bony ridge irregularities / create adequate interarch space, which will allow proper construction of the prosthesis in the posterior area.

Anesthesia may be obtained by local infiltration or by posterior superior alveolar nerve block and greater palatine nerve blocks. Crestal incision is made that extends up to the posterior aspect of the tuberosity area. Reflection of a full thickness mucoperiosteal flap is completed both in the buccal and palatal directions to allow adequate access to the entire tuberosity area. Bone is removed either by a side cutting rongeur or rotary instrument by carefully avoiding perforation of the floor of the maxillary sinus. After appropriate amount of bone has been removed, the area is smoothened with a bone file and copiously irrigated with saline. Mucoperiosteal flaps can be readapted and excess, overlapping soft tissue resulting from the bone removal is excised in an elliptical fashion. Sutures are allowed to remain in place for seven days.

Buccal Exostosis and Excessive Undercuts

Excessive bony proturberances and resulting undercut areas are common in maxilla than in mandible.

Local anesthesia should be infiltrated around the area requiring bony reduction. A crestal incision extends 1 to 1.5 cms beyond each end of the area, requiring contour and a full thickness mucoperiosteal flap is reflected to expose the areas of bony exostosis. Vertical incision can be given for proper access and visibility and the ridges prepared to give suitable foundation to the prosthesis that is fabricated

Mylohyoid Ridge Reduction

Inferior alveolar, buccal and lingual nerve blocks are required for mylohyoid ridge reduction. Linear incision is made over the crest of the ridge in the posterior aspect of the mandible. Extension of incision too far to the lingual aspect is avoided as this may cause trauma to lingual nerve. Full thickness muco-periosteal flap is reflected which exposes mylohyoid ridge area and mylohyoid muscle attachments. Mylohyoid muscle fibres are removed by sharply incising the muscle attachments at the area of bony origin. A rotary instrument or bone file can be used to remove sharp prominence of the mylohyoid ridge.

Genial Tubercle Reduction

Local anesthesia infiltration and bilateral lingual nerve blocks should provide adequate anaesthesia. A crestal incision is made from each premolar area to midline of the mandible. A full thickness mucoperiosteal flap is dissected lingually to expose the genial tubercles. The genioglossus muscle attachment can be removed by a sharp incision. Smoothening with the bur or a rongeur followed by a bone file reduces the genial tubercles. Genioglossus muscle is left to reattach in a random fashion. If the areas of irregularity are small, recontouring with a bone file can be done. If the areas of irregularity are large, use of a rongeur or a rotary instrument may be necessary. After the completion of the bone contouring soft tissue is readapted and visual inspection and palpation assure that no irregularities or bony undercuts exist. Interrupted or continuous sutures are used to close soft tissue incisions. Sutures removed in seven days.

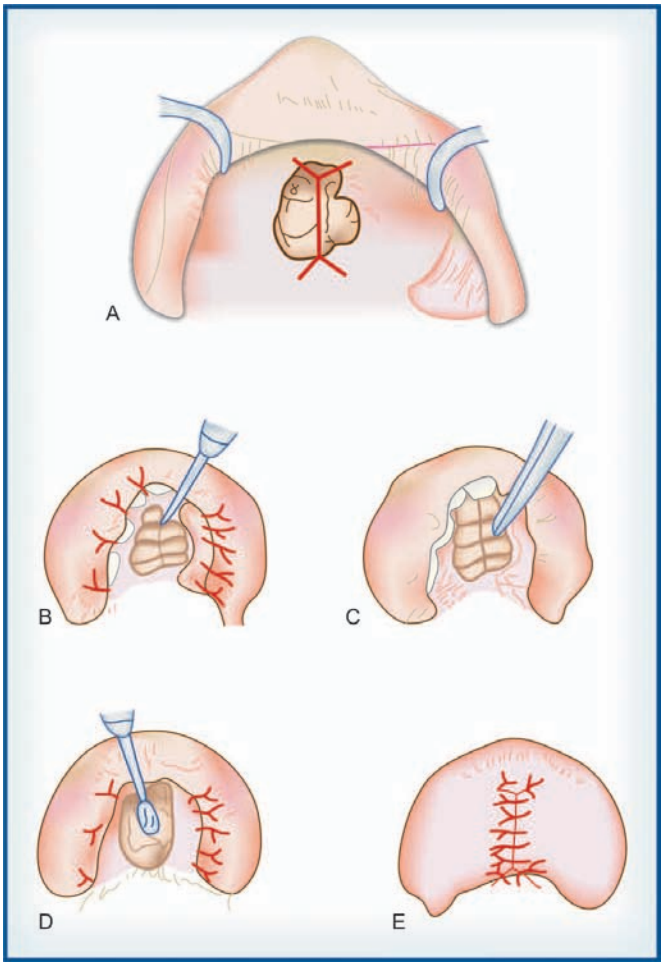
Lateral Palatal Exostosis

This presents problems in denture construction because of the undercut created by exostosis and the narrowing of the palatal vault. Local anaesthesia is adsministered by greater palatine nerve block and infiltration. A crestal incision is made from the posterior aspect of the tuberosity extending slightly beyond the anterior area of exostosis. Reflection of mucoperiosteal flap in the palatal direction is accomplished with careful attention to the area of palatine foramen to avoid damage to the blood vessels as they leave the foramen and extend forward. After adequate exposure, a rotary instrument or bone file can be used to remove excess bony projection in this area. The area is irrigated with sterile saline and closed with continuous or interrupted sutures. No surgical splint or packing is generally required after this procedure.

Excision of Tori

Maxillary tori (Fig. 5.2): Local anaesthesia by bilateral greater palatine and incisive blocks or local infiltrations provides the necessary anesthesia for tori removal. A linear incision in the midline of the torus with oblique vertical releasing incisions at one or both ends is necessary. Raise the mucoperiosteal flap carefully. When tori with a small pedunculated base are present, an osteome and mallet may be used to remove the bony mass. For larger tori, it is usually best to section the tori into multiple fragments with a bur in a rotary handpiece. After sectioning, individual portions of the tori can be removed with a mallet and osteotome or a rongeur and area can be smoothened with a large bone bur. Tissue is readapted by finger pressure and inspected to determine the amount of excess mucosa that may need to be removed. The mucosa is reapproximated and sutured by interrupted suture technique. Vaseline gauze formed into a pack and adapted to the palate can be sutured in place with a 2-0 silk suture tied to the lateral aspects of the palatal vault, which suspends the Vaseline pack in place under pressure against the palatal bone. Major complications of maxillary tori removal include postoperative hematoma formation, fracture or perforation of the floor of the nose and necrosis of the flap.

Mandibular tori (Fig. 5.3): They are bony protuberances on the lingual aspect of the mandible that usually occur in the premolar area. Bilateral lingual and inferior alveolar injections provide adequate anesthesia for tori removal. An incision on the crest of the ridge should be made extending 1-1.5 cm beyond each end of the tori to be reduced when bilateral tori are to be removed simultaneously, It is best to leave a small band of tissue attached to midline between the anterior extents of the two incisions. When the torus has a small pedunculated base, a mallet and osteotome may be used to cleave the torus from the medial aspect of the mandible. The line of cleavage can be directed by creating a small trough with a bur and a handpiece before using an osteotome. It is important to ensure that the direction of the initial bur trough is parallel with the medial aspect of the mandible to avoid an unfavourable fracture of the lingual or inferior cortex. A bone bur or file can be used to smoothen the lingual cortex. The tissue should be readapted and palpated to evaluate contour and elimination of undercuts. An interrupted suture or continuous suture technique is used to close the incision. Gauze packs placed in the floor of the mouth and retained for 12 hr are helpful in reducing postoperative hematoma and edema formation.

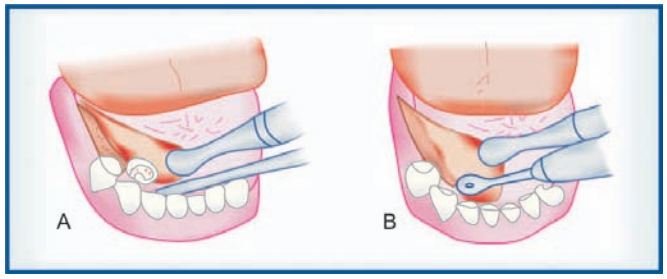


FIGURES 5.2A to E: Technique for removal of palatal torus: (A) Median palatal incision (B) Dental bur used to cut grooves (C) Sharp chisel used to remove small pieces (D) Bone bur used to smooth the stump (E) Palatal incision sutured

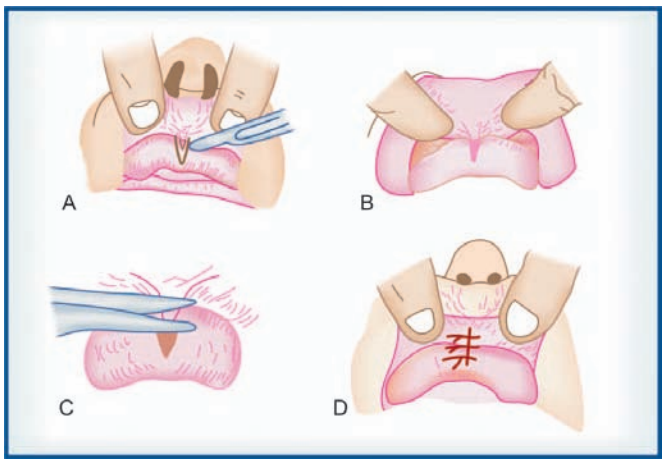
Soft Tissue Abnormalities

Abnormalities of the soft tissue in the denture bearing and peripheral tissue areas include:

- Abnormal muscular and frenal attachments (Figs 5.4 and 5.5).



FIGURES 5.3A and B: Technique for removal of mandibular torus: (A) Mucoperiosteal flap reflected to expose large torus and sharp chisel used to remove it. (B) Large bone bur used to smoothen the stump



FIGURES 5.4A to D: Maxillary labial frenectomy (A) Narrow 'v'shaped incision made around the frenum (B) Fibres of frenum stripped away from bone and retracted into lip (C) Small tag of labial mucosa and redundant connective tissue removed with scissor (D) Wound closed with suture

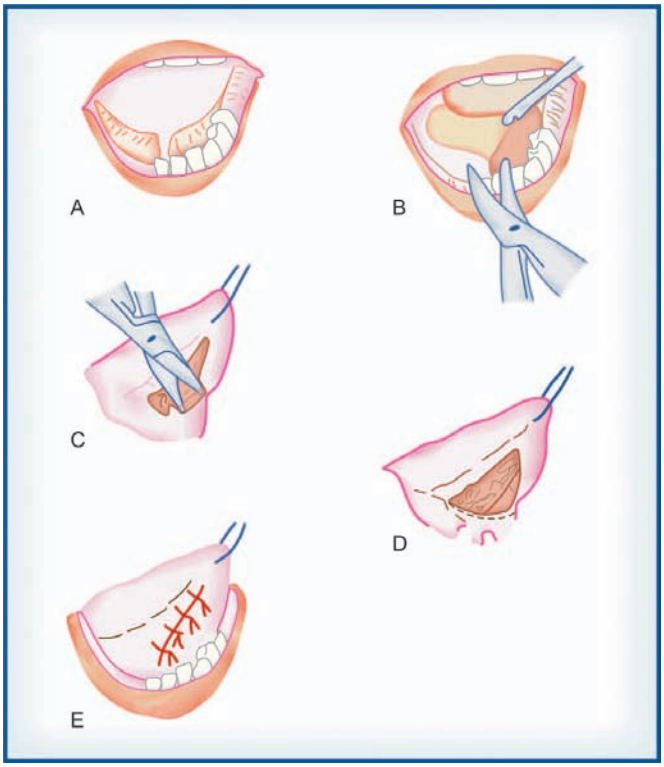
- Excessive fibrous or hypermobile tissue (Figs 5.6 and 5.7).
- Inflammatory lesions such as inflammatory fibrous hyperplasia of the vestibule (Fig. 5.8).
- Inflammatory papillary hyperplasia of the palate.

ADVANCED PREPROSTHETIC SURGERY

Ridge Augmentation Procedures

Types

1. Rib graft augmentation to the superior border of mandible.
2. Rib graft augmentation to the inferior border of mandible.
3. Residual ridge augmentation by pedicled bone flap procedure.



FIGURES 5.5A to E: Lingual frenectomy (A) Preoperative view (B) Transverse incision made with scalpel or scissor through the frenum. Deeper dissection with scissor is continued in the midline until the tip touches the maxillary teeth (C)(D) Margins of the diamond shaped wound undermined with scissors (E) Sutured as a median palatal incision

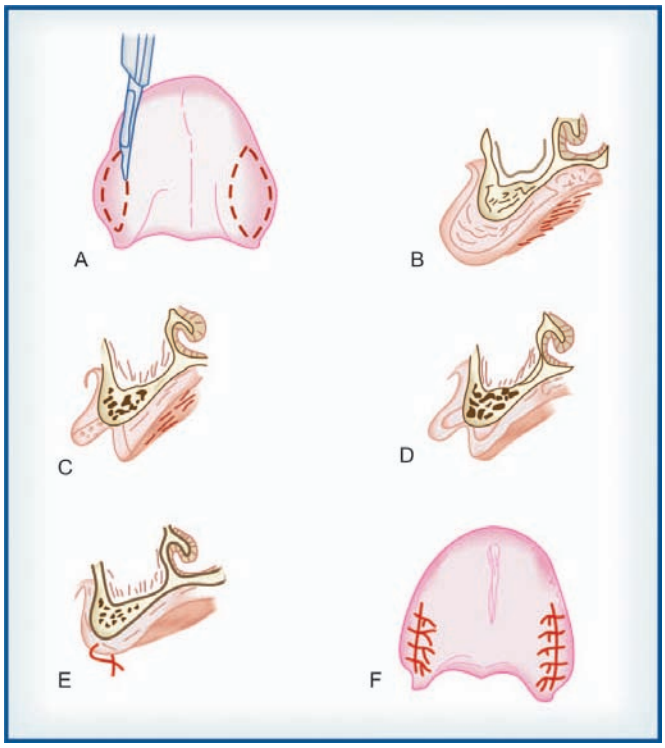
   a. Horizontal osteotomy (sandwich technique)
   b. Vertical osteotomy (visor's technique)

Rib Graft Augmentation to the Superior Border of Mandible (Fig. 5.9)

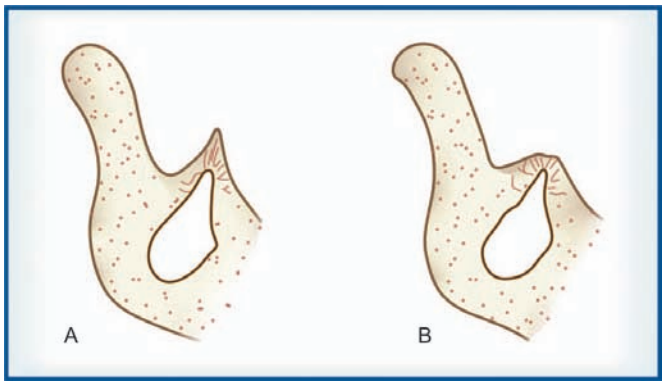
Indications:

i. Atrophic mandible with decreased vertical height.
ii. Atrophic mandible susceptible to fracture.
iii. Atrophic mandible where there is possibility of neural disturbances.

Procedure: Incision is made within the fixed crestal tissue after general anaesthesia is administered. Mucoperiosteal flap is reflected. Grooves in the anterior area are placed as lingually as possible. Ribs are used for the procedure. Rib is adapted to shape of arch and grooved prior to placement. Ligature with stainless steel wire is adapted.



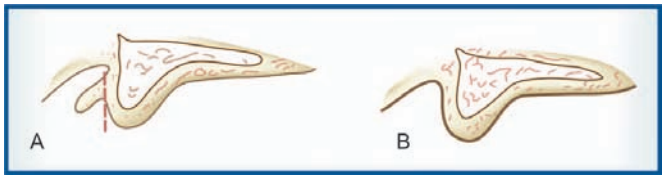
FIGURES 5.6A to F: Excision of fibrous tissue on maxillary ridge (A)(B) Elliptical incisions made around the hyperplastic soft tissue masses (C) Block of tissue removed (D) Blocks of submucous connective tissue are removed so the buccal and palatal flaps are thinned and mobilized (E)(F) Wound margins are approximated and sutured



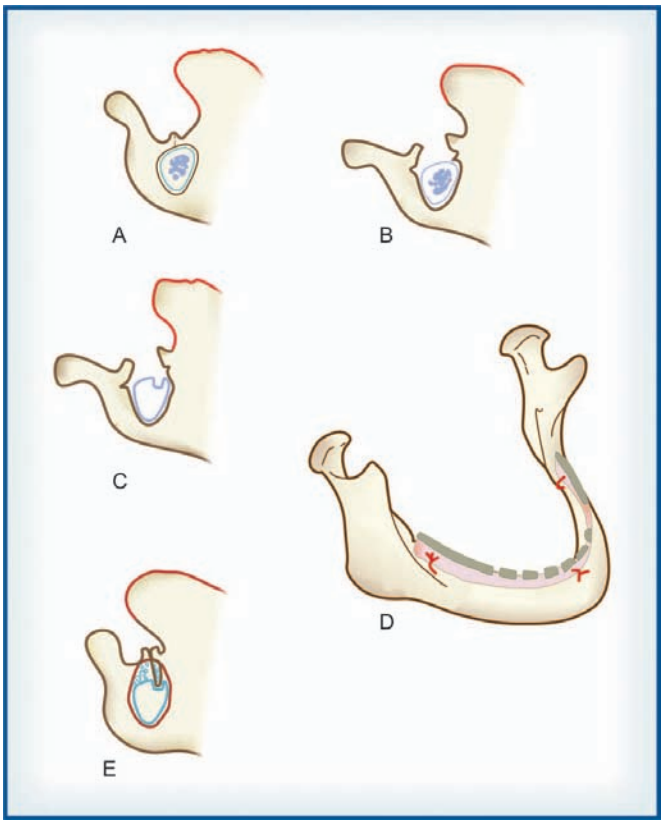
FIGURES 5.7A to B: Excision of fibrous tissue on mandibular ridge: (A) Thin freely moveable mucosa on the resorbed ridge (B) Partial excision of the moveable portion of the mucosa with scissors

Disadvantages

- Morbidity associated with removal of ribs.
- 70 percent of chance that graft is going to get resorbed.
- Done under general anaesthesia.



FIGURES 5.8A and B: Excision of hyperplastic vestibular mucosa: (A) Excision of inflammatory hyperplasia of the vestibule (B) Wound healed by granulation



FIGURES 5.9A to E: Rib graft augmentation to the superior border of mandible: (A) Incision made within the fixed crestal tissue (B) Periosteum releasing incision (C) Groove in the anterior area is placed lingually as much as possible (D) Ligation of the rib strut-the position of the three ligating wires (E) Final configuration after the graft is placed and the wound sutured

Advantage

- Increase in vertical height.

Other materials used

- Illiac crest
- Freeze dried bone

Rib Augmentation to Inferior Border of Mandible

Indications

- Atrophy of alveolar ridge area.
- Prevention and management of fractures of the atrophic mandible.

Disadvantages

- Increased inter arch distance is not achieved.
- Morbidity of rib harvesting.
- Superior border irregularities.
- Exposed position of the mental nerve, which results from mandibular atrophy.
- Need for hospitalization.

Pedicle Bone / Interpositional Graft

It was introduced by Haile, which was later modified by Peterson and Scade.

Advantages

- There is decreased amount of resorption as continuous blood supply is maintained.
- Since relatively little cancellous bone is needed, donor site morbidity can also be reduced.
- As this augmentation repositions the lingual aspect of the mandible, a correction of class III ridge relationship that can result from severe bony resorption may occur.

Disadvantages

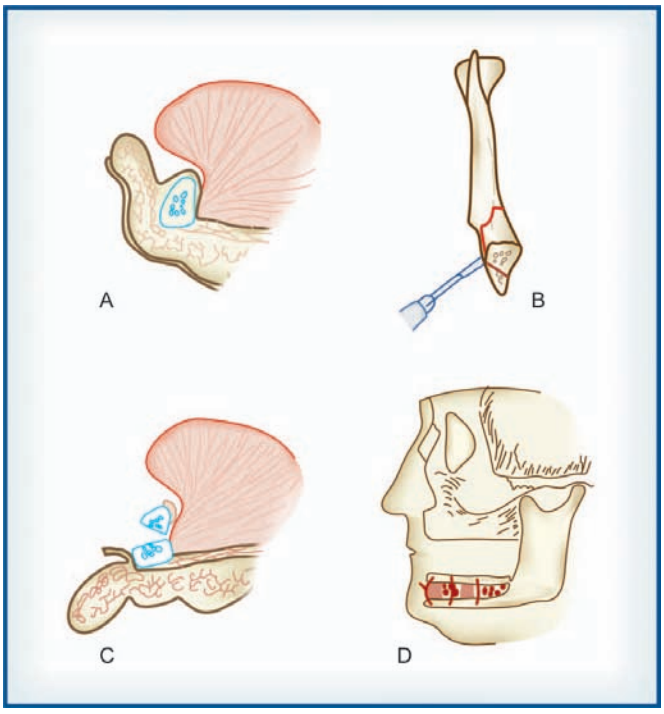
- Need for hospitalization.
- Done under general anaesthesia.
- Donor site surgery and the inability to wear denture for 3 to 5 months after surgery.
- Postoperative neurosensory deficit has also been noted.

Horizontal Osteotomy (Sandwich Technique) (Fig. 5.10)

It is done by splitting the superior – inferior dimension of the residual jaw and bone is grafted into this osteotomy. In maxilla, the Le Fort osteotomy with interpositional grafting often is used. Useful for augmentation of anterior mandible

Advantage

- Less resorption

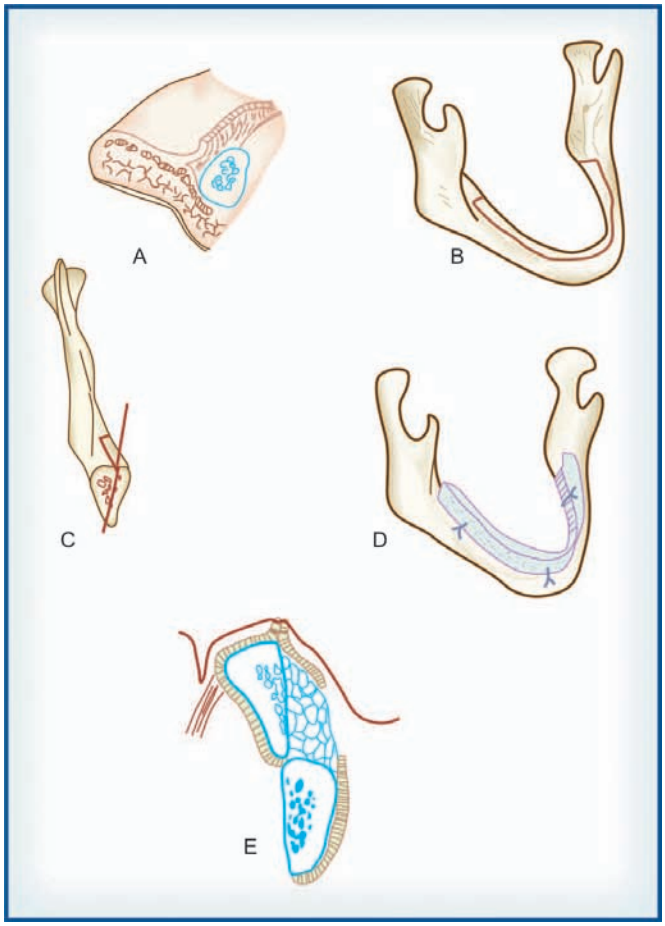


FIGURES 5.10A to D: Horizontal osteotomy: (A) Sagittal view showing the attachment of the genioglossus and suprahyoid muscles,which can provide blood supply to a lingual mandibular bone flap (B) Reciprocating saw inserted from the lateral ,is used to make the horizontal osteotomy in the body of the mandible (C) When the superior aspect of the mandible is mobilized it remains attached to the lingual mucosa and the musculature (D) Cortical struts of the mandible are used to stabilize the bone flap and cancellous marrow is packed in the remaining space

- Allows for more predictable long-term results
- Decreased incidence of nerve parasthesia.

Vertical Osteotomy (Visor's Technique) (Fig. 5.11)

In this technique,the bucco lingual dimension of the mandible is split and lingual cortical plate is repositioned superiorly. It extends from retromolar triangle to retro molar triangle on the other side and from crest of the ridge to the inferior border of mandible. Osteotomy must be angled laterally so that it will extend completely to inferior border of mandible. Mobilized lingual bone flap is elevated in visor fashion and secured with sutures. Cancellous marrow from the illium is placed on the lateral aspect of the elevated bone flap. The periosteum may be needed to be incised to prevent tension during the closure.



FIGURES 5.11A to E: Vertical osteotomy (A) Buccal muco-periosteal flap is reflected,leaving the lingual soft tissue attached. (B) Extension of vertial osteotomy (C) Osteotomy should be angled laterally so that I will extend completely to the inferior border of the mandible. (D) Mobilized lingual bone flap is elevated in visor fashion and secured with sutures (E) Cancellous marrow from the ilium is placed on the lateral aspect of the elevated bone flap.the periosteum may need to be incised to prevent tension during the closure.

Advantages

- There is decreased postoperative bone resorption.
- Good vertical bone augmentation.
- Simultaneous vestibuloplasty procedures can be performed.

Disadvantage

- Need for hospitalization.
- Increased incidence of paresthesia of the mandibular nerve.
- Postoperative ridge form following visor osteotomy is poor.

Hydroxyapatite Augmentation (Table 5.1)

It is a dense biocompatible material that can be produced synthetically or obtained from biologic sources such as coral. Granular or particle form is most commonly used for alveolar ridge augmentation. When placed in sub-periosteal environment adjacent to bone, hydroxyapatite bonds physically and chemically to the bone.

Augmentation of Mandible with Hydroxyapatite

It can generally be performed on an outpatient basis using local anaesthesia combined with conscious sedation techniques.

Procedure: A subperiosteal tunnel technique is used, which exposes entire superior aspect of mandible. After tunnel is created, a preloaded beveled syringe containing hydroxyapatite is inserted in most posterior aspect and it is injected until the desired height and contour of mandible is obtained. Insertion of hydroxyapatite from each lateral incision area augments the anterior of the mandible. Splints are preferred to minimize hydroxy-appatite displacement and to improve vestibular form during postoperative period. Vestibuloplasty and skin grafting can be performed 8 to 12 weeks after augmentation.

Advantages

- The need for donor site surgery is eliminated.
- Done under local anaesthesia.
- There is no postoperative loss of graft.
- Vascular tissue ingrowth around hydroxyappatite provides adequate vascular bed for future soft tissue grafts.

Disadvantages

- It is difficult to contain the material within the tunnel and obtain adequate absolute height augmentation.
- Nerve dysesthesias.

Augmentation of Maxilla with Hydroxyapatite

Indications

- Alveolar ridge resorption results in an inability to construct a denture.
- Elimination of undercut areas in maxilla.

Table 5.1: Classification of alveolar ridges and treatment protocol

Class	*Characteristics*	*Treatment*
I	Alveolar ridge adequate in height but inadequate in width, usually with lateral deficiency or undercut areas.	Hydroxyapatite (HA) alone
II	Alveolar ridge deficient in both height and width and has a knife-edge appearance.	HA alone
III	Alveolar ridge resorbed to level of the basilar bone producing concave form on posterior areas of the mandible and sharp bony ridge form with bulbous, mobile soft tissue in the maxilla.	HA alone or mixed with autogenous cancellous iliac bone
IV	Resorption of basilar bone, producing pencil thin, flat mandible or flat maxilla.	HA mixed with autogenous cancellous iliac bone

Procedure: Incision made in mid-line is usually sufficient for adequate access to both sides of the maxillary ridge. Bilateral vertical maxillary incisions in the canine-premolar area can be used to improve visibility. Subperiosteal tunnels are created over crest of the alveolar ridge and hydroxyappatite particles are injected and molded to the desired height and contour of the maxillary ridge. The incisions are closed with a horizontal mattress suture.

Ridge Extension Procedure

Vestibuloplasty

It is a sulcus deepening procedure, which is a selective method of ridge extension by deepening the vestibule without any addition of bone. Only the soft tissue attachments are shifted to a favorable zone in the jawbones so that more of denture bearing area is available to increase the retention and stability of the denture.

Indications

- High muscle attachments.
- Inadequate depth in labial and buccal vestibule.
- Inadequate fixed tissue coverage in denture bearing areas.

Contraindications

- Patients diagnosed with hypertension, diabetes, bleeding disorders (haemophilia thrombocytopenic purpura).
- Cardiac conditions like myocardial infarction.
- Pregnancy.

Goals

- To provide adequate depth for lateral and buccal flange area.
- To have adequate amount of fixed tissue to form denture seal.

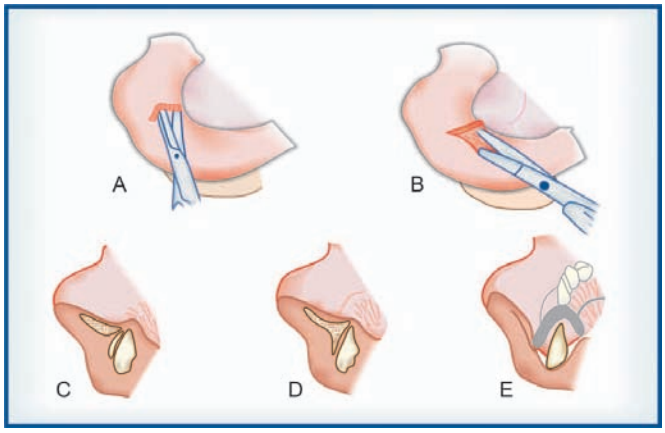
Techniques of vestibuloplasty

1. Mucosal advancement or submucous vestibuloplasty.
   - A. Closed submucous vestibuloplasty.
   - B. Open view submucous vestibuloplasty.
2. Secondary epithelialisation (repethelialisation)
   - A. Kazanjian's technique
     - i. Godwin's technique.
     - ii. Lipswitch or transpositional vestibuloplasty.
   - B. Clarks technique
     - i. Periosteal fenestration (tortorelli).
3. Grafting vestibuloplasty
   - i. Skin.
   - ii. Mucosal.
4. Lingual sulcoplasty
   - i. Anterior lingual sulcoplasty.
   - ii. Posterior lingual sulcoplasty.
     - A. Caldwell's procedure.
     - B. Trauner's procedure.
     - C. Obwegeser's technique.

Mucosal Advancement Vestibuloplasty (Fig. 5.12)

Indication

- Correction of soft tissue attachment on or near the crest of the alveolar ridge of the maxilla.



FIGURES 5.12A to E: Mandibular mucosal advancement Vestibuloplasty: (A) Midline vertical incision is made in the vestibule through the mucosa (B) Vertical incision is deepened to bone and supraperiosteal dissection is performed. (C) Connective tissue septum separating the submucosal and subperiosteal tunnels is excised. (D) Mucosa is adapted to the deepened vestibule. (E) A surgical stent is placed by circumferential wiring

- Useful when maxillary alveolar ridge resorption has occurred but the residual bony maxilla is adequate for proper denture support.
- To provide adequate vestibular depth without providing an abnormal appearance of upper lip with adequate mucosal length available in this area.

A simple test to determine whether adequate labial vestibular mucosa is present is performed by placing a dental mouth mirror under the upper lip and elevating the superior aspect of the vestibule to desired post-operative depth. If no inversion or shortening of the lip occurs, then adequate mucosa is present to perform a proper submucosal vestibuloplasty.

Procedure: A midline vertical incision is made in the vestibule through the mucosa with only mucosa undermined into the lip and the cheek. Vertical incision is deepened to bone and supra periosteal dissection is performed. Connective tissue septum separating the submucosal and subperiosteal tunnels is then developed. Mucosa is adapted to the deepened vestibule. A surgical stent is placed and held in place by circumferential wiring. Maxillary submucosal vestibuloplasty can also be combined with hydroxyapatite augmentation of the alveolar ridge area.

Advantages: It provides a predictable increase in vestibular depth attachment of mucosa and thus increasing the denture bearing area.

Secondary Epithelialisation

Kazanjian's technique (Fig. 5.13)
Transpositional flap vestibuloplasty

Indication:

- Adequate mandibular height.
- Inadequate facial vestibular depth from mucosal and muscular attachments in the anterior mandible.
- Presence of adequate vestibular depth on the lingual aspect of mandible.

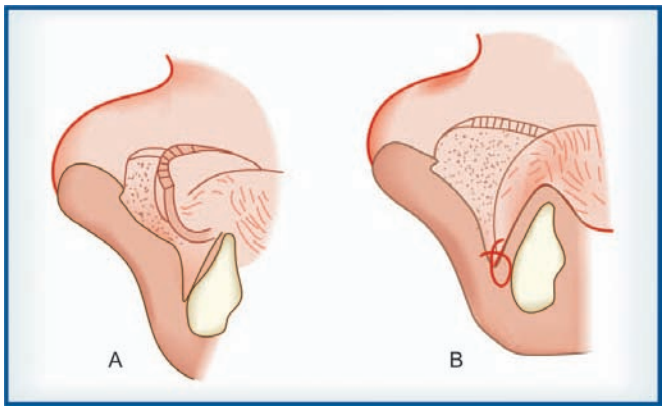
Procedure: Incision is made on the labial vestibular mucosa and large flap of labial and vestibular mucosa is reflected. Supra periosteal dissection is performed to deepen the vestibule. Flap of mucosa is sutured to the periosteum in the vestibule. Raw lip heals by granulation and secondary epithelialisation. It can be combined with hydroxyapatite augmentation procedures.

Advantages

- Provides adequate results.
- Do not require hospitalization.

Disadvantages

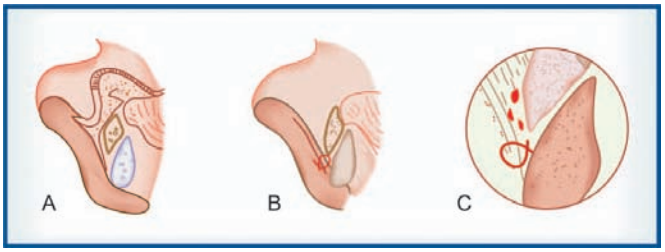
- Unpredictability of the amount of relapse of vestibular depth.



FIGURES 5.13A and B: Secondary epithelialisation vestibuloplasty (Kazanjian's technique): (A) Incision is made on the labial vestibular mucosa,large flap of labial and vestibular mucosa is reflected.supraperiosteal dissection is performed to deepen the vestibule.(B) Flap of mucosa sutured to the periosteum in the vestibule

- Scaring in the depth of the vestibule.
- Problems with adaptation of peripheral flange area of the denture to the depth of the vestibule.

Clark's technique with Tortorelli's periosteal fenestration (Fig. 5.14): Horizontal incision at muco-gingival junction and supra periosteal dissection done deep into vestibule. At the base of vestibule, periosteum is incised horizontally. Inferior periosteal margin is elevated. Mucosal flap is transferred and sutured to the bone covered with periosteum that heals by epithelialisation.



FIGURES 5.14A to C: Secondary epithelialisation vestibuloplasty (Clark's technique): (A) Horizontal incision at the mucogingival junction.supraperiosteal dissection done deep into the vestibule. (B) At the base of the vestibule,periosteum is incised horizontally. (C) Inferior periosteal margins is elevated. Mucosal flap is transferred and sutured to the lower periosteal margin. The bone covered by periosteum heals by secondary epithelialization

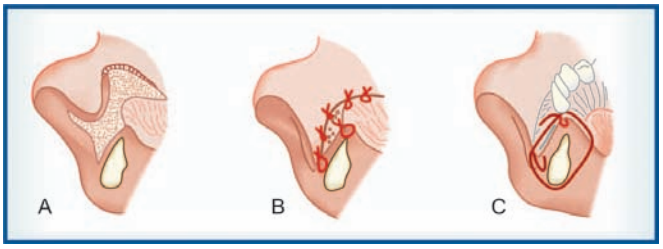
Skin Grafting or Mandibular Vestibuloplasty with Mucosa (Fig. 5.15)

Incision is placed along muco-gingival junction and vestibule is deepened by supraperiosteal dissection. Mucosal flap is sutured to the periosteum at the base of the vestibule. A skin or mucosal graft is used to cover the raw periosteal surface and sutured to the wound margins. Graft can be placed on the stent that is secured to mandible by circumferential wiring.

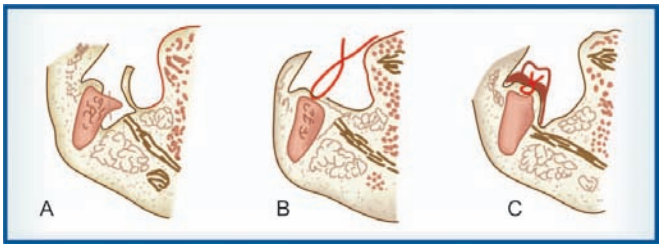
Lingual Sulcoplasty

Posterior Lingual Sulcoplasty

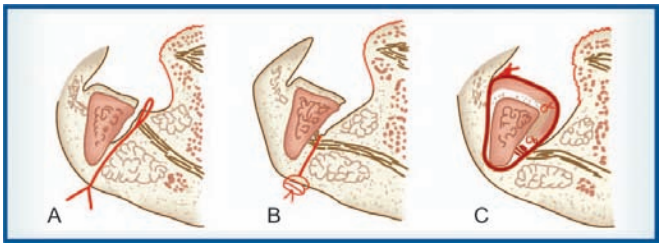
Caldwell's technique (Fig. 5.16): Incision is placed on the crest of the ridge. Mylohyoid muscle is stripped away and mylohyoid ridge is removed. Flap is sutured at the crest. Denture or splinting with elongated lingual flange is fixed with circumferential wirings.



FIGURES 5.15A to C: Skin grafting or mandibular vestibuloplasty with mucosa: (A) Incision placed along mucogingival junction. (B) Mucosal flap is sutured to the periosteum at the base of the vestibule. A skin or mucosal graft is used to cover the raw periosteal surface and sutured to the wound margins (C) Graft can be placed on the stent that is secured to the mandible by circumferential wiring

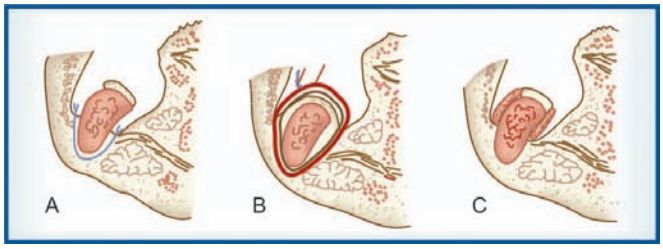


FIGURES 5.16A to C: Lingual sulcoplasty (Caldwell's technique): (A) Incision placed on the crest of the ridge, mylohyoid muscle is stripped away and the mylohyoid ridge is removed. (B) Flap is sutured at the crest. (C) Denture or splint with elongated lingual flanges is fixed with circumferential wires



FIGURES 5.17 A to C: Lingual sulcoplasty (Trauner's technique): (A) The medial surface of mandible is exposed he supraperiosteal dissection. is severed and mylohyoid muscle is placed inferiorly with sutures. (B) Periosteal surface is left raw (C) Periosteum is coverd with skin graft and stentis placed

Trauner's technique (Fig. 5.17): By supraperiosteal dissection the medial surface of the mandible is exposed and mylohyoid muscle is detached from the mylohyoid ridge area and repositioned inferiorly by sutures, thus effectively deepening the floor of mouth and relieving the influence of mylohyoid muscle on denture. Periosteal surface is left raw or periosteum is covered with skin grafts and stent is placed.



FIGURES 5.18A to C: Obwegeser's technique: (A) Incision on mucogingival junction on both facial and lingual surface supra-periosteal dissection done mycohyoid and genioglossal muscle stripped (B) Split thickness skin graft secured to the stent and are placed over mandible by circumferential wiring (C) Skin adhered to raw periosteal surface

Obwegeser's Technique (Fig. 5.18)

Incision is done on mucogingival junction of both facial and lingual surfaces. Supraperiosteal dissection is done. Mylohyoid and genioglossus muscles are stripped. Split thickness skin graft secured to the stent is placed over mandible by circumferential wiring.

Advantages

- Early covering of the exposed periosteal bed, this improves patient comfort and allows earlier denture construction.
- Long-term results of vestibular extension are predictable.

Disadvantages

- Need for hospitalization.
- Donor – site surgery combined with moderate swelling.
- Discomfort experienced postoperatively.

SELF-HELP QUESTIONS

1. Classify preprosthetic surgeries.
2. Mention the simplest forms of alveoloplasty.
3. Define vestibuloplasty.
4. What is Deans interseptal alveoloplasty.
5. What is Clarks procedure of vestibuloplasty.
6. Elaborate on Kazanjians procedure of vestibulo-plasty .
7. Elaborate on Obwegeser's technique.
8. Elaborate on Visor osteotomy.
9. Elaborate on sandwich technique.
10. Elaborate on horizontal ridge augmentation procedure.
11. Mention the common sites for mandibular tori
12. What are the types of vestibuloplasty?
13. Mention the recent advances in preprosthetic surgery.
14. What are the various alloplastic materials for ridge augmentation?
15. Mention the autogeneous bone graft sites.
16. What do you understand by superior border augmentation?
17. What do you understand by inferior border augmentation?
18. Mention the various types of incisions for alveoloplasty.
19. Elaborate on tuberoplasty.
20. Mention the armamentarium for alveoloplasty
21. What are the indications for vestibuloplasty?

CHAPTER

6

Impression Techniques and Procedures in Complete Denture Treatment

INTRODUCTION

Impression forms an important virtue for the success of complete denture treatment and hence the concepts of impression should be properly understood. From time immemorial, there have been different impression theories that have been advocated. There are various techniques adopted by different practitioners and there may be as many techniques as the number of dentists regarding impression, which in general means *negative likeness*. But *in Prosthodontics, it is the negative registration of the denture bearing, denture stabilizing, denture bracing and peripheral limiting structures obtained in one of the plastic or semi plastic materials, which is registered at the moment of crystallization of the impression material.* Since the denture bearing area is in a continuous state of flux with new cells being generated and cells being shed off at different moments of time, the tissues at the time of impression making may differ from that at the time of denture insertion. Hence, the term 'at the moment of crystallization' means, the registration obtained, is specific for a particular time. An impression is made in order to reproduce a positive form or cast of the recorded tissues.

For successful complete denture treatment, an accurately recorded primary impression, border molding and final impression are mandatory. *Primary impression* is a negative likeness made for the purpose of diagnosis, treatment planning and fabrication of a custom tray. *Border molding* is the shaping of the border areas of an impression by functional manipulation of the tissues to duplicate the contour and the size of the vestibule. *Final impression* is the negative registration of the entire denture foundation (including denture bearing and stabilizing areas) and border seal areas present in the edentulous mouth, which is used for making master cast. It is the impression that represents the completion of the registration of the surface.

IMPRESSION TRAY

It is a receptacle into which a suitable material is placed to make an impression. It can also be defined as a device, which is used to carry, confine and control impression material for making an impression.

Functions

- To support the impression material in planned contact with oral tissues.
- To support the impression material when removed from the mouth so that a cast can be poured.

Types

1. Stock trays
   A. Edentulous tray (Fig. 6.1)
      a. Non-perforated.
      b. Perforated.

FIGURES 6.1A and B: Stock impression trays: (A) Non-perforated edentulous trays (B) Perforated edentulous trays

FIGURES 6.2A and B: Compound tray (A) Primary impression in impression compound (B) Impression separated from stock tray and converted to an impression tray

FIGURE 6.3: Shellac tray

B. Dentulous box tray
   a. Non-perforated.
   b. Perforated.
   c. Rim lock.

2. Custom tray
   A. Compound tray (Fig. 6.2).
   B. Shellac tray (Fig. 6.3).
   C. Acrylic resin tray
      a. Close fitting.
      b. With spacer and stops.

Custom Tray (Figs 6.4 to 6.6 and 6.8)

It is an impression tray made on the diagnostic cast and is designed to make a more accurate and detailed impression. It is fabricated for a specific impression procedure for the patient and is discarded after use.

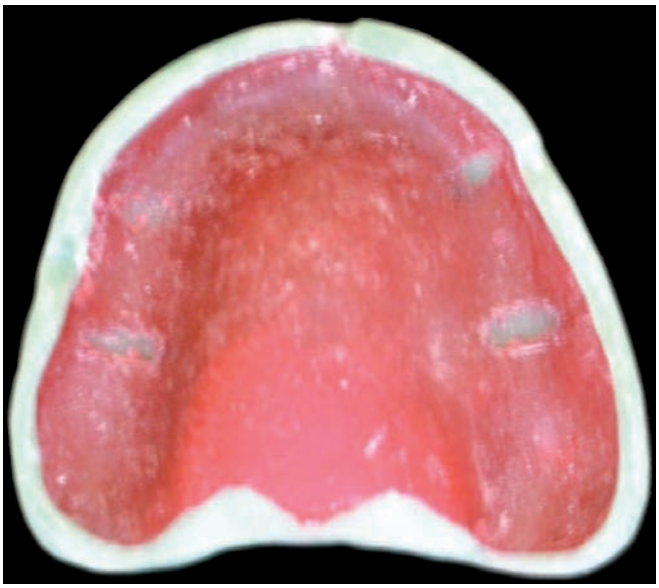


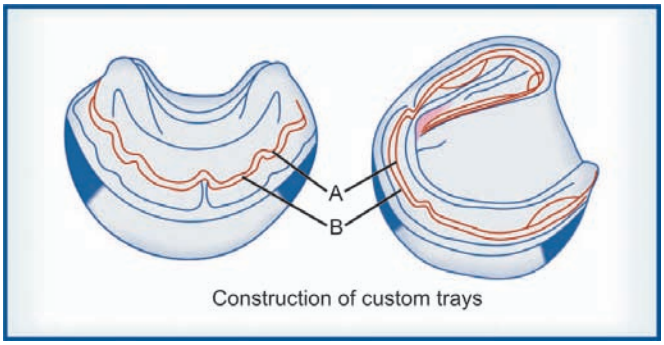
FIGURE 6.4: Custom tray with spacer

FIGURE 6.5: Mandibular custom tray with finger rests made in auto-polymerizing acrylic resin

Requirements

- It should be dimensionally accurate
- It should be rigid
- It should nearly have the shape of the completed impression
- It should be evenly thick (2 mm)
- Tray borders should be short of the final impression by 2 mm.

FIGURE 6.6: Maxillary custom tray made with tray acrylic resin



FIGURES 6.7A and B: Outline on diagnostic cast for custom tray fabrication (A) For spacer (B) For custom tray

FIGURE 6.8: Maxillary and mandibular custom tray made in tray acrylic resin

Fabrication: Custom tray fabrication should be done only after ensuring completeness of diagnostic cast, with well-formed uniform land area of the cast. All the relevant anatomical landmarks with functional limits should be evident. In atrophied foundations and altered anatomy, special considerations should be given for requirements of coverage in the light of altered physiology. Estimated border should be marked with indelible pencil on the diagnostic cast before designing the custom tray (Fig. 6.7). Tray should be sufficiently thick as to be rigid/inflexible. The design of the tray should be rationalized on the basis of technique, i.e. minimal pressure or controlled pressure. The spacers and tissue stops should be planned accordingly (Fig. 6.9).

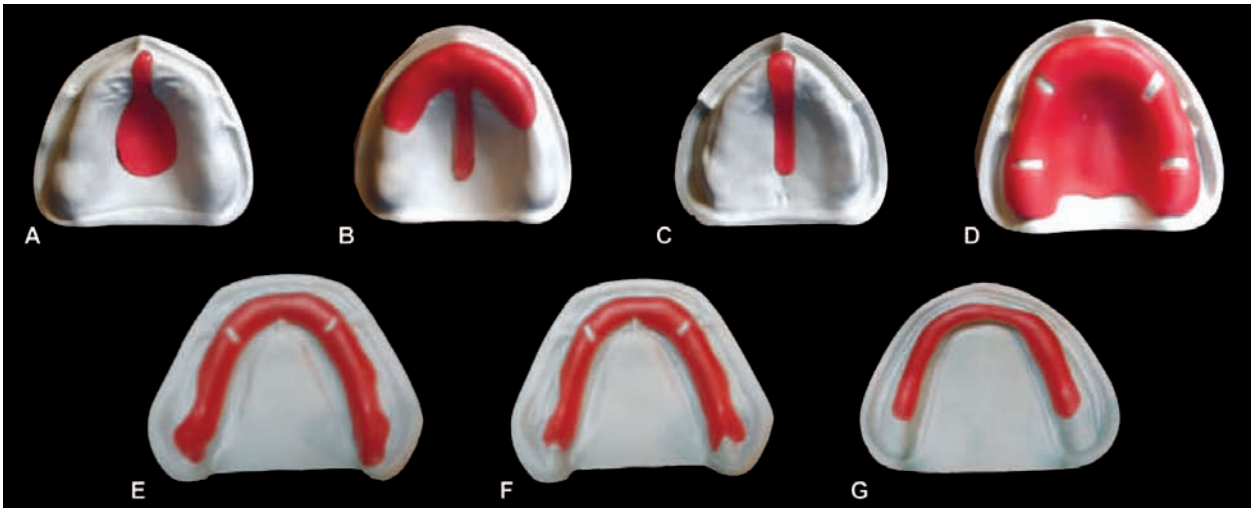


FIGURE 6.9: Spacer designs for edentulous foundation. Maxillary: (A) Deep vault palate (B) Anterior flabby tissue (C) Flat vault palate (D) Full spacer. Mandibular: (E) Full spacer covering the retromolar pad (F) Full spacer not covering the retromolar pad (G) Spacer on crest of the ridge

IMPRESSION MATERIALS

Many impression materials are available to the profession today with definite characteristics and physical qualities for making impressions of edentulous foundations. Material should be selected on the basis of requirements of procedure and the objectives of an impression. The objectives of the impression are retention, stability, support, esthetics and preservation of residual alveolar ridge and soft tissues.

The materials used for preliminary impression are medium fusing impression compound (Fig. 6.10), reversible and irreversible hydrocolloid. Impression compound is however, the favorable material because it is reversible and can be modified to obtain the finer details. The medium fusing impression compound/ compound tracing sticks are used for the purpose of border molding. Zinc oxide eugenol impression paste, non-eugenol impression paste, mouth temperature waxes and rubber base impression material are used for final impression.

Requirements of an Impression

- It should be as complete as possible. i.e. it should include the entire denture bearing area.
- It should be closely contacting the tissues. In other words, it should reproduce the tissues without any distortion.
- The periphery of the impression should closely contact the resilient tissues in the vestibule.
- It should not displace the tissues.
- There should not be gross surface defects in the impression such as tray exposure, fold and air voids.

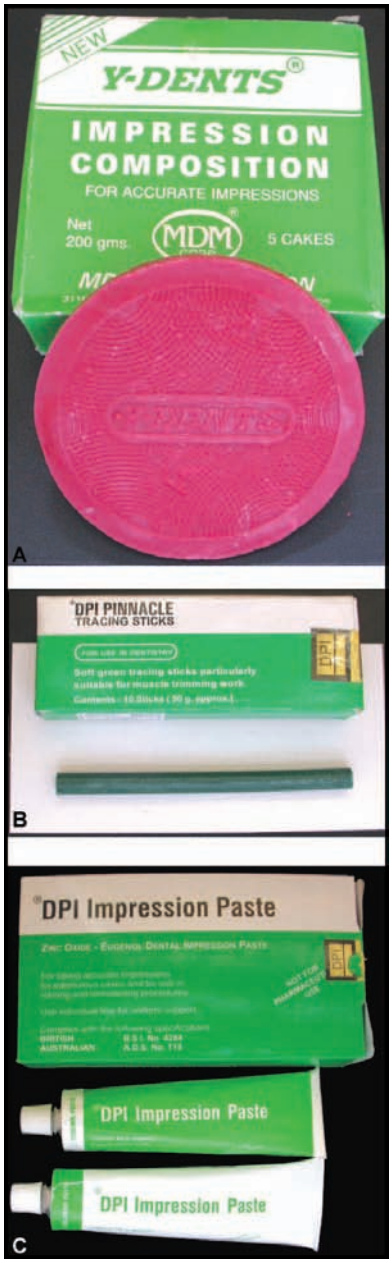
Theories of Impression Technique

Depending on the pressure exerted on the tissues during the registration of the impression, the theories of impression techniques can be classified into:

- Mucocompressive theory.
- Mucostatic theory/minimal pressure theory.
- Mucoselective theory/controlled pressure theory.

Mucocompressive Theory

Greene Brothers advocated it. They considered it essential for the denture to contact the tissues during function.



FIGURES 6.10A to C: Impression materials: (A) Impression compound (B) Low fusing stick compound (C) Zinc oxide eugenol impression paste

They preferred the closed-mouth technique so as to record the tissues in function, especially under masticatory load.

In this technique, impression is recorded in trays that have occlusal rims attached on the polished surface. Maxillary and mandibular trays, loaded with the impression material, are inserted into the mouth and

the patient is instructed to close the mouth applying pressure on the occlusal rims as the material sets. During the procedure, the patient is instructed to swallow, grin and purse the lips while the material flows. Thus in this technique, the mucosa is compressed while the patient does the functional movements and under masticatory force.

Advantage

- Good retention during function.

Disadvantages

- The pressure applied during the procedure may overstress the tissues and eventually cause bone resorption.
- The gradual resorption of the bone will hinder retention of the denture over a period of time.
- The closed-mouth technique will not enable accurate recording of the border tissues.
- Tissues held under pressure rebound to their original form at rest.
- This technique does not respect the principle of tissue biology.

Mucostatic Theory

Harry L Page advocated it in 1938. This theory is claimed to be based on Pascal's law, which states, "The pressure applied on the confined liquid will be equally transmitted undiminished throughout the liquid in all directions." This law is applied here because the denture-bearing mucosa, which is made of 80 percent water, is confined between the firm denture base and the hard bone of the denture bearing area. In this technique, the spacer is adapted on the entire tissue surface with four stops to enable orientation and stabilization of the tray. It is not practically possible to make an impression with absolutely no pressure on the supporting ridge. Hence, it is called the minimal pressure technique, which is used in cases of medically compromised conditions and excessively resorbed ridges.

Advantage

- Tissue health is preserved and maintained.

Limitations:

- Since the borders of the impression are not extended to the functional depth of the sulcus, the tissue fluid can easily escape through the borders of the denture and thus Pascal's law is not applicable.
- Mucosal topography is not stable over 24-hour period and hence the stress on the mucosa will vary.
- This technique considers interfacial surface tension as the only retentive mechanism and is not optimal.
- Presence of short flanges of the denture affects the retention and stability.

Selective Pressure Technique

Carl O Boucher, in 1950, combined the principles of both mucocompressive and mucostatic theories and adopted the mucoselective theory. Here, the pressure is applied to the stress bearing areas and the areas that cannot bear the stress are relieved. The stress relief areas in the maxillary foundation are the mid palatine raphe and the incisive papilla. In the mandibular foundation, it is the crest of the alveolar ridge. These areas are relieved in the diagnostic casts while fabricating the custom tray. Border molding is done with low fusing impression compound and a wash impression is made with zinc oxide eugenol impression paste or Impression plaster. This technique is used in patients with well-formed healthy ridges.

PRACTICAL GUIDE TO CLINICAL IMPRESSION PROCEDURE

The patient should be seated in an upright and relaxed position in the dental chair. The jaw should be at the level of the operator's elbow for the upper impression and at the level of the operator shoulder for the lower impression. Hands should be washed in the view of the patient even though it may be washed previously. The operator should occupy right side back of the patient for maxillary impression and right front of the patient for mandibular impression.

Selection of tray should be done from the stock trays, which are sterilized. Rotatory movement should be used while inserting the tray in the patient's mouth. A tray with clearance of about 6-8mm between the tray and the tissues all round should be selected. The tray should also cover the entire denture-bearing area. The distobuccal area in the upper and the distolingual region in the lower should be observed carefully since they constitute stability potential in treatment consideration.

Preliminary Impression Procedure (Fig. 6.11)

The impression compound should be softened in hot water at the correct temperature. The compound should be kneaded so that it is uniformly softened. The tray should be loaded adequately with sufficient bulk of compound. The tray should be inserted into the mouth with a rotatary movement so that contact with the corner of the mouth does not displace the material. The maxillary tray should be centered in such a manner that it is slightly anterior to the final position assumed by the tray when it is correctly seated. Move the tray in an upward and backward direction. The patient's mouth should not be wide open because the border tissues will be stretched in this position and a distorted impression will be obtained. After seating the tray into its determined position the compound should be manipulated into the sulcus especially into the deep distobuccal sulcus. Simulation of tissue functions should be carried out for molding the border of the compound. In case of lower impression, the tray should be centered exactly over the ridge and seated straight down. Special care should be taken to manipulate the material into the deep distolingual sulcus with the index finger. After the compound hardens, the tray is withdrawn and the impression should be chilled in cold water. The impression should be checked for completeness, distortion or any gross surface defects. Simulating the tissue movements as would occur during their function then modifies the borders of the impression.

FIGURE 6.11: Maxillary and mandibular primary impression made in impression compound

Border Molding and Final Impression Procedure (Figs 6.12 and 6.13)

The custom tray should be checked on the cast to confirm that the tray border should have an all round clearance of 2-3 mm from the marked outline on the cast. The tray borders should be smooth and rounded. The tray should cover the entire denture- bearing area. The tray border should be uniformly short of the periphery by 2-3 mm.

The compound tracing stick should be softened adequately to prevent undue distortion of border tissues. The tray is inserted and seated in the correct position and the border molding is done by simulating the tissue function. No facial gymnastics should be performed while molding the borders. On the labial and buccal aspects, simulation of tissue function is carried out by straight pull outwards (labially) on the lips and lateral and distal pull of the cheeks from the corner of the mouth. Patient is trained to perform limited tongue movements by touching the tip of the tongue to the upper lip and then touching the tip of the tongue to the buccal mucosa on the right and then the left side for recording the lingual borders of the mandibular impression. Extending and dropping a line on the lingual side from the base of the retro molar triangle guides formation of disto lingual limit of the mandibular impression. Distolingual border should be functionally moulded so as to be least conspicuous to the tongue when the tongue is moved in anterior direction. The hamular notch is located with a 'T' burnisher. The line of minimal movement when the patient says 'Ah' is marked and joined to the hamular notch. This forms the posterior vibrating line. The round end of the 'T'burnisher is used to palpate the tissue anterior to the posterior vibrating line. The junction between the resilient and the hard unyielding bone is marked which forms the anterior limit in the form of cupid bow. The low-fusing compound is softened and placed in the posterior palatal seal area, the marking of which is transferred on to the tray from the mouth. The contact of the material with the tissue may cause some material to flow beyond the posterior palatal seal area, which has to be trimmed and rerecorded to obtain the proper extension and depth of this area.

FIGURE 6.12: Bordermolding with low-fusing stick ompound

The spacer is removed and escape vents are made in the mid palatine raphe area and on either sides to permit excess material to flow out. The loaded tray is inserted into the patient's mouth, centered correctly and seated in position. Tissue function is simulated and pressure is maintained till the material has set. The tray is then withdrawn and the impression is rinsed in cold water, followed by thorough examination of the impression surface.

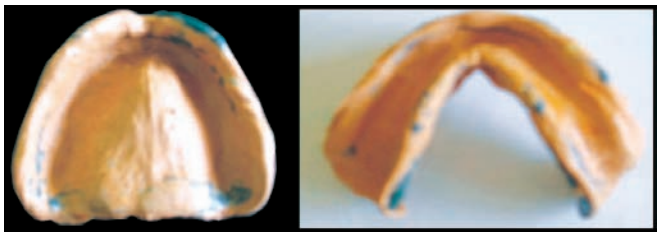


FIGURE 6.13: Final impression made in zinc oxide eugenol impression paste

IMPRESSION TECHNIQUE FOR PATIENTS WITH COMPROMISED CONDITION

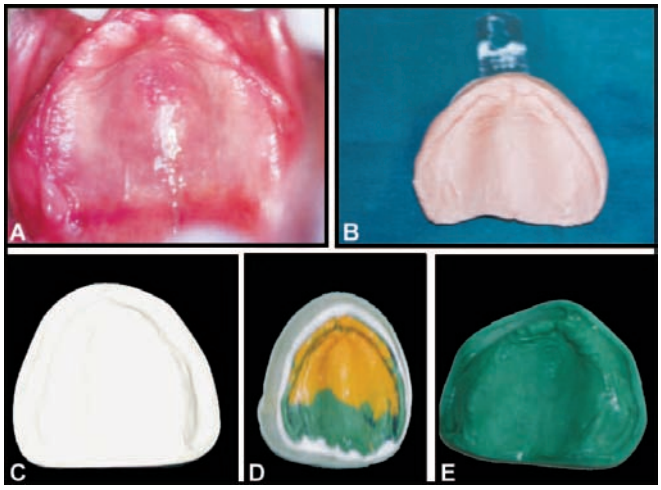
Impression Technique for Resorbed Ridges

Impression Technique by Zafarulla Khan

A window was cut in the custom tray in relation to the unsupported flabby tissue. The unsupported area was recorded with elastic impression material.

Impression Technique by Hobrick

Border molding was done in the usual manner and impression was made with heavy- bodied addition silicone material. The area of moveable tissue was cut out and relief holes were made. Impression was made with light-bodied impression material (Fig. 6.14).



FIGURES 6.14A to E: Impression technique for anterior flabby tissue (A) Flabby tissue in maxillary anterior region (B) Primary impression in alginate (C) Diagnostic cast (D) Beaded final impression (E) Master cast

Impression Technique by John D Walter

The healthy denture-bearing tissue was recorded with zinc oxide eugenol impression material and the displaceable tissue was recorded with impression plaster.

Impression Technique by Allan Mack

A loosely fitting tray was made with heavy relief over the flabby area. Impression plaster was mixed and applied over the flabby area to a thickness of about 3 mm and was allowed to set. The tray was loaded with 2nd mix of plaster and the impression was made, with the initial coating of flabby areas thus acting as a splint during the impression procedure.

Impression Technique for Restricted Opening to the Mouth

Walter described a technique with the use of sectional stock trays. Impression of each side of the jaw was made

one at a time and the cast was poured by joining the impressions in the sectional trays.

Impression Technique for Severely Resorbed Foundation

Lott and Levin introduced the flange technique in 1966. It involves impression of soft tissues adjacent to the buccal, lingual and labial surface resulting in maximum extension of the flange.

Care should be taken to obtain maximum extension in the distolingual sulcus within physiologic limits in highly resorbed alveolar ridges. The impression should involve the entire basal bone including the genial tubercles.

Since the impression procedure forms the basic foundation for the retention and stability of the complete denture, all the steps should be methodically followed with scientific understanding of the theories of impression techniques.

CASTS

Positive reproduction of the form of tissues of the upper jaw or lower jaw, which is made in an impression and over which denture bases or other dental restorations may be fabricated.

Types of Cast

1. Diagnostic cast
2. Master cast
3. Refractory cast

Parts of a Cast (Fig. 6.15)

The parts of the cast are the base, landarea and the anatomical surface. The height of the base should be 15-16 mm at the thinnest portion of the cast. The width of the land area should be 3-4 mm and the distance from the sulcus depth to the land area should be 3-4 mm.

Methods of Pouring a Cast

1. Inversion method
2. Boxing- in method

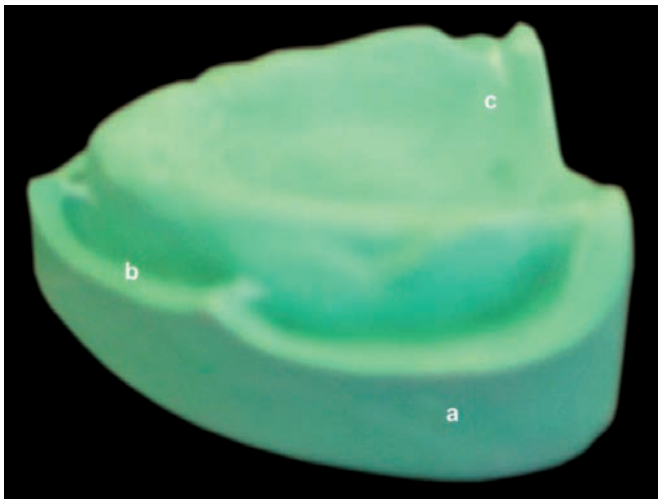


FIGURE 6.15: Parts of a cast: (a) Base (b) Land area (c) Anatomical surface

Inversion Method (Fig. 6.16)

The dental plaster or stone is mixed in proper consistency and placed at one end of the impression and gently tapped so that the material flows evenly throughout the impression. This avoids incorporation of voids in the cast. The impression is completely filled. The remaining mix of the plaster or stone is placed on the slab and the poured impression is inverted over the mix. The land area and the base are carefully developed. The mix should be limited only to the borders of the impression with adequate land area to minimize trimming of the cast.

Boxing-in Method (Figs 6.17 and 6.18)

Boxing-in method preserves the extension as well as the thickness of the base of the cast. The beading wax is adapted and sealed around the periphery of the impression. Adapting and sealing a sheet of base plate wax or boxing wax cut to the proper form fill the tongue space of the mandibular impression. An additional short length of beading wax is adapted and sealed to the heal region of the mandibular impression and across the posterior edge of the waxed-in tongue area to make the border wider in these areas. The spatula used to seal the wax to the impression should be handled carefully to avoid damaging the impression or allowing the wax to flow on to the border of the impression. The boxing

FIGURE 6.16: Procedure of pouring the cast by inversion method

FIGURE 6.17: Procedure of Boxing-in method

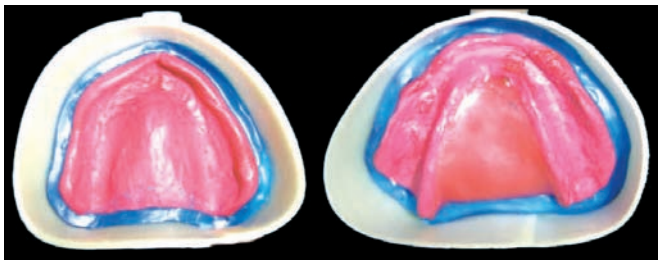


FIGURE 6.18: Beading and Boxing-in done for maxillary and mandibular final impression

wax should extend approximately 13 mm above the highest point on the Impression. The boxing strip is carefully warmed and adapted around the beading wax and ends of the boxing strip are sealed to the underlying layer of wax. The impression is filled with cool water to check the leaks. The impression is finally poured in dental stone or plaster.

SELF-HELP QUESTIONS

1. Define impression.
2. What are the objectives of impression making?
3. What is the purpose of preliminary impression?
4. What are the materials used to make preliminary impression?
5. Define border molding.
6. What is the purpose of final impression?
7. Mention the materials used to make final impression.
8. Define impression tray.
9. Mention the uses of impression tray.
10. Classify impression trays.
11. What is the advantage of custom tray over stock tray?
12. Mention the theories of impression making.
13. What is the rationale of different theories of impression making?
14. What is the method of management of resorbed ridges at the impression making stage?
15. What are the different techniques of impression making in case of flabby ridges?
16. What are the parts of cast?
17. What are the specifications for fabrication of custom tray?
18. Mention the advantages and disadvantages of different materials used to fabricate custom tray.
19. What is the purpose of spacers and tissue stops in custom tray fabrication?
20. What are the indications for different types of spacer designs?
21. What are the synonyms for border molding?
22. Where do you locate the posterior border of a maxillary complete denture?
23. What are the objectives of final impression?

24. Why is a thermostatically controlled water bath used to soften impression compound?
25. What role do perforations play in an impression tray?
26. What is a functional impression?
27. What is the significance of posterior palatal seal area?
28. What are the different types of cast?
29. What is wash impression?

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CHAPTER 7

Retention, Stability and Support in Complete Denture Treatment

INTRODUCTION

Retention is the quality inherent in a prosthesis acting to resist forces of dislodgement. Heartewell defined it as the resistance of a denture to removal in a direction opposite to that of insertion. It is that quality required to be incorporated in the treatment, when the complete dentures would resist dislodging forces which move the dentures away and out at right angles to the supporting tissues.

Stability is the quality of the denture to be firm, steady and constant to displacement by functional, horizontal or rotational stresses.

Support is the resistance to vertical movement of the denture base, towards the ridges. It is that quality required to be incorporated in the treatment, when complete dentures would resist the dislodging forces, which are acting towards the seating surface.

FACTORS OF RETENTION

Physical Factors

Adhesion

It is the physical force of *attraction between unlike molecules* between the surfaces in close contact.

In case of a denture, it is the attraction between the saliva denture base and saliva mucous membrane of the basal seat. It acts when saliva sticks to the denture base and to the mucous membrane of the basal seat. It depends on:

- Close adaptation of the denture base
- Size of denture bearing area
- Type of saliva

Mandibular foundation has decreased surface area and hence decreased adhesion.

V shaped palate induces sliding or deflection, hence retention by adhesion is less.

Cohesion

It is the *physical attraction of like molecules* between the surfaces in close contact. Cohesion is the physical factor of electromagnetic force acting between molecules of the same material. In case of complete dentures, the force of attraction is developed between the molecules of saliva, between the molecules of denture base material and between the molecules of mucous membrane.

Interfacial Surface Tension

It is the *force created on the surface of fluid film or resistance to separation developed between two well-adapted surfaces by a thin film of fluid.* The phenomenon surface tension is defined as the force that maintains the surface continuity of fluid. The cohesive attraction between molecules is balanced in equilibrium within the fluid but at the surface the neighboring molecules create one sided attraction and imbalance that causes a free potential energy called surface tension.

Atmospheric Pressure

It is the physical factor of hydrostatic pressure due to weight of the atmosphere on the earth's surface. At sea level, this force amounts to 14.7 psi. When a dislodging force is applied on the denture having good border seal, a negative pressure develops in the space created between the denture base and the mucous membrane. When the negative pressure develops inside, the atmospheric pressure from outside pushes the denture towards the basal seat helping in retention of the denture.

Capillarity or Capillarity Attraction

It is a *force developed because of surface tension that causes the surface of a liquid to become elevated or depressed when it is in contact with a solid.* When the adaptation of the denture base to the mucosa on which it rests is very close, the space filled with a thin film of saliva acts like capillary tube and helps to retain the denture. This force, like the others, is directly proportional to the area of the basal seat covered by denture base.

Mechanical Factors

Undercut

It is the portion of the surface of an object that is beyond the height of contour in relationship to the path of placement.

- It acts as a mechanical locking system in retention of denture.
- Unilateral undercut aids in retention of denture.
- Bilateral undercut helps retention but causes injury to tissues during placement and removal and hence dictates surgical correction.
- During surgical correction, the undercut is eliminated on the side the patient chews.

Use of Springs

It is made up of coiled stainless steel or gold plated base metal. Ends of springs are attached to shrivel in the premolar region on both sides of upper and lower dentures. Thus, they are permanently attached to each other and are held in occlusion for insertion into the mouth. As soon as they are released the dentures are forced apart by the action of springs, which causes the denture to seat in place.

Disadvantages

- Restricted lateral movement
- Soreness of cheek mucosa resulting in irritation
- Increased alveolar ridge resorption

Denture Adhesives

It is available either in the powder or paste form to be applied on the fitting surface of the denture. The patient may have a feeling of discomfort. It should be thoroughly cleaned regularly to prevent growth of microorganisms. However, it should not be an alternative for an ill-fitting denture.

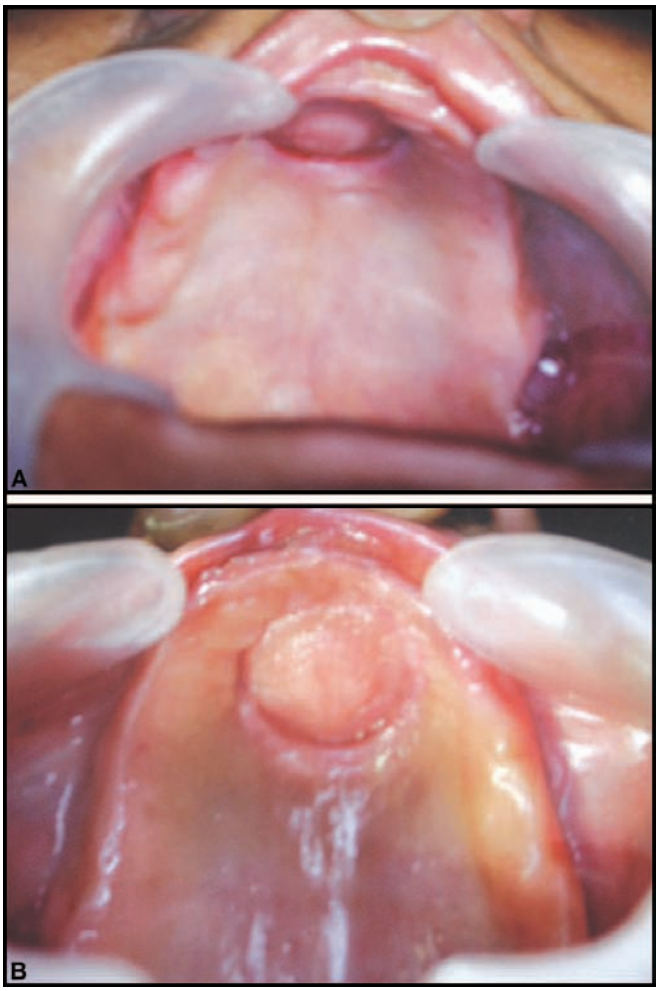
Incorporation of Rubber Suction Discs/Suction Chambers (Figs 7.1 and 7.3)

It consists of a rubber disc buttoned on to a stud shunt into the fitting surface of the denture. Partial vacuum created within aids in retention.

Disadvantage

- Constant irritation causing damage to the soft tissue by proliferation of tissue within the recess (Fig. 7.2).
- Irritation leads to Epitheliomo (Malignant tumor), which may lead to perforation in the palate.

FIGURE 7.1: Maxillary complete denture with suction disc



FIGURES 7.2A and B: Soft tissue changes induced by suction disc

FIGURE 7.3: Maxillary complete denture after removal of suction disc

Use of Magnets

Magnets are placed in premolar region of maxillary and mandibular denture with like-poles facing each other. The repulsive forces aid in retention.

Disadvantages

Constant repulsive forces and pressure may be the cause of increased rate of resorption of bone.

Occlusion

Teeth placed or located lateral to the neutral zone cause faulty leverage, affecting stability and thus retention.

Physiologic Factors

Oral and Facial Musculature

It provides supplementary retentive forces if—

- Teeth are placed in neutral zone
- Polished surface of dentures are properly shaped and contoured to be braced by the buccinator, mylohyoid and tongue muscles. Base of the tongue rises up at the back and press against the distal border of the maxillary denture during incision of food by anterior teeth.

Neuromuscular Control

Neuromuscular forces refer to functional forces exerted by musculature of patient that can affect the retention. It is a learned biological phenomenon. Patient's ability to control the denture with lips, cheeks and tongue depend on neuromuscular control. The polished surface of the dentures should be contoured in such a way that the muscles brace against this surface of the denture.

Saliva

It affects the effectiveness of physical forces. Serous saliva provides better cohesive force than mucous saliva.

Jaw Size

Retention is directly proportional to the area of coverage. As the size increases, the area of coverage increases and hence the retention is better.

Type and Class of Soft Palate

Class I type allows wider posterior palatal seal and thus aids in better retention compared to class III type of soft palate.

Surgical Method

Vestibuloplasty

It is a surgical procedure to restore alveolar ridge height and width by deepening the sulcus.

Ridge Augmentation Procedure

It is done to increase the width and height of residual ridge by placing bone material / alloplasty material / combination.

Implants

Implant fixtures placed within the bone by surgical procedure aid in retention of the superstructure.

Psychological Factors

Mental Attitude

Success of prosthodontic treatment is a shared responsibility of the operator and the patient. Philosophical patients are better predisposed to a successful treatment. Patient has to make a positive effort towards the skill to use the dentures.

Expectations

Patients with over-expectations need motivation and education. They should not be promised anything impossible to please them.

Factors of Stability

Relationship of the Denture Base to the Underlying Tissues

- Ridges should be well-formed.
- Incorporation of surfaces that are at right angles to the occlusal surface.
- Maximum use of tissue surfaces that are firmly and closely attached to bone.
- Steep palatal vault increases stability.

Relationship of External Surface and Periphery to the Surrounding Oro-facial Musculature

There should be provision for optimum bracing of the denture by buccinator, mylohyoid and tongue muscles.

Relationship of Opposing Occlusal Surfaces

- Balanced occlusion aids in stability of the denture
- In Prognathic and retrognathic cases, the extent of posterior occlusion should be more than half the distance between the incisive papilla and the hamular notch

Factors of Support

Effective support is realized when:

1. Denture is extended to cover maximum surface area without impinging on moveable/friable tissues.
   Snow Shoe principle: Increased surface area decreases the stress/unit area leading to decreased tissue displacement which in turn causes denture movement.
2. Those tissues most capable of resisting resorption are selectively loaded during function. Those tissues most capable of resisting vertical displacement are allowed to make firm contact with the denture base during function.
3. Compensation is made for varying tissue resiliency to provide for uniform denture base under function and maintain harmonious occlusal relationship.

The soft tissues supporting the prosthesis should withstand pressures induced by normal function, which is facilitated by firmly bound keratinized mucosa. The supporting hard tissues should be resistant to remodeling and resorption changes. The supporting regions of the mucosa without intervening layer of submucosa, should be relieved and recorded without displacement. Minimizing the pressures in those regions most susceptible and directing the forces towards those regions relatively resistant to resorption helps to maintain healthy residual ridge.

The buccal shelf area provides the primary support in the mandibular edentulous foundation. In a resorbed mandible, the genial tubercles provide a bony foundation resistant to resoption due to genioglossus muscle attachments, but the friable overlying mucosa usually objects its use as a primary support area.

In the maxillary edentulous foundation, the hard palate which forms the primary supporting area resists resorption, which can be attributed to the functioning of tensorveli palatini and levator palatini muscles of the soft palate. These muscle attachments provide the sources of tension that counteract the pressure resorption normally expected beneath a denture base. In addition, the hard palate is covered by keratinized mucosa and resilient submucosa.

SELF-HELP QUESTIONS

1. Define retention, stability and support.
2. What are the factors aiding in retention of complete denture treatment and how?
3. What is the drawback of incorporating suction discs in the palatal aspect of complete denture?
4. What relevance does undercut have in retention of complete denture?
5. What role does saliva play in the retention of complete denture?
6. Mention the surgical procedures that contribute to retention of complete denture prosthesis.
7. Mention the factors that enhance stability of complete denture.
8. What is snow-shoe principle?

9. What type of ridge provides good support for complete denture prosthesis?
10. Enumerate the mechanical methods of retention.

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CHAPTER

8

Principles and Concepts of Occlusion in Complete Denture Service

INTRODUCTION

The word 'Occlusion' means a closure, which indicates a contact relationship of the teeth (Fig. 8.1). In a broad sense, however, it represents a vast field of dentistry encompassing the study of all factors associated with jaw closure. However, this chapter will put forward an attempt to give the basic knowledge on occlusion and various concepts of occlusion in complete denture treatment. *Occlusion* by definition is *any contact between the incising or masticating surfaces of maxillary and mandibular teeth or tooth analogues.*

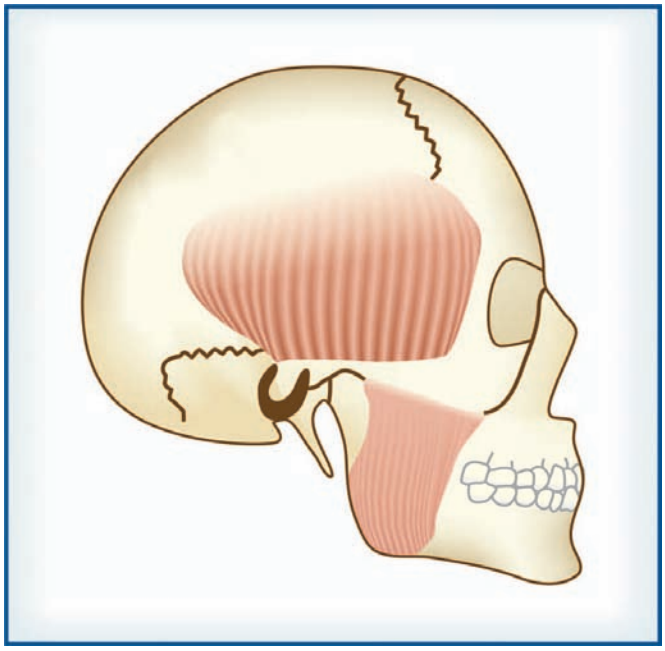


FIGURE 8.1: Maxillary and mandibular teeth in occlusion

ARTICULATION

It is defined as the contact relationship of maxillary and mandibular teeth as they move against each other.

Occlusion and articulation forms the basic need for the:

1. Function of incisng, mastication and swallowing.
2. Provision of lip seal.
3. Speech.

Before discussing the various concepts of occlusion, the operator should be well aware of the differences between natural and artificial occlusion so that the limitations of complete denture can be explained to the patient.

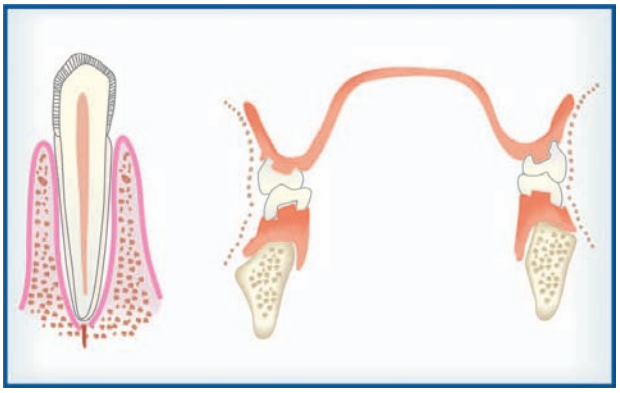


FIGURE 8.2: Effects of forces on supporting tissue created by natural versus artificial denture occlusion

For successful complete denture treatment, the basic objectives of complete denture occlusion have to be accomplished. The objectives of complete denture occlusion can be achieved by the following:

Table 8.1: Difference between natural teeth and residual ridge replaced by complete denture

Natural teeth	*Artificial teeth*
1. Fixed in bone	1. Rest on the residual tissue
2. Suspended by periodontal ligament	2. Not fixed to the soft tissue
3. Tooth moves into socket during mastication because of elasticity of ligament (Fig. 8.2)	3. Denture moves towards tissue because of resiliency of mucosa (Fig. 8.2)
4. When teeth move on one side during mastication, the other side is unaffected	4. When teeth meet on one side, the other side loses balance upsetting retention and stability
5. When teeth move into the socket, they produce stretching effect and exert tensile force	5. Compression of the tissues causes displacement of the supporting tissues
6. Tensile force provides stimulation for underlying bone	6. Compression causes pressure on mucosa affecting vascular supply of the bone
7. Physiologic stimulation maintains good health of the bone	7. Instability of dentures causes loss of bone because of leverage
8. To maintain the stimulus optimal occlusion of natural teeth is important	8. To maintain the supporting tissue in good health, planned occlusion is necessary

1. Creating stable occlusion in centric relation.
2. Stable occlusion in forward and lateral relation.
3. Control horizontal forces by buccolingual cusp height reduction.
4. Proper tooth to ridge crest position.
5. Incisal clearance during posterior masticatory function.
6. Minimum occlusal contact area.

Theory means observation based on principles and *concept* is the application of theory. In pertinence to Occlusion, concepts can be classified as *non-balanced Occlusion and Balanced Occlusion.* Any occlusion other than balanced occlusion is termed as non-balanced occlusion. This includes arrangement according to spherical theory, organic occlusion, neutrocentric occlusion and lingualised occlusion

Occlusion based on Spherical Theory (Fig. 8.3)

Monson advocated it. Lower teeth move over the surface of the upper teeth as over the external surface of the sphere with a radius of four inches. It involves positioning of teeth with anterior-posterior and medio-lateral inclines in harmony with the spherical surface. It is sometimes referred to as having Monson curve. This occlusion must be developed in curved form, the arc plane having its convex face downwards and its concave surface upwards.

Disadvantage

Forces delivered at right angles to occlusal plane will cause increased stress due to butting action. Forces against the lower denture will drive it to one side against the poorly formed and sensitive tissues of mylohyoid ridge.

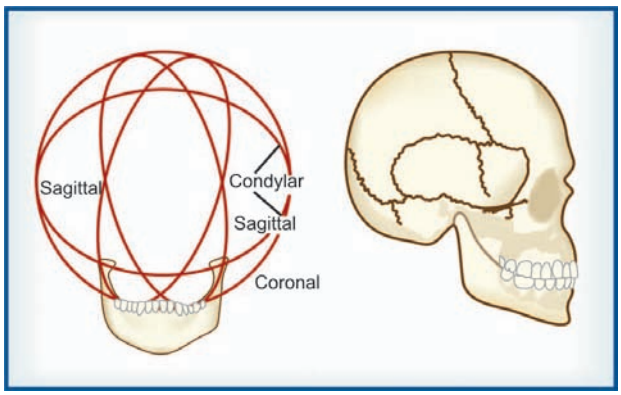


FIGURE 8.3: Schematic representation of spherical theory of occlusion

Organic Occlusion

In organic occlusion, three phases of mutually inter-dependent protection are present.

a. The posterior teeth should protect the anterior teeth in centric occlusal position.
b. The maxillary incisors should have vertical overlap sufficient to provide separation of posterior teeth when incisors are in edge-to-edge contact.
c. In lateral mandibular positions outside the masticatory movements, the cuspids should prevent contact of all other teeth.

Neutrocentric Occlusion

It was advocated by *DeVan.*This concept maintains that the antero-posterior plane of occlusion should be parallel with plane of denture foundation and not dictated by horizontal condylar guidance. Thus, the teeth are not inclined to form compensatory curves. According to this concept, non-anatomic teeth should be used. The bucco-lingual width is reduced and the number of teeth is also reduced to direct the forces in the molar and bicuspid area of support.

Lingualised Occlusion

It is used in an attempt to maintain the aesthetic and food-penetration advantages of anatomic form while maintaining the mechanical freedom of non-anatomic form. The Lingualised concept utilizes anatomic teeth for maxillary denture with prominent palatal cusps and modified, non-anatomic or semi-anatomic teeth for mandibular denture. It is particularly helpful when the patient places high priority on aesthetics, but a non-anatomic occlusal scheme is indicated by oral conditions such as alveolar resorption, Class II Jaw relationship or displaceable supporting tissues. Here the maxillary palatal cusps should contact mandibular teeth in centric occlusion. The mandibular buccal cusps should not contact the upper teeth in centric occlusion.

Proponents of nonbalanced occlusion emphasize that:

1. Character of supporting foundation makes it impossible to effect gliding contacts between teeth to harmonize with mandibular movements.

2. Contact between opposing teeth would occur only during centric closure.
3. Artificial teeth should not contact in eccentric jaw position since these contacts are responsible for instability.
4. When teeth in centric contact produce no discomfort to the supporting tissue or joints, patient is encouraged to make similar jaw movements repeatedly.

Balanced Occlusion

It is defined as a *stable simultaneous contact of the opposing upper and lower teeth in centric relation position and a continuous smooth bilateral gliding from this position to any eccentric position within the normal range of mandibular function.* It is generally considered with the use of cuspal posterior tooth forms and viewed on the basis of providing stabilizing influence on denture bases against basal seat tissue. This is felt necessary during centric and eccentric relation of the mandible.

Advantages

1. Bilateral balanced contacts during terminal arc of closure help to seat the denture in a stable position.
2. Patients with balanced design do not upset the normal static, stable and retentive qualities of their denture.
3. In bilateral balance, the bases are stable during bruxing activity.

Disadvantages or Limitations

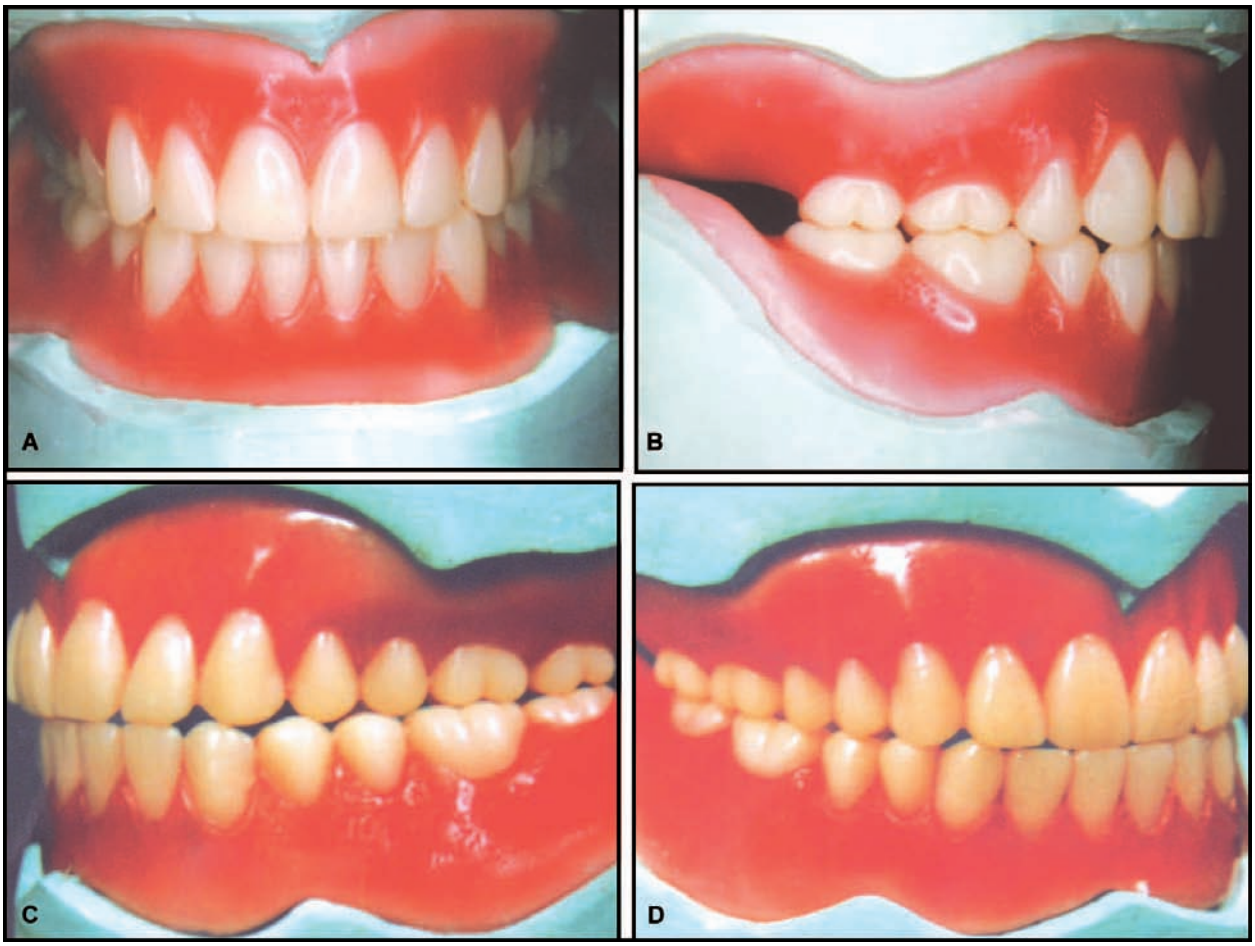
1. It may tend to encourage lateral and protrusive grinding, although this may be confined to people who are subjective to irrelevant muscle activity.
2. A semi-adjustable or fully adjustable articulator is mandatory.

FACTORS THAT AFFECT OCCLUSAL BALANCE

1. Inclination of condylar guidance.
2. Inclination of incisal guidance.
3. Orientation of occlusal plane.
4. Inclination of the cusp.
5. Prominence of compensating curve.

These factors are stated by *Hanau* and are exemplified in the *Hanau's quint.* The inclination of condylar guidance and Inclination of incisal guidance control the movements of the articulator and are the *end controlling factors,* with condyles at one end and the incisal edges at the other end. The orientation of occlusal plane, inclination of the cusp and prominence of compensating curve may be changed by the dentist to attain harmony among all five factors. Of these factors, only the condylar inclination is generated by the patient and all other factors are in the hands of the dentist.

1. *Condylar guidance (CG):* It is the *posterior end-controlling factor* of mandibular or articulator movements. It is a *mechanical equivalent* on the articulator. It is a guiding influence, which is furnished to the condyles of the mandible by the temporomandibular articulation during eccentric jaw movements. It represents the angle of downward and forward movements of the condyles relative to the axis orbital plane. This factor is obtained by means of protrusive registration. The pathways followed by the condyles are inherent for the patient and are not under the control of the dentist. The condylar elements must be adjusted to simulate as closely as possible the condylar paths of the patient.
2. *Incisal guidance (IG):* It is the *anterior end-controlling factor.* It is the guiding influence, which results from the positional relationship of the upper and lower anterior teeth when the mandible is moved into eccentric relation to the maxilla with the anterior teeth remaining in contact. The incisal guidance influences the protrusive articular movement and is interdependent with condylar guidance. Incisal guidance depends upon the extent to which the upper anterior teeth overlap the lower anterior teeth in both horizontal and vertical direction. The incisal guide table on the articulator is adjusted so that the table will be in harmony with the incisal guidance of the anterior teeth. Therefore, it can be used as a mechanical convenience to permit the articulator to be moved into lateral and protrusive relationship without damaging the anterior teeth on the cast or without fracturing the artificial teeth on dentures while establishing the occlusion in posterior region.



FIGURES 8.4A to D: Balanced occlusion: (A) Relation of anterior teeth in centric occlusion (B) Relation of posterior teeth in centric occlusion (C) Lateral relation (D) Relation of anterior teeth and posterior teeth in protrusive relation

3. *Plane of orientation (PO):* Hanau states that the plane of orientation is a purely geometric factor. It is a plane assumed to pass through three dental landmarks or points namely, the central incisal contact point and the summits of the mesio-buccal cusps of the last molars on either side. The plane of orientation, which is the inclination of the plane of occlusion, is generally established in the patient's mouth in reference to the ala-tragal line or camper's plane and on the articulator in reference to the face bow transfer.
4. *Cuspal height and inclination (CI) (Fig. 8.5):* These are important determinants as they modify the effect of plane of Occlusion and the compensating curve. *Cuspal inclination refers to the angle between the total occlusal surface of the tooth and the inclination of the cusp in relation to that surface.* Tipping of teeth can produce a compensating curve and make the effective height of the cusps greater or lesser. By this means, even monoplane (zero degree) teeth can be arranged to present inclined planes to their opposing teeth.
5. *Compensating curve (CC):* It refers to the anterior-posterior and lateral curve produced in the alignment and arrangement of Occluding surfaces and incisal edges in artificial teeth (Fig. 8.1). It compensates for the space between upper and lower teeth called as *Christensen's phenomenon* (Fig. 8.6) that occurs in posterior region when protrusive movement is made (Fig. 8.6). Therefore, compensating curve, when mandible is protruded, is determined by the inclination

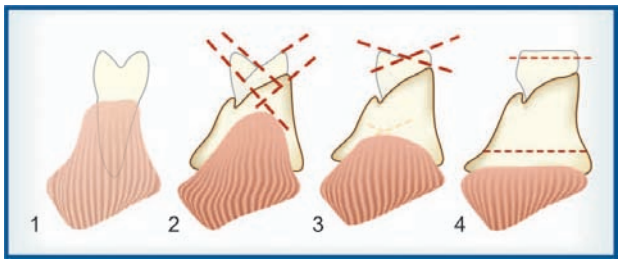


FIGURE 8.5: Influence of cuspal inclines on stability of dentures: (1) Natural tooth embedded in its alveolar socket resists deflective influence of tooth cusps (2) Denture base covering well formed ridge can resist dislodging forces caused by cuspal inclines of artificial tooth form (3) Reduced cuspal inclines are indicated for stabilising the dentures in case of bone resorption (4) Greater modification of tooth cusp can resist dislodging forces on the dentures in atrophied foundation

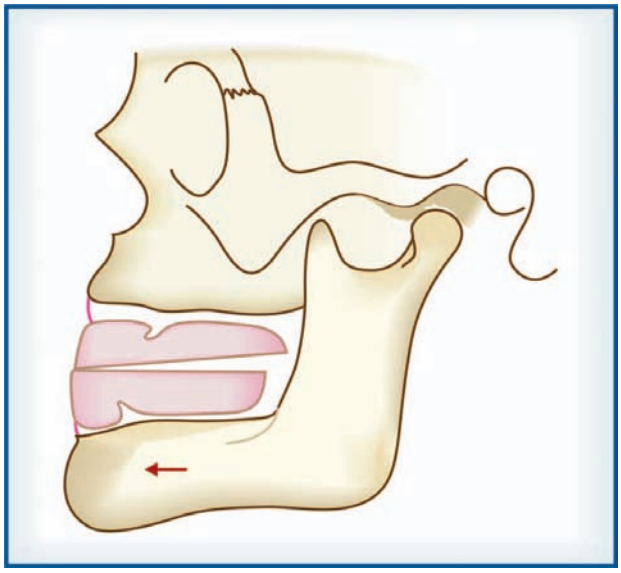


FIGURE 8.6: Christenson's phenomenon

of the posterior teeth and their vertical relationship to the Occlusal plane so that the occlusal surface results in a curve that is in harmony with the movement of the mandible as guided posteriorly by the condylar path. *Curve of Spee refers* to the anterior-posterior curve, which passes from canine tip along the buccal cusps of all posterior teeth in natural dentition when viewed from buccal aspect. In complete dentures, it is called the *anterior-posterior compensating curve* (Fig. 8.7). *The medio-lateral curve or curve of Monson* is the transverse curve made by the lingual inclination of posterior teeth. The reverse Monson's curve is called the Wilson's curve.

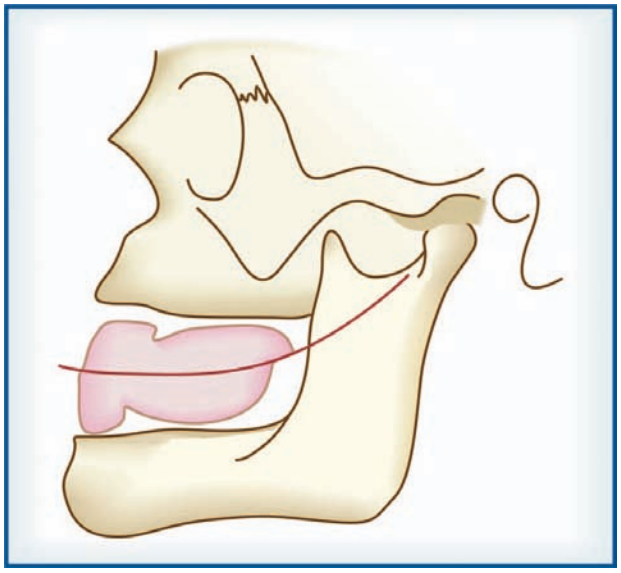


FIGURE 8.7: Balance through incorporation of anteroposterior compensating curve

The interdependence of the five factors is explained only hypothetically by > (increase) of one factor or < (decrease) of any of the five factors. The size of the circle o or o with the sign > or< therefore with red circle implies increase or decrease. For example condylar guidance is a factor with the patient and cannot be changed. In other words it is only interplay on the articulator (which is hypothetical as shown in Figs 8.8 and 8.9).

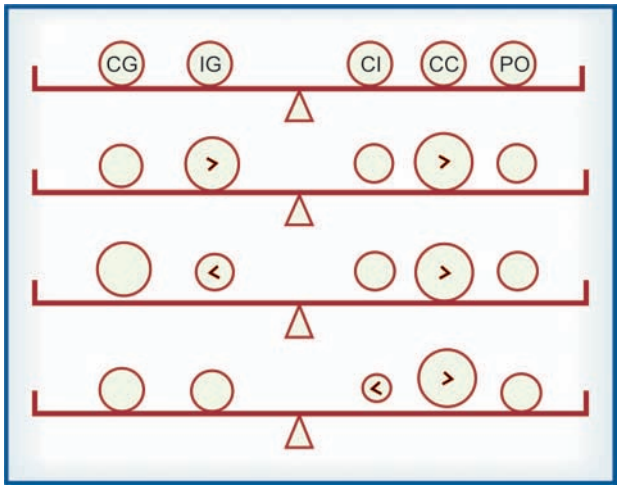


FIGURE 8.8: Balancing feat influence of anterior end controlling factor on the other determinants

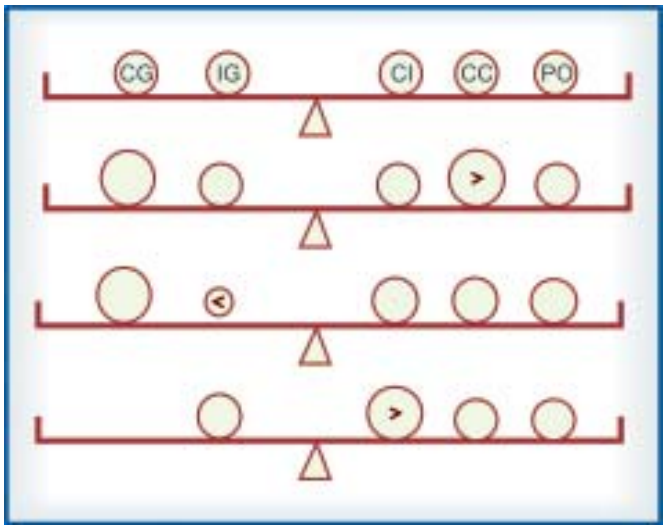


FIGURE 8.9: Balancing feat influence of posterior end controlling factor on other determinants

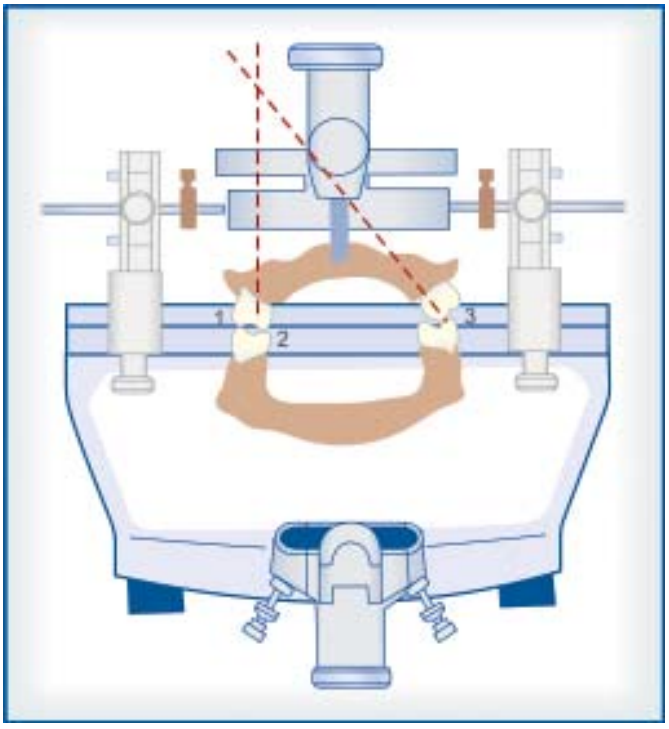


FIGURE 8.10: Schematic interpretation of balanced occlusion: 1 and 2: Contacts on the working side (W). 3 Contact on the balancing side (B)

Contacts in Balanced Articulation

In balanced articulation, the mandibular lingual cusp ridges make contact with the maxillary palatal cusp ridges and the maxillary buccal cusp ridges make contact with the mandibular buccal cusp ridges on the working side.

On the balancing side, the mandibular buccal cusps and their occlusal-facing ridge contact maxillary lingual cusps and ridge (Fig. 8.10).

In protrusive relation, the incisal edges of the mandibular anterior teeth contact the incisal edges of the maxillary anterior teeth. The buccal cusps of the maxillary posterior teeth contact the mandibular buccal cusps and the mandibular lingual cusps contact the maxillary palatal cusps (Figure 8.4).

Factors that Determine Protrusive Balance

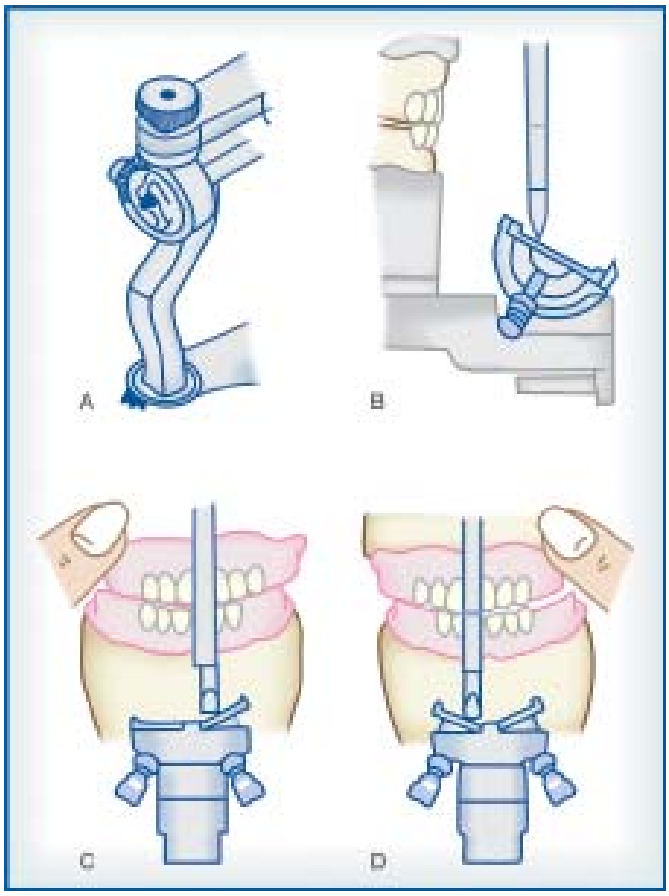
1. Inclination of condylar path on the articulator (Fig. 8.11A).
2. Inclination of incisal guidance (Fig. 8.11B).
3. Inclination of plane of occlusion set to physiologic factor.
4. Compensating curve to harmonize with condylar and incisal guidance.
5. Control of cusp inclinations antero-posteriorly.

Factors that Determine Lateral Balance

1. Inclination of condylar path on balancing side.
2. Inclination of incisal guidance set by raising side wings of incisal guide table (Figs 8.11.C and D).
3. Inclination of plane of occlusion.
4. Compensating curve on working and balancing side.
5. Control of cusp inclinations.
6. Adjustment of Bennett side shift on working side.

ARRANGEMENT OF MONOPLANE TEETH

For denture stability to be increased by eliminating cuspal inclines and minimising lateral shifting of the denture bases, the teeth must be set in a flat, monoplane arrangement. Irregular placement of non-anatomic teeth or the use of compensating curve will give the same effect as the cuspal inclines of anatomic teeth in the maxillary trial denture. Ideally, this plane should be parallel to both upper and lower ridges. The maxillary anterior teeth must be placed accurately for length and lip support. The maxillary posterior teeth are placed over the crest of the ridge. The palatal cusp region should be approximately over the crest of the mandibular ridge.



FIGURES 8.11 A to D: (A) Condylar guidance (B) Incisal guide table adjustment for protrusive relation (C) Right lateral relation (D) Left lateral relation

The completed maxillary arrangement shows the incisal edges of the central incisors and cuspids, and the occlusal surfaces of all the bicuspids and molars flat against the occlusal plane (Fig. 8.12).

The mandibular anteriors are positioned in such a manner that there is no contact between maxillary and mandibular teeth in centric occlusion. The antero-posterior relation of the maxillary posterior teeth to the mandibular teeth is not critical since there is no intercuspation of cusps. However, the mandibular teeth should not extend distal to the point where the mandibular ridge begins its ascending curve. Any combination of bicuspids and or molars can be used to satisfy the food table requirements of an individual patient. The horizontal overlap of maxillary posterior teeth over the mandibular posterior teeth is one third of their buccolingual width. The position will tend to prevent cheek biting, and will also reduce the buccolingual width of the opposing contacting surfaces. The cross bite situation is easily handled by reversing the horizontal overlap.

BALANCING RAMPS IN PROSTHETIC OCCLUSION

Balanced occlusion may be generally associated with the use of anatomic teeth. When non-anatomic teeth are used in complete denture and an attempt is made to balance the occlusion, a compromise may be done in relation to aesthetics. If aesthetics is considered more important, the posterior teeth will not contact in protrusive positions of the mandible and this lack of posterior teeth contact will cause tipping of dentures. This drawback can be overcome by the use of balancing ramps regardless of the vertical and horizontal overlap of anterior teeth. As the mandible moves in protrusive relation to the maxilla, the distal marginal ridges of the occlusal surfaces of most posterior maxillary teeth, usually the second molars begin to ascend the balancing ramps. The maxillary molars against the ramps balance the incisors, in protrusive position. The same balancing ramps are made broad enough so that they will balance the denture in lateral excursions of the mandible.

Wax is added to the surface, posterior to the most distal mandibular molar in relation to the most posterior maxillary molar. Centric locks are released on the articulator. The upper member is moved sequentially into edge-to-edge position and centric relation. The wax is reheated and the upper member is moved through lateral border excursions. The balancing contacts are evaluated and wax is added wherever necessary. The balancing ramps are evaluated during clinical remount to ensure smooth balancing contacts without interference.

CORRECTION OF DISHARMONY OF OCCLUSION

Remounting procedures, carried out for different purposes, are:

1. Laboratory remount.
2. Clinical or patient remount.

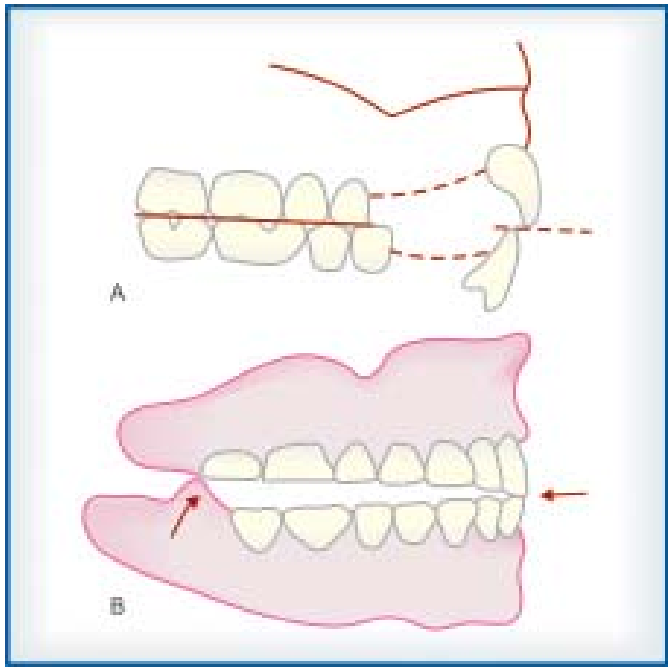


FIGURE 8.12: Concept of prosthodontic occlusion with the use of non-anatomical posterior tooth forms (A) Posterior teeth parallel to the occlusal plane (B) Balancing ramp

Laboratory remount: It refers to securing or holding the master casts to the same relationship on the articulator with a view to observe the degree of laboratory processing errors of occlusion and eliminate the same by selective grinding procedure.

Clinical or patient remount procedure: It refers to the articulation of dentures after their recovery by preserving the facebow record and after making a new record of centric relation. The errors due to tissue resiliency are corrected through this procedure.

Correction of Occlusion

1. Transfer upper and lower casts with attached dentures to the articulator as fixed by indices.
2. Change in vertical dimension will be observed from the relation of incisal pin to the incisal table.
3. Refine and equalize centric occlusion by selective grinding.
4. Check and correct working and balanced occlusion.
5. Correct the protrusive occlusion.
   A. *Establishing equalized centric tooth contact*
      1. Areas of heavy occlusion /premature contact should be identified as clear or shining areas in blue dye mark
      2. Active masticatory cusps/centric cusp tips refer to tips of buccal cusps of mandibular posteriors and tips of palatal cusps of maxillary posteriors
      3. A heavy contact /premature contact on active masticatory cusp or centric tip should be treated by deepening or grinding the opposing fossa. Do not reduce active cusp
   B. *Establishing harmony of lateral tooth contact*
      1. For correcting working side occlusion, follow the "BULL" principle by grinding/or reducing buccal cusp ridges of maxillary and lingual cusp ridges of mandibular teeth (Fig. 8.13)
      2. For correcting occlusion on balancing side, reduce /alter the cusp inclines
   C. *Establishing harmony of protrusive tooth contact*
      1. For eliminating prematurity in protrusive balance, modify the labial aspect of incisal edges of the lower anteriors and palatal aspect of incisal edges of upper anteriors. For refining protrusive balance in posterior teeth, reduce the upper buccal cusp slopes and lower lingual cusp slopes.

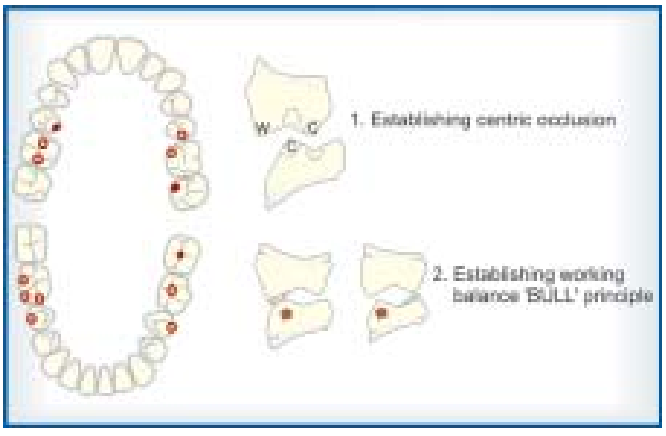


FIGURE 8.13: Establishment of occlusal contact through selective grinding procedure

SELF-HELP QUESTIONS

1. Define occlusion.
2. What is balanced occlusion?
3. What is the importance of balanced occlusion?
4. What are the factors responsible for balanced occlusion?
5. What is centric occlusion?
6. What is Bennett angle?
7. What is Bennett movement?
8. What is lingualized occlusion?
9. What are the indications for lingualized occlusion?
10. Mention the geometric theories of occlusion.
11. What is the logic behind the spherical theory of occlusion?
12. Differentiate between natural and artificial occlusion.
13. Why should centric occlusion coincide with centric relation?
14. What is the use of balancing ramps in prosthetic occlusion?
15. What is laboratory remount procedure?
16. How do you accomplish clinical remount procedure?

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CHAPTER

9

Maxillomandibular Relation: A Biological and Mechanical Contemplation

INTRODUCTION

It is of paramount importance to recognize that the anatomy of temporomandibular joint involves condylar head, petrous part of temporal bone that constitutes glenoid recess and an interposed fibro-cartilage. The condyles because of their curvature and mechanical lever, cause circular arc motion of the mandible. This arc of a circle as scribed by the mandible is very specific for each patient and added to the fact that maxilla bears fixed relationship to temporomandibular joint or the cranial reference positions when the mandible has to co-ordinate the function when working against teeth in maxilla (Fig. 9.1). This anatomical fact or reality makes it obligatory on the part of prosthodontist to record this three-dimensional position of maxilla to cranial planes. Failure to record this orientation relation will understandably cause occlusal disharmony and adversely affect health of supporting and associated tissues.

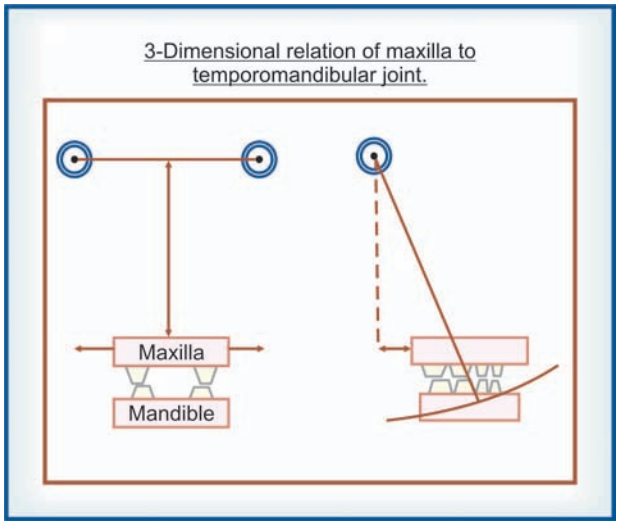


FIGURE 9.1: Three-dimensional relation of maxilla to temporomandibular joints

Maxillomandibular relationship: is the spatial relationship of the mandible to the maxilla. *Maxillomandibular relationship record* is a registration of any positional relationship of the mandible relative to the maxilla. The maxillomandibular relation records are:

1. *Orientation relation record:* Relation of the maxilla to the intercondylar axis/temporomandibular joint axis.
2. *Vertical relation record:* Relation of the mandible to the maxilla in the vertical plane.
   a. Physiologic rest position of mandible.
   b. Vertical relation at occlusion.
3. *Horizontal relation record*: Relation of mandible to maxilla in the horizontal plane.
   a. Centric relation record.
   b. Eccentric relation record.

ORIENTATION JAW RELATION

It orients the maxilla to the cranium in such a way that when the mandible is kept in its most posterior unstrained position, the mandible can rotate in the transverse plane around an imaginary axis passing through the condyle.

Hinge Axis

It is an imaginary line around which the mandible may rotate within the sagittal plane. It is also known as *transverse horizontal axis.*

Description of Hinge Axis

As the mandible opens and closes in the most retruded position, the rotational path of motion that it makes is a part of a circle which has an axis of rotation called *hinge axis/transverse hinge axis.* This closure is a guided motion or one that is learned by the patient and used by the dentist for the purpose of recording this position. The hinge axis is an imaginary line connecting the point centers of rotary motion of the mandible occurring in the sagittal plane. A hinge type opening and closing can be made in any position of the mandible but the axis can only be located in the terminal hinge position, which is the most retruded position. The terminal hinge position is the only position that can be repeatedly located and it is the only position in which the hinge axis movement is isolated from the other components of mandibular motion.

Face Bow

It is a *caliper-like device,* which is used to record the relationship of the jaw to the temporomandibular joints and to orient the cast in the same relationship to the opening axis of the articulator.

Principle of Face Bow Use

The axis of opening of the articulator should be similar to the patient's mandibular arc of movement when the prosthesis is fabricated with the help of articulators. Since it is difficult to orient the mandible to the articulator, the maxillary cast is related to the articulator in the same relationship as that between the maxilla and condyles of the mandible, which is the center of mandibular movements. The mandibular cast is oriented to the maxillary cast, which in turn is oriented in the articulator. To accomplish this act of orientation, the face bow is used.

Types

There are two types of facebows:

- *Kinematic face bow* which locates the true hinge axis
- *Arbitrary face bow,* which locates the arbitrary hinge axis. These are of two types-*fascia type* and *earpiece type*

Parts of a Face Bow (Figs 9.2 and 9.3)

It consists of a *U shaped frame* that is large enough to extend from the region of the TMJ to a position 2-3inches in front of the face. The fascia type of face bow has *condyle rods* that contact the skin over the TMJ. In the earpiece type, it is known as *condylar compensator* since their location on the articulator approximately compensates for the distance from the external auditory meatus and is posterior to the transverse opening axis of the mandible. The part that attaches to the occlusal rims is the *bite fork.* The fork is attached to the face bow by means of a *locking device,* which also serves to support the face bow, the occlusal rims and the cast while they are being attached to the articulator. The orbital pointer or the nasal pointer locates the third point of reference.

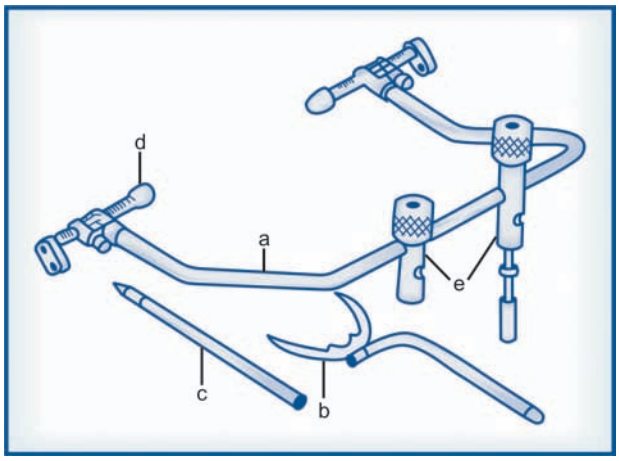


FIGURE 9.2: Parts of face bow: (a) U shaped frame (b) Bite fork (c) Orbital pointer (d) Condylar compensator (e) Locking device

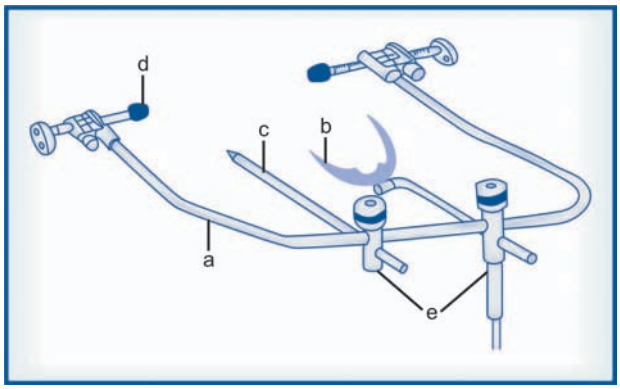


FIGURE 9.3: The part of face bow assemblage used to attach the occlusion rim to the Face bow proper (a) U-shaped frame (b) Bite fork (c) Orbital pointer (d) Condylar compensator (e) Locking device

Face Bow Record

Arbitrary record: Axis of rotation was roughly fixed at 13mm anterior to external auditory meatus on a line from the top of the tragus of the ear to the outer canthus of the eye in the fascia type face bow. With the earpiece face bow, external auditary meatus is used as a reference for the arbitrary position of axis of rotation. This actual position used is posterior to the condyles and attaching the face bow 6 mm anterior to the condyles on the articulator compensates it. Temporomandibular joint position thus becomes posterior area of reference for location of axis of rotation of condyles.

Kinematic face bow record: The true hinge axis is determined by a series of opening and closing movements when the mandible is in the terminal hinge position. After this determination, hinge axis position is marked on the skin on the face. Another anatomic point of reference also used is infraorbital notch through orbital indicator on the face bow.

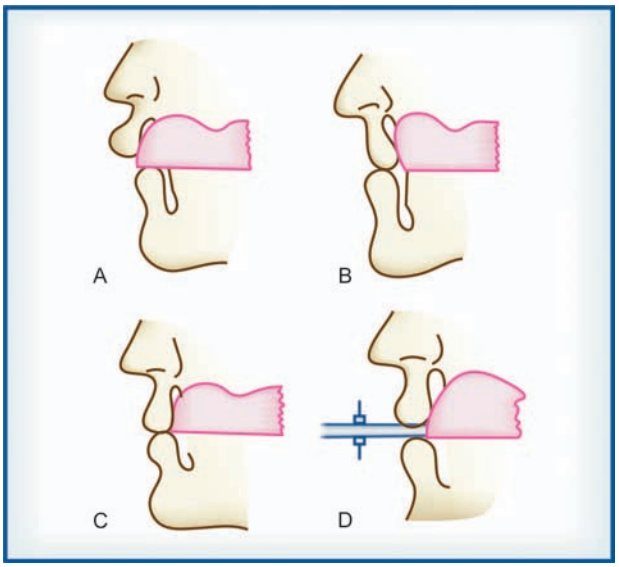
Functions of Face Bow

1. To record the relationship of maxilla to temporomandibular joints.
2. Transfer the above relation from the patient to the articulator by using posterior and anterior reference points.
3. Simulation of mandibular movements of the patient on the articulator by accurate transfer of the cast to the articulator.

Hence, face bow is mandatory in complete denture treatment.

Establishment of Plane of Orientation

The facial surface of the maxillary occlusal rim is contoured to provide proper lip support as this influences the resting length of the upper lip (Fig. 9.4). The facial profile of



FIGURES 9.4 A to D: Effects of labial bulk of upper occlusal rim on the position of upper lip (A) Increased lip support (B) Insufficient lip support (C) Correct lip support (D) Correct amount of wax of the upper occlusal rim visible below the upper lip

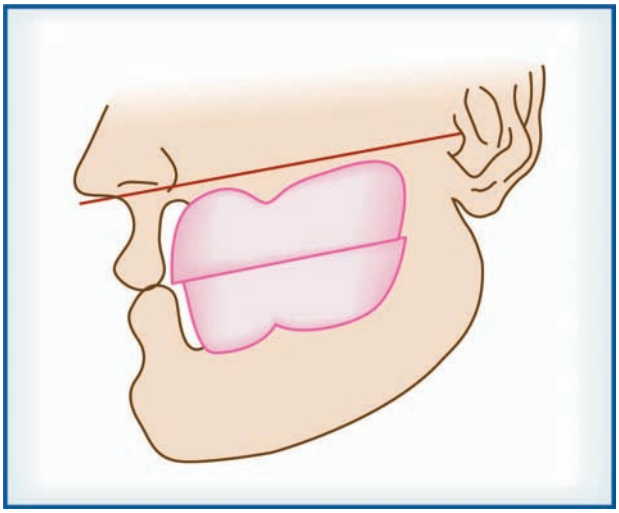


FIGURE 9.5: Occlusal plane made parallel to the imaginary "Ala-Tragal line"

FIGURES 9.6A and B: Adjustment of occlusal plane using Fox—plane (A) Anterior plane made parallel to the interpupillary line (B) Posterior plane made parallel to the ala-tragal line

the patient is then checked when the lips are at rest. The rims should support the lips and normal amount of vermillion border should be visible. The face should have a relaxed appearance. The occlusal plane is located by using the fox plane against the occlusal rim (Fig. 9.6). The lateral plane of the fox plane should be parallel to the campers plane i.e., the ala-tragal line (Fig. 9.5). The anterior plane should be parallel to the interpupillary line. The mandibular anterior teeth and the anterior 2/3 of the retro molar pads posteriorly will ultimately determine the location of the occlusal plane. After the anticipated location of the incisal edge of maxillary anterior teeth, the mid line, high lip line and the canine lines are marked. The maxillary occlusal rim is oriented to the opening axis of the jaws with the help of a face bow after recording the vertical relation and the tentative centric relation.

Orientation of Occlusal Rims to the Opening Axis of the Jaws with the Face bow

Hinge Type Earpiece Face Bow

The softened material on the bite fork is seated against the maxillary occlusal rim to create a distinct imprint, with the stem extending approximately parallel to the sagittal plane. The nylon earpiece and the scales can be interchangeably threaded while registering the relation in the patient's mouth and transferring it to the articulator. The facebow is brought gently over the face with the stem of the bite-plane or bite-fork entering the bite clamp and the nylon earpieces into the external auditory meatus of the ears. The frames are simultaneously slid laterally to adjust the scales while maintaining a comfortable, yet secure suspension of the nylon earpieces in the meatus. The thumbscrews are tightened to maintain symmetry of suspension. The bite-fork is securely locked to the bow in the proper relation. The orbital pointer is aligned with the infraorbital notch on the patient's face and the thumbscrew is tightened to maintain this alignment. The two frame thumbscrews have to be released to withdraw the scales with nylon earpieces from the meatus. The entire facebow assembly is then transferred to the articulator (Figs 9.7 to 9.9).

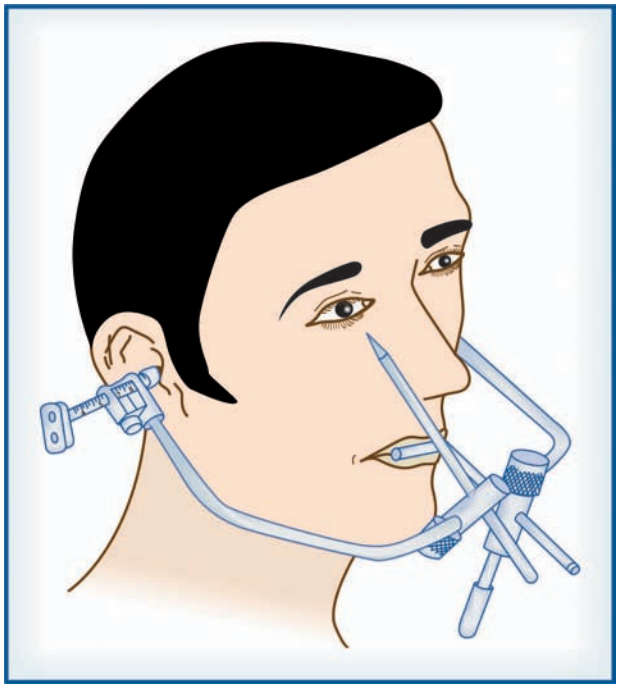


FIGURE 9.7: Arbitrary location of axis of rotation

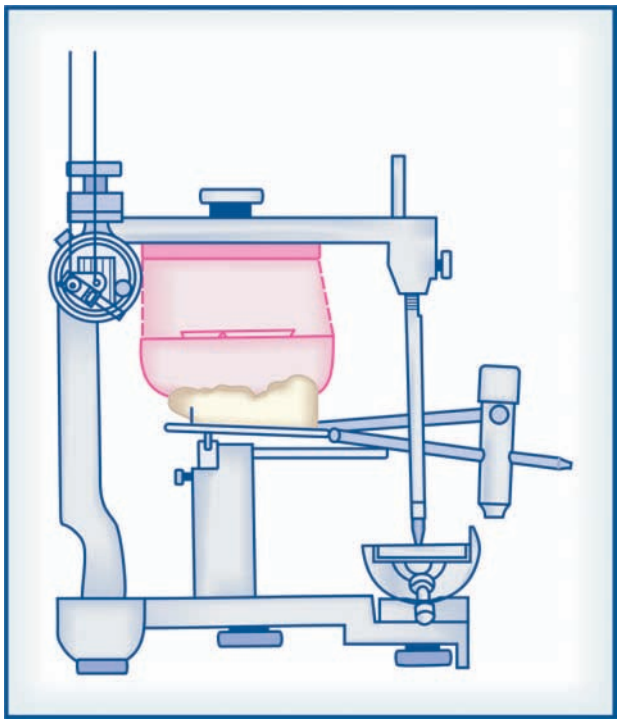


FIGURE 9.8: Face bow transfer: Method of positioning the upper final cast and occlusion rim on the articulator by means of face bow

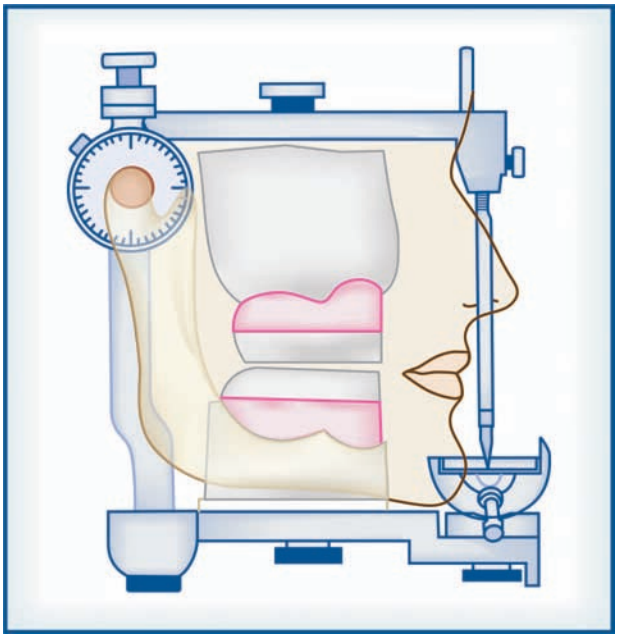
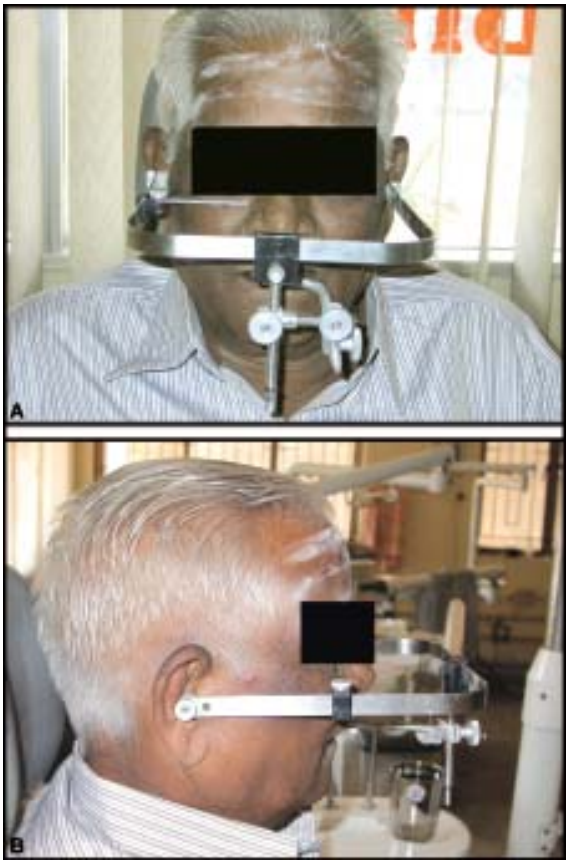


FIGURE 9.9: Face bow superimposed on an adjustable articulator to show how the relation of maxilla to condyles is copied on the articulator by a face bow

Spring Bow (Figs 9.10 to 9.12)

The bite fork is attached to the maxillary occlusal rim by heating it and piercing into the wax rim. It should be parallel to the occlusal surface. The stem of the bite fork should be to the patient's left and be approximately parallel to the sagittal plane. The prepared bite fork should be accurately seated in the patient's mouth. The stem of the bite fork should be slide into the bite clamp and the bow is sprung opened as the earpieces enter the external auditory meatus. The orbital pointer is aligned at the orbitale by elevating the bow at the transfer rod. The top of earpiece relates against the portion, which is said to be the posterior reference. The bite fork clamp is tightened to the stem of the bite fork. Bite fork registrations should be released from the maxillary arch. The posterior ends of the bow should be grasped and the earpieces released from the meatus. The complete assembly has to be withdrawn from the patient with the bite fork index rigidly attached to the bow. Transfer of facebow record to the articulator follows this.

FIGURE 9.10: Spring bow



FIGURES 9.11A and B: Orientation of the maxillary occlusal rim to the patient's intercondylar axis by the spring bow (A) Frontal view (B) Lateral view

FIGURE 9.12: Transfer of the orientation jaw relation to the Hanau Wide-vue articulator

VERTICAL JAW RELATION

It is the relation of mandible to the maxilla in a vertical plane. The physiological rest position of the mandible as related to the maxilla and the relation of the mandible to the maxilla when the teeth are in occlusion are the two dimensions of jaw separation that are of primary concern in complete denture fabrication.

Physiologic Rest Position

It is the postural position of the mandible when the individual is resting comfortably in an upright position and the associated muscles are in a state of minimal contractual activity (Fig. 9.13).

Vertical Dimension

It is a vertical measurement of the face between any two arbitrarily selected points which are conveniently located one above and one below the mouth in the midline.

Vertical dimension at rest: It is the vertical dimension of face with jaws in rest position (Fig. 9.14A).

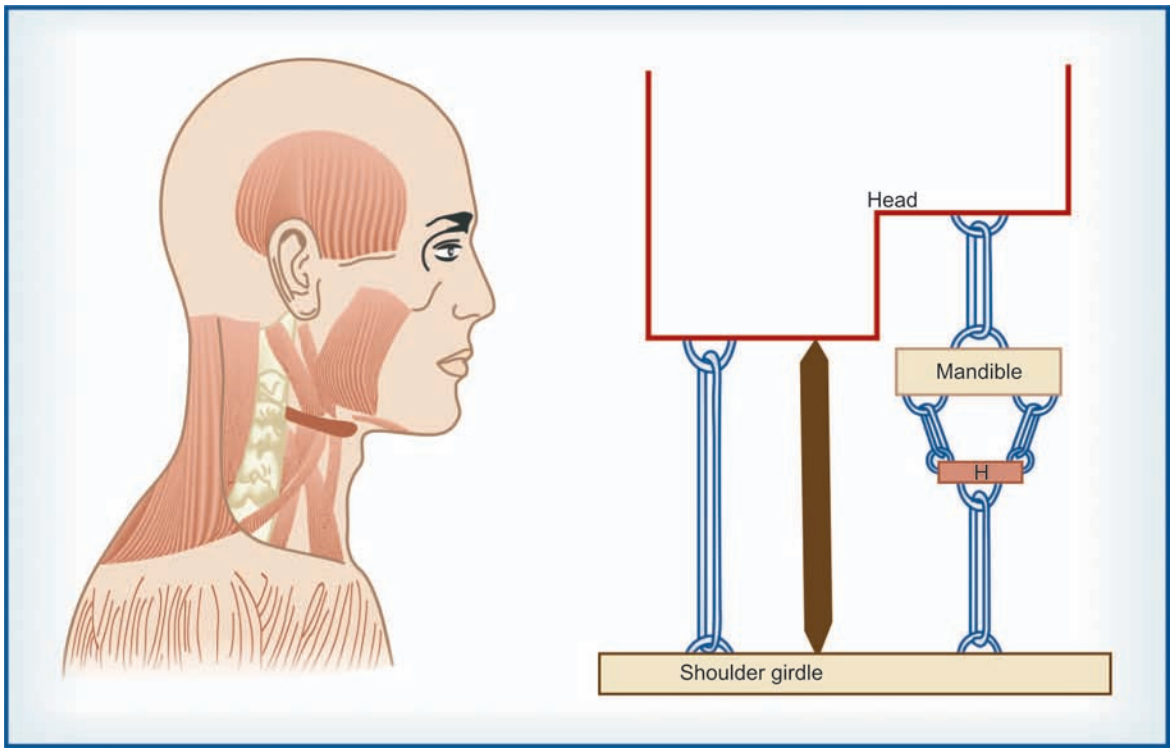


FIGURE 9.13: Schematic representation of physiologic rest position of mandible

Vertical dimension at occlusion: It is the vertical dimension of face when the teeth or occlusal rims are in contact in centric occlusion (Fig. 9.14B).

Freeway space: It is the difference between the vertical dimension at rest and vertical dimension at occlusion.

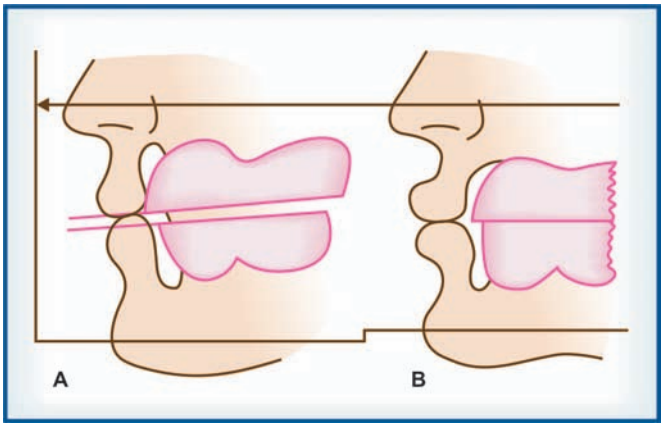


FIGURE 9.14: (A) Vertical relation record of rest showing the free way space (B) Vertical relation record of occlusion showing rims in occlusion

Methods of Measuring

Vertical relation are roughly grouped under *mechanical methods* and *Physiological methods.*

Mechanical Methods

1. Ridge relation:
   a. Distance of incisive papilla from mandibular incisors.
   b. Parallelism of the ridges.
2. Measurement of former dentures:
3. Pre-extraction records:
   a. Profile radiograph
   b. Profile photograph
   c. Lead wire adaptation
   d. Swenson method
   e. Articulated casts.
4. Post-extraction methods:
   a. Willis's method
   b. Concept of equal thirds
   c. Silverman's closest speaking space
   d. Boo's method
   e. Electromyography.

Distance of incisive papilla from the mandibular incisors: The incisive papilla is used to measure the patient's vertical relation since it is a stable landmark and is changed little by resorption of residual alveolar ridge. The distance of the incisive papilla from the incisal edge of the mandibular incisors is about 4 mm in the natural dentition. The incisal edge of the maxillary central incisor is an average of 6 mm below the incisive papilla. So the average vertical overlap of the opposing central incisor is about 2 mm.

Disadvantage

- In complete edentulous arches there is absence of lower teeth and so it is useful only in the treatment of single dentures.

Parallelism of the ridges: In most patients, the teeth are lost at irregular intervals and the residual alveolar ridges are no longer parallel.

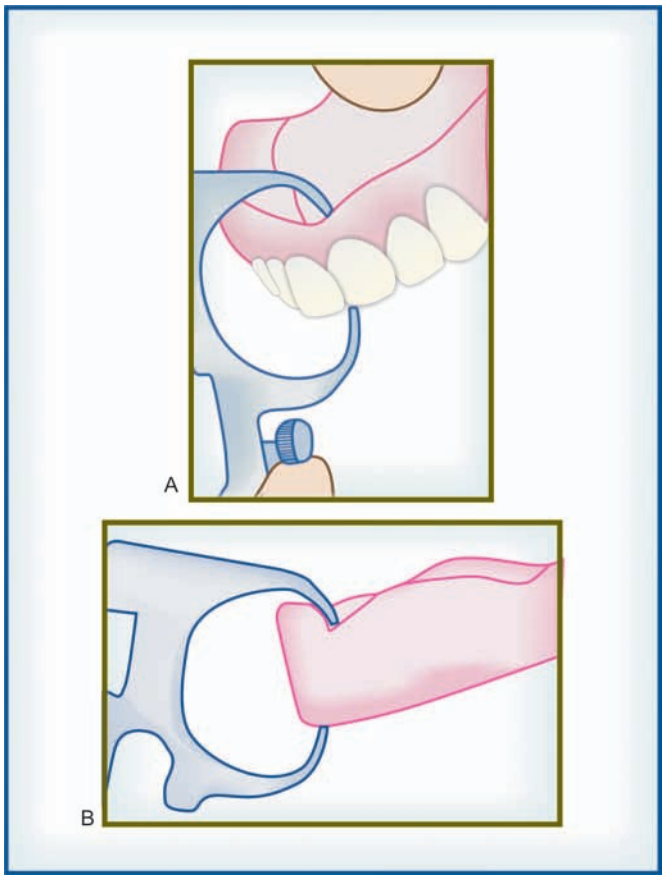
Limitation

- Many patients present such marked resorption that the use of this rule would not be possible

Measurement of former dentures: The patient's old denture can be used as a reference for the vertical dimension of the new denture. Complete dentures which have been used for a long duration would have adapted well to the oral structures and hence caution should be exercised if vertical dimension has to be changed in the new denture. Comparing the distance between the maxilla and mandible in rest position and the position with the old denture in occlusion, is essential for determining a suitable vertical dimension. The need to increase the vertical dimension should be restricted to compensating for the abrasion of artificial teeth and bone resorption.

Another method of using the old denture as a reference is to measure the distance from the incisive papilla to the incisal edge of the central incisor in the old denture and to measure the distance from the incisive papilla of the upper denture to the interior surface of the anterior region of the lower denture. These distances are then compared with those of the upper and lower occlusion rims in mandibular rest position. Similarly, the distance between the bases of old dentures in the molar

region should be measured and compared with those of the occlusion rims (Figs 9.15 and 9.16).

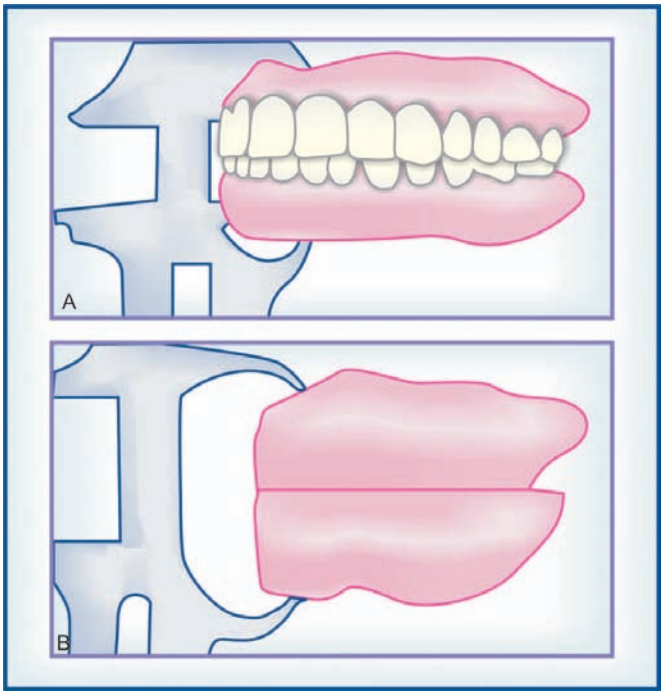


FIGURES 9.15A and B: Distance from the incisive papilla to the incisal edge is measured and compared to the maxillary occlusion rim (A) Old denture (B) Occlusion rim

Pre-extraction records: It is frequently possible to see the patient before he or she becomes edentulous. In such cases, the jaw relation can be obtained and transferred to the edentulous situation. This is relatively an easy procedure and can be accomplished in several ways.

a. *profile Radiograph:* The exposure of a full lateral radiograph is made with the teeth in occlusion. After extraction, trial bases with occlusal rims are made to an apparently correct vertical relation and inserted in the patient's mouth. Radiograph is obtained with the occlusal rims in contact. The two films are compared and necessary adjustment is made to simulate the correct position as in the initial film. The image should have approximately 1:1 ratio to the patient.

   Disadvantages:
   - Inaccuracy due to enlargement of the image.
   - It is time-consuming and it may result in frequent exposure to radiation.



FIGURES 9.16A and B: Distance from the incisive papilla to the mandibular alveolar ridge is measured and compared to the vertical distance of that of the upper and lower occlusion rims (A) Old denture (B) Occlusion rim

b. *Profile photographs:* Profile photos are made and enlarged to life size. The photographs should be made with the teeth in maximum occlusion. Measurements of anatomical landmarks on the photograph are compared with measurements on the face, using the same landmarks. These measurements can be re-evaluated during the try-in appointment.

   Disadvantage:
   - The angulation of the photograph might differ with the patient's posture.

c. *Lead wire adaptation:* Lead wire 'may be adapted carefully to pre-extraction face profiles, and this contour is transferred to a cardboard. The resultant cutout is stored until after extraction. When the dentist estimates the vertical relation using the trial plates,

the cardboard cutout is placed against the profile in order to see whether the facial contour has been maintained or established. It is not in common use today.

d. *Swenson's method:* Swenson suggested that acrylic resin facemasks be made before the extraction, and later when the patient is rendered edentulous, it is fitted on the face to see whether the vertical relation has been restored properly.

Disadvantages

- It is time consuming.
- Requires lot of skill and experience with the use of facial impression and casts for the fabrication of artificial facial parts.
- The face assumes a different topography in the erect posture from that in the recumbent or semi-recumbent position.

e. *Articulated casts:* These are of practical value in the assessment of the vertical relation. Measurements can be made of the casts in occlusion with relatively stable points.

Post-extraction methods:

a. Niswonger's method: Niswonger, in 1934, suggested a method for determining the vertical dimension that is commonly used today.

The patient is seated so that the ala-tragal line is parallel with the floor. Two markings are made, one at the tip of the nose and the other on the most prominent part of the chin. The patient is instructed to relax and swallow. The distances between the marks are recorded. Subsequently the occlusal rims are fabricated so that when they occlude, the measured distance is 2 to 4 mm less than the original measurement (Fig. 9.17). This method has a disadvantage of the marks moving with the skin and sometimes it is difficult to obtain two constant measurements of the rest position. However, when combined with other observations, this technique is reasonably reliable.

b. *Willi's method:* Willi believed that the distance from the pupil of the eye to the rimaoris should be equal to the distance from the base of the nose to the inferior border of the chin, when the occlusal rims are in contact (Fig. 9.18).

FIGURE 9.17: Vertical relation record by Niswonger's method

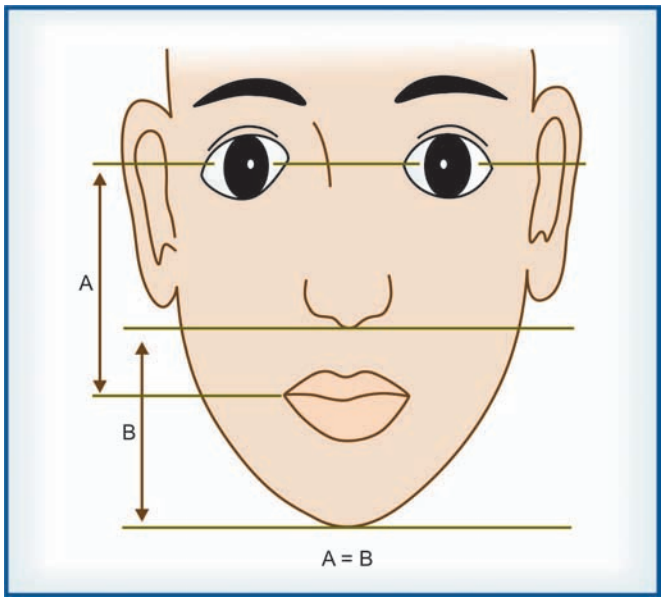


FIGURE 9.18: Willi's method

c. *Concept of equal thirds:* Some observers suggested that the face could be divided into equal thirds. Each third being forehead, the nose and the lips-chin. This concept is of little practical value since the points of measurements are vague.

d. *Silverman's closest speaking space:* The closest speaking space measures the vertical relation when the mandible and muscles involved are in physiologic

function of speech. The occlusal rims are placed in the mouth and the height is adjusted until a minimum of 2 mm space exists when the patient pronounces the letter "s." It may vary from 1 to 10 mm but an average of 2 mm will generally prevent the increase in vertical relation.

Disadvantage: The patient who has 8 to 10 mm closest speaking space will require other means for determination of vertical relation.

e. *Boo's method:* Boo found that there is a point of maximum biting power. He stated that the patient registers the greatest amount of pressure on a spring dynamometer at a point considerably more open than the denture occlusion.
f. *Electromyography:* Rest position of mandible can be determined by means of electromyography which would record the minimal activity of the muscles. All the muscles show greater activity in other positions than in rest position.

Physiologic Methods

1. Physiologic rest position.
2. Phonetics.
3. Facial expression.
4. Swallowing method.
5. Tactile sense.

Physiologic rest position: After the insertion of occlusal rims into the patient's mouth, the patient is asked to swallow and let the jaw relax. Then the lips are carefully parted to see the amount of space between the occlusal rims. The patient must allow the dentist to separate the lips without moving the jaws or lips. This interocclusal rest space should be 2 to 4 mm.

Phonetics: The patient is instructed to repeat the letter 'm' until he is aware of lip contact. The patient is told to stop all jaw movements when the lips lightly touch. The lips and cheek are retracted and the inter-occlusal space of 2 to 4mm is checked. When the patient uses the sibilants, the occlusion rims should just come close together but not touch.

Facial expression: The experienced dentist learns the advantage of recognizing the relaxed facial expressions when the jaws are at rest. In normally related jaws, the lips will be even antero-posteriorly and in slight contact. The skin around the eyes and over the chin will be relaxed. The lip of a patient with the retruded mandible will not be even; the lower lip will be distal to the upper and not in contact. In case of protruded mandible, the lips will not be evenly related antero-posteriorly and the lower lip will be anterior to the upper lip and out of contact. These evidences of rest position of the maxillo-mandibular musculature are the indications for recording the measurement of the vertical relation at rest.

Swallowing threshold: The position of the mandible at the beginning of the swallowing act has been used as a guide to the vertical relation. The theory behind the method is that when a person swallows, the teeth come together with very light contact at the beginning of the swallowing cycle. If denture occlusion is continuously missing during swallowing, the occlusal vertical dimension may be insufficient.

The technique involves building a cone of soft wax on the lower denture base so that it contacts the upper occlusal rim with the jaws too wide open. The flow of saliva is stimulated and the repeated action of swallowing will gradually reduce the height of wax cone to allow the mandible to reach the level of occlusal vertical relation. It is, however, difficult to find consistency in the final vertical positioning of the mandible by this method.

Tactile sense: The patient's tactile sense is used as a guide to the determination of the occlusal vertical relation. The occlusal rims are inserted into the patient's mouth and the patient is instructed to open and close his/her mouth until the rims contact. The patient is asked if the rims appear to touch prematurely, i.e. whether the jaws seem to close too far before they touch or if the height feels just right. This method is not very effective with senile patients or those who have impaired neuromuscular conditions.

Effects of Increased Vertical Relation

1. Discomfort to the patient
2. Trauma to the mucous membrane by frequent contact of teeth

3. Loss of freeway space, which may lead to:
   - Muscular fatigue of any one or group of muscles of mastication.
   - Trauma caused by constant pressure on mucous membrane.
   - Annoyance from the inability to find comfortable position.
4. Clicking teeth/clattering of teeth.
5. The face has an elongated appearance since at rest the lips are parted and closing them together will produce an expression of strain.
6. Residual alveolar bone undergoes rapid resorption.
7. Temporomandibular joint pains.

Effects of Decreased Vertical Relation

1. **Inefficiency**: It is due to the fact that the pressure to be exerted with the teeth in contact decreases considerably with over closure because the muscles of mastication act from attachments, which have been brought close together.
2. **Cheek biting**: In some cases, there is losing of muscular tone, as a result of reduced vertical height, where the flabby cheek tends to become trapped between the teeth during mastication.
3. **Appearance:** The general effect of over closure on facial expression is increased with age. There is close approximation of nose to chin, the soft tissue sag and the lines on the face are deepened. The lips loose their fullness and the vermillion borders are reduced to approximately a line.
4. **Angular cheilitis:** A reduced vertical relation results in crease at the corners of the mouth beyond the vermillion border and the deep fold thus formed becomes bathed in saliva leading to infection and soreness.
5. **Pain in TMJ:** Trauma in the region of tempro-mandibular fossa may be attributed to a reduced vertical relation with symptoms like obscure pains, discomfort, clicking sounds, headaches and neuralgia.
6. **Costen's syndrome:** In 1934,Costen listed a number of symptoms that he believed were caused by over closure of mandible following loss of teeth .The symptoms associated with the syndrome were impaired hearing, stuffy sensation in the ear, impingement of auriculotemporal nerve and chorda tympani nerve causing pain and burning sensations in the throat, tongue and the sinuses.

HORIZONTAL JAW RELATION

Horizontal jaw relation is the relation that is established antero-posteriorly and medio-lateraly. It is classified as:

1. Centric relation.
2. Eccentric relation.
   a. Protrusive relation.
   b. Lateral relation.
      i. Right lateral relation.
      ii. Left lateral relation

Centric Relation

Definitions

1. Centric relation is the most posterior relation of the mandible to the maxilla when the condyles are in the most posterior unstrained position in the glenoid fossa from which lateral movements can be made at any given degree of jaw separation (GPT-4)
2. The maxillomandibular relationship in which the condyles articulate with the thinnest avascular portion of their respective discs with the complex in the anterior superior position against the slopes of the articular eminence (GPT-5)

Eccentric relation: It is the relationship of the mandible to the maxilla other than the centric position.

Centric occlusion: It is the centered contact position of lower occlusal surfaces against the upper ones, a reference position from which all other horizontal positions are eccentric.

Eccentric occlusion: This relation of the mandible is registered by making interocclusal record of protrusion by bringing anterior teeth in edge-to-edge contact position. Interocclusal record thus made helps in setting condylar guidances of the articulator.

The Rationale for Difference in Definitions on Centric Relation Position

The two definitions taken from glossary of prosthodontic terms (GPT-4 and GPT-5) appear to contradict each

other. The earlier definition mentions of a most posterior position of condyles in glenoid fossa while the latter definition speaks of an anterior superior position of condyle against the slopes of the articular eminence. But surprisingly, the discrepancy between the two positions is only approximately 0.2 mm. Theoretically, the difference is only on the emphasis of the condylar position.

Significance of Centric Relation

1. This position is more definite than the vertical relation and is independent of the presence or absence of teeth.
2. It is a reproducible position, which can be repeatedly arrived at and thus serves as a reliable guide to develop centric occlusion in complete dentures.
3. Centric relation is related to terminal hinge axis. In centric relation, condyles exhibit pure rotation without any translation. It is, therefore, a relationship of mandible to maxilla when both the condyles are in terminal hinge closure.
4. The final act of masticatory stroke ends in centric relation. It is also a position where maxillary and mandibular teeth are braced against each other during deglutition.
5. It is a border position and the posterior limit of the envelope of motion.

Why Centric Relation should Coincide with Centric Occlusion for Successful Complete Denture Treatment?

When natural teeth are removed, many receptors that initiate impulses resulting in positioning of the mandible are lost or destroyed. Therefore, the edentulous patient cannot control mandibular movements or avoid deflective occlusal contacts in centric relation in the same manner as the dentulous patient. Deflective occlusal contacts in centric relation cause movement of denture base and displacement of the supporting tissues or direct the mandible away from this relation. Therefore, centric relation must be recorded for edentulous patients to enable centric occlusion to be established in harmony with it. This can be achieved with centric occlusion and centric relation coinciding. However, in some patients a broader area of stable contacts near centric relation is necessary. It is called the freedom of centric or *long centric.*

Methods of Assisting the Patient to move the Mandible to the Centric Relation

1. The patient is instructed to let his or her jaw relax, pull it back and close slowly on the back teeth.
2. The patient is instructed to get the feeling of pushing his upper jaw out and then close the mouth with back teeth in contact.
3. Assist the patient to protrude and retrude the mandible repeatedly with the operator holding the finger lightly against the chin.
4. Boo's series of stretch exercises: The patient is instructed to open the mouth wide and relax, to move the jaws to left and relax, to move the jaw to the right and relax and to move the jaw forward and relax in series of movements. The results to be expected are for the patient to be able to follow the dentist's directions in moving the jaw to centric relation and to the desired eccentric positions.
5. The patient can be instructed to turn the tongue towards the posterior border of the upper denture base and close the rims together until they meet. The disadvantage with this method is the likelihood of displacing the mandibular record base by the action of the tongue (Fig. 9.19).
6. The patient is told to swallow and conclude the act with the occlusal rims in contact. However, the person can swallow when the mandible is not completely retruded. This method must be verified by other techniques.

Difficulties in Guiding Mandible to Centric Relation Position

1. **Biologic:** It may arise due to lack of coordination of opposing muscles. When the patient is requested to close the jaws in the retruded position, the lack of synchronization between the protruding and retruding muscles may be caused by habitual eccentric jaw positions adopted by patients to accommodate to malocclusion.

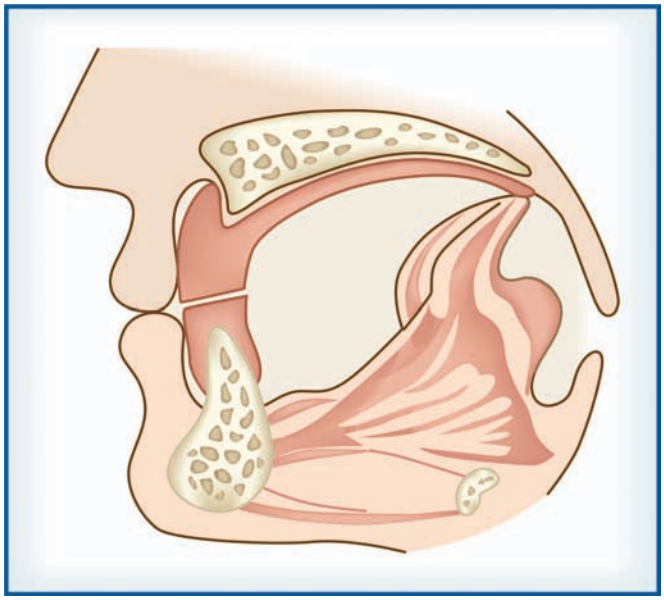


FIGURE 9.19: The position of tongue during recording of centric relation

2. **Psychological:** The more the operator becomes irritated over the apparent lack of ability of the patient to retrude the mandible, the more confused the patient becomes and less likely the patient is to respond to the directions provided. Then dentist must be prepared to calmly spend adequate time in securing the centric relation records.
3. **Mechanical:** It is essential that the denture bases on which the occlusal rims is made fit perfectly and do not interfere with each other. Failure of adaptation of denture base to the tissue surface may result in unevenly distributed pressure on the underlying resilient tissue leading to discrepancy in jaw relation recording.

Various Methods of Recording Centric Relation

1. Functional (Chew-in) methods
   a. Needle house method.
   b. Patterson's method.
   c. Meyer's method.
2. Excursive methods (Graphic method)
   a. Intraoral tracing. [Intraoral balancer (Hanau co.), S-Agothic arch tracer(Tokyo shikasha)]
   b. Extra-oral tracing. [Height Tracer (Hanau co.)
3. Tactile or interocclusal check records.
4. Terminal hinge axis method
5. Other methods.
   a. Heating the surface of one of the rims.
   b. Softened wax placed over the occlusal surfaces of the occlusal rim.
   c. Soft cones of wax placed on the lower denture trial bases.

Functional methods:

a. *Needle house method:* Compound occlusion rims with four metal styli placed in the maxillary occlusal rim are to be used. When the mandible moves with the styli contacting the mandibular rim, they cut four diamond shaped tracings. The tracings incorporate the movement in three planes and records are placed on a suitable articulator to receive and duplicate the record.

b. *Patterson's method:* Wax occlusion rims are used. A trench is to be made in the mandibular rim and a mixture of half plaster and half carborundum paste should be placed in the trench. The mandibular movements generate compensating curves in the plaster and carborundum paste. When the paste is reduced to the predetermined vertical height of occlusion, the patient is instructed to retrude the mandible and the occlusal rims are joined together with metal staples.

c. *Meyer's method:* Meyer's used soft wax on the occlusal rims to establish a generated path. Tin foil was placed over the wax and lubricated. The patient performed the functional movements to produce a wax path. The plaster index was made of the wax path and the teeth were set to the plaster index.

Excursive methods: The most common of the excursive recording is the *gothic arch tracing.* This can be employed intraorally or extraorally. This tracing is shaped like a gothic arch and so is referred to as Gothic arch tracing. It is also known as *arrow point tracing.*

After tentative centric relation record has been made with soft wax at the predetermined vertical relation of occlusion, the rims are secured on the articulator with the help of face bow transfer. The lower rim is reduced by 2 mm while maintaining the occlusal plane. Central-bearing devices are placed and fastened to the occlusal

rims taking care to center them laterally and antero-posteriorly. The tracing devices (Fig. 9.21) are then attached securely to the rims. The stylus is attached to the maxillary rim and the recording plate to the mandibular (Fig. 9.22). This arrangement develops an arrow point tracing with the apex anteriorly. The tracing is not acceptable unless a pointed apex is developed.

A blunted apex usually indicates an acquired functional relationship. *A sharp apex* indicates the position of centric relation (Figs 9.20 and 9.23).

Double tracing indicates lack of coordinated movements.

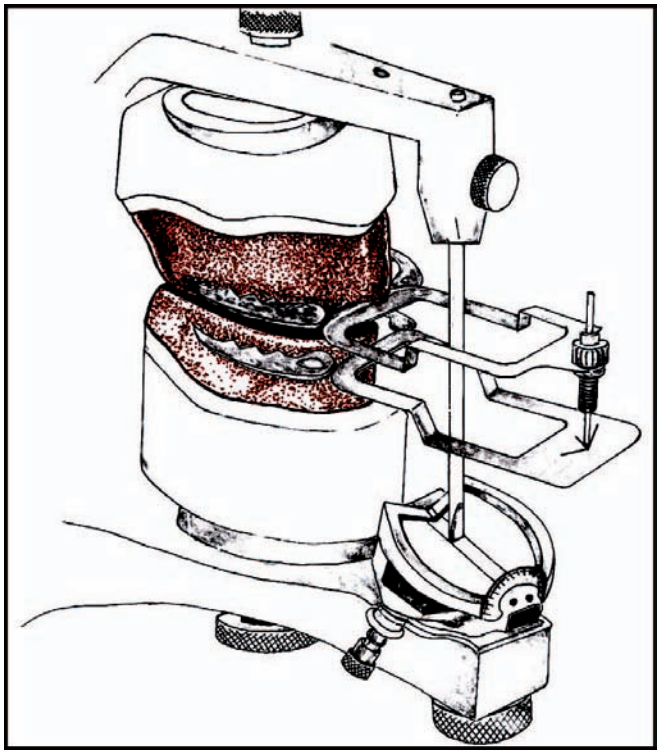


FIGURE 9.20: Graphic record of centric relation

Interocclusal check records: It is particularly indicated in situation of:

1. Abnormally related jaws.
2. Excessively displaceable supporting tissues.
3. Large awkward tongue.
4. Uncontrollable or abnormal mandibular movements.
5. To check the occlusion of teeth in trial dentures.

Vertical dimension of occlusion is first established and at this established vertical dimension, patient is made to

FIGURE 9.21: Extra-oral height tracers and central bearing plates

FIGURE 9.22: Tracer attached to the occlusal rims

FIGURE 9.23: Arrow point tracing on the tracer

practice retrusion of the mandible. The operator should stand on the right side and in front of the patient. Maxillary occlusal rim is held with the thumb and index finger of the

left hand in inverted position. At the same time, mandibular rim is held in position with the index finger of the right hand. The record is made by placing a nick and notch on the maxillary rim and a trough on the mandibular rim in the region of the posterior teeth (Figs 9.24 and 9.25). The nick placed in the premolar region prevents lateral movement of rims and the notch in the molar region prevents the antero-posterior movement of the occlusal rims. The patient is made to retrude the mandible by applying any one of the methods mentioned earlier. The recording materials used are quick setting plaster, Zinc oxide eugenol impression paste, Inter-occlusal recording material, wax etc (Fig. 9.26). The recording material is placed in the trough and the rims are carried to the mouth and the retrusion exercise is repeated as the patient closes the mandible at the predetermined vertical dimension of occlusion. The material is allowed to set before removal of the occlusal rims from the mouth and accuracy of the interocclusal recording of the centric relation is checked again by repeating the retrusion exercise.

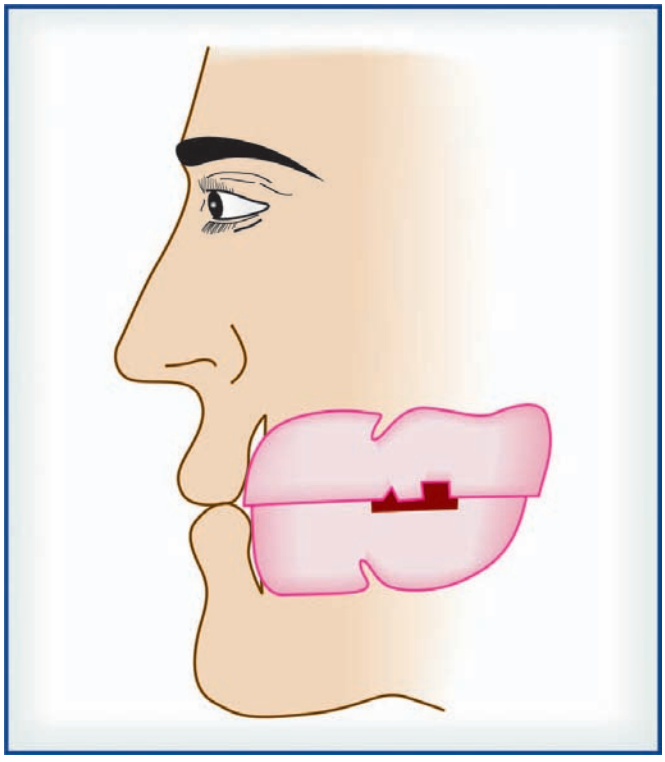
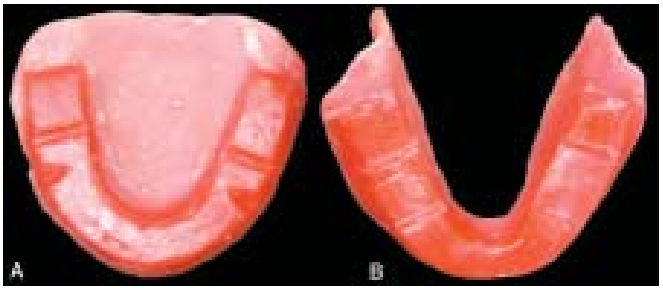
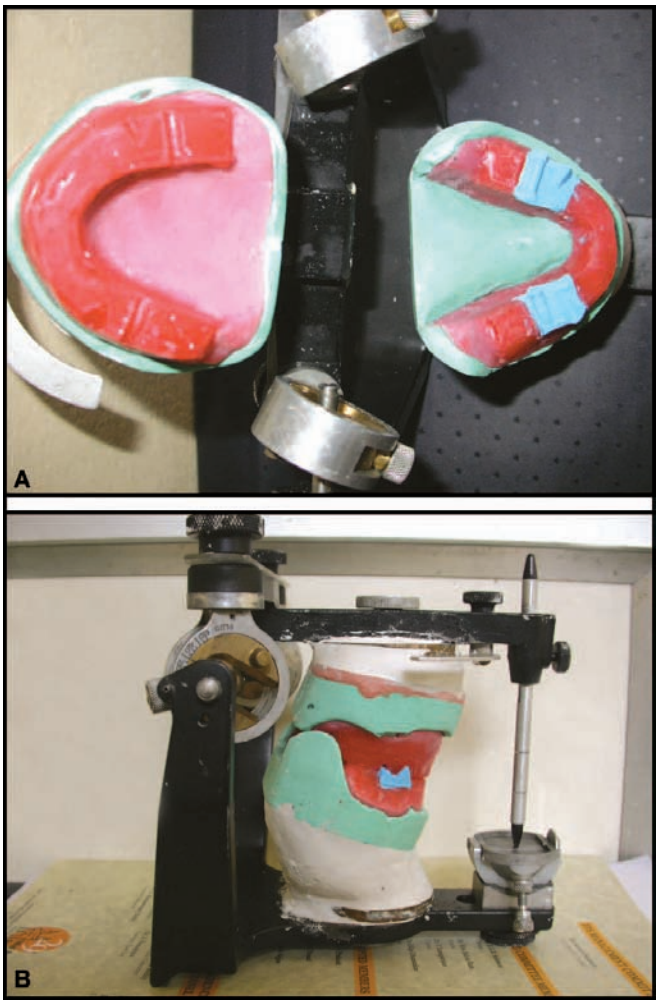


FIGURE 9.24: Inter-occlusal record of centric relation



FIGURES 9.25A and B: Inter-occlusal record: (A) Nick and notch in the maxillary occlusal rim (B) Trough in the mandibular occlusal rim



FIGURES 9.26: Inter-occlusal centric relation record

Terminal hinge axis: As in the determination of the physiologic transverse hinge axis, the mandible is in its most posterior relation to the maxilla when the centric relation is recorded. Therefore, if the upper cast is correctly oriented to the hinge axis of the articulator by

an accurate face bow transfer, the lower cast will also be correctly oriented to the opening axis of the instrument when it is transferred to the articulator with the accurate centric relation record.

Eccentric Relation Record

Eccentric positions to be recorded are protrusive and lateral. The graphic method of making eccentric maxillomamdibular relation records is performed at the same sitting and with the same equipment used for centric relation record. After the mandibular cast has been mounted in the centric relation, the recording device is replaced in the patient's mouth. A distance of 5 to 6 mm is measured from the apex of the arrow point tracing and the protrusive tracing is marked. The patient is instructed to protrude until the point of the stylus rests in the mark. Quick setting dental stone is injected to seal the rims. The horizontal condylar elements on the articulator are released by turning the lock nuts. Incisal guide pin is raised to about one half inch from the top of the guide table. The record bases are seated on the casts and the lock nuts are manipulated on one side and then the other side. The lock nuts are secured with positive finger pressure and the calibrations are recorded.

Lateral Relation Records

Lateral positions can be recorded and used to establish lateral guidance on certain adjustable articulators, but they cannot be used with semi-adjustable articulators. Graphic methods are used in the same manner as protrusive relation record except that the records required are one of the right laterals and one of the left laterals. Hanau recommended a formula to arrive at an acceptable lateral inclination- L = H\8 + 12 where,
L = Lateral condylar inclination in degrees.
H = Horizontal condylar inclination in degrees as established by the protrusive relation record.

Laboratory Considerations for Jaw Relation Recording

Record Base/Temporary Base/Trial Base/Baseplate

It is a temporary form representing the base of a denture which is used for making maxillomandibular (jaw) relation records and for the arrangement of teeth.

Materials Used to Fabricate Record Bases

Shellac base plate: This material is preferably not used because of its distortion during the application of heat in the process of correcting the occlusal rims during recording of jaw relation (Fig. 9.27).

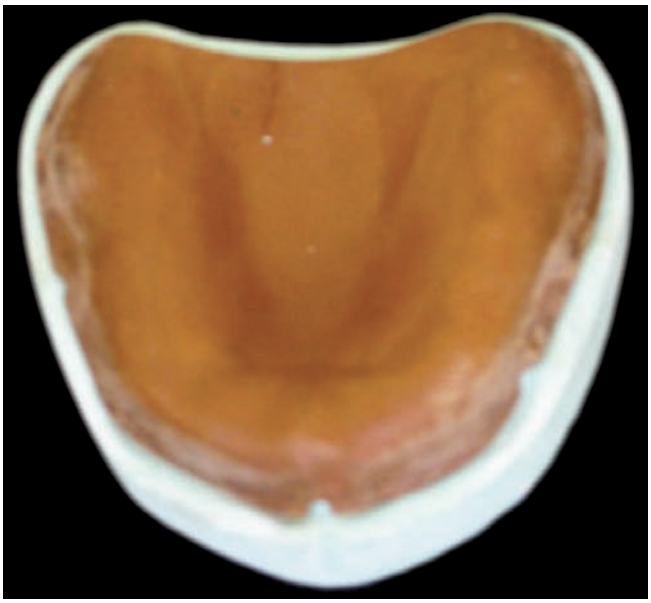


FIGURE 9.27: Record base made of shellac base plate

Self-cure acrylic resin: It is the material of choice because of its easy manipulation and favorable dimensional stability (Fig. 9.28).

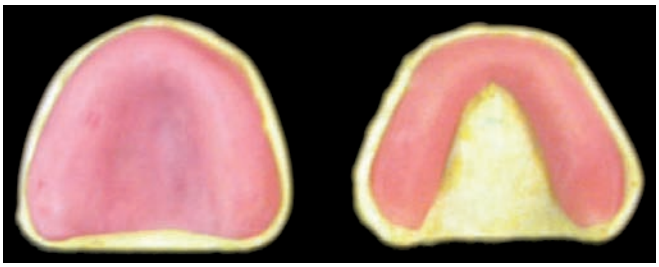
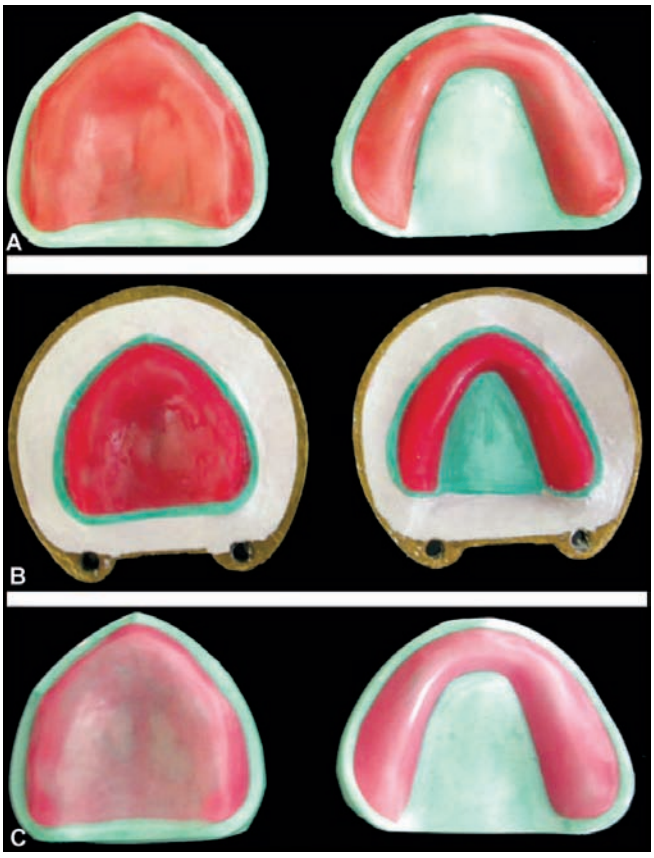


FIGURE 9.28: Record base made of self-cure acrylic resin

Heat cure acrylic resin: It is used in the fabrication of permanent denture base. It has good dimensional stability but the fabrication involves an elaborate procedure (Fig. 9.29).

Requirements of Completed Record Base

1. It should be rigid, accurate and stable.
2. The borders should be developed like borders of finished denture.



FIGURES 9.29A to C: Heat cure record base: (A) Wax pattern (B) Processing (C) Processed record base

3. The surface that contacts lips, cheeks and tongue should be smooth and polished.
4. The slopes of the base on labial and buccal sides and in the crest area should be thin for placement of teeth.
5. The non-anatomical surface should be smooth for the comfort of the patient during jaw relation-recording procedure.

Occlusal Rim /Record Rim (Fig. 9.30)

Occluding surfaces built on the temporary or permanent denture bases for the purpose of making maxillo-mandibular relation records and for arranging the teeth. The ideal dimension of maxillary occlusion rim:

1. Height
   A. Anterior—24 mm (from the deepest area of the sulcus)
   B. Posterior—21 mm (in the first molar region)

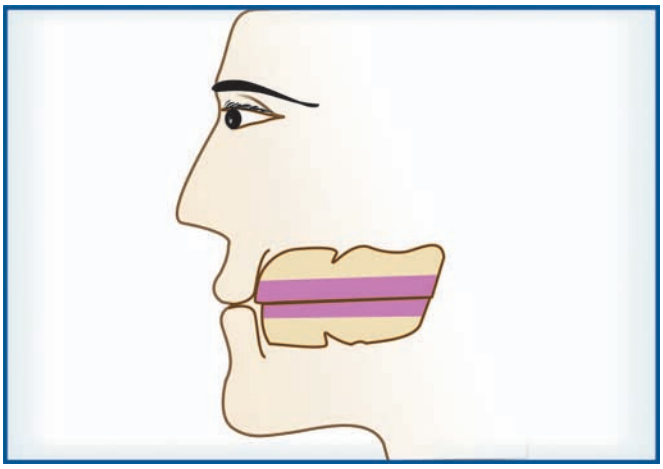


FIGURE 9.30: Dimensions of occlusal rims

The ideal dimension of mandibular occlusion rim:

1. Height
   A. Anterior—20 mm (from the deepest area of the sulcus)
   B. Posterior—approximately 18 mm (height of anterior 2/3rd of retro molar pad) (Fig. 9.31).
2. Width of occlusal rim (maxillary and mandibular)
   Anterior—6 mm
   Posterior—8 mm

A good prosthodontic treatment bears a direct relation to the structures of the temporomandibular articulation, since the occlusion is one of the prime concerns to the dentist during the treatment of complete denture patients. The temporomandibular joints affect

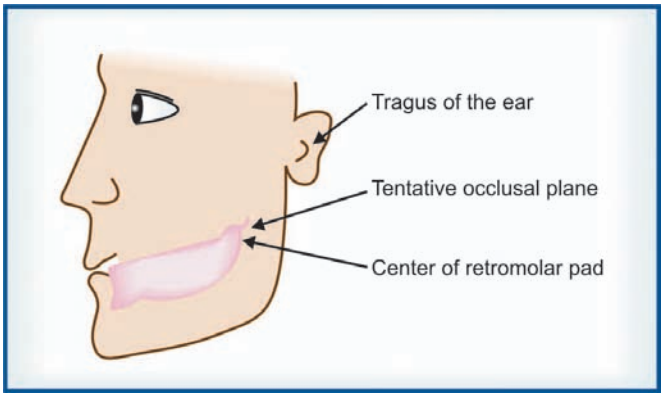
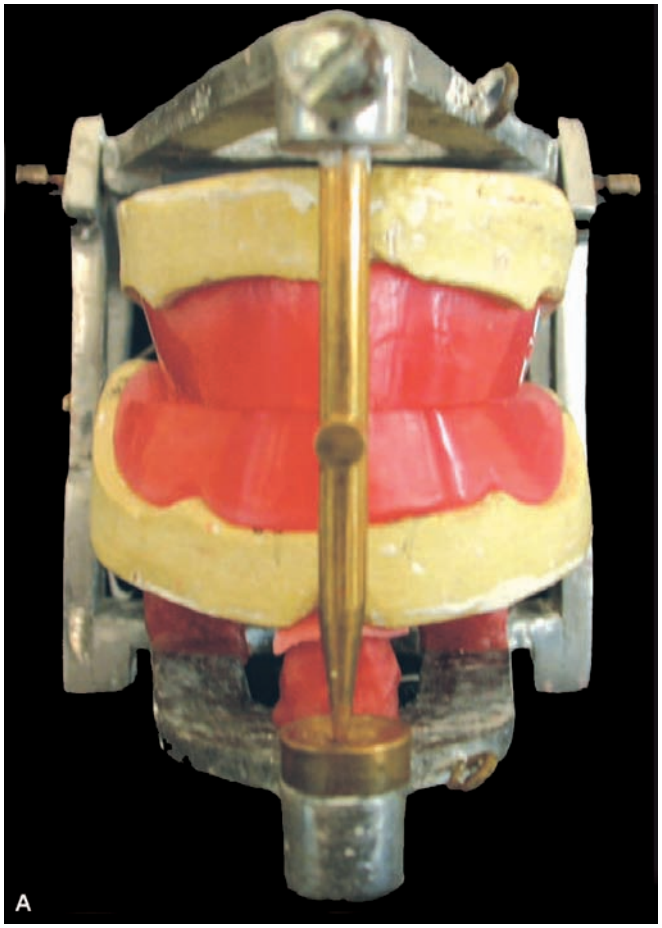


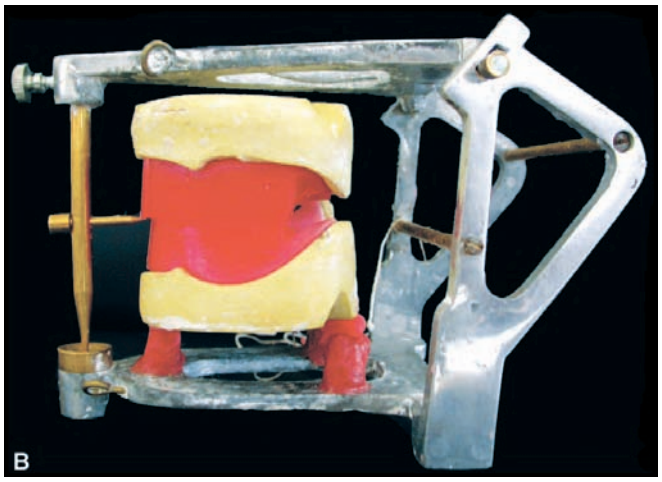
FIGURE 9.31: Mandibular occlusal plane in relation to the anterior 2/3rd of the retromolar pad

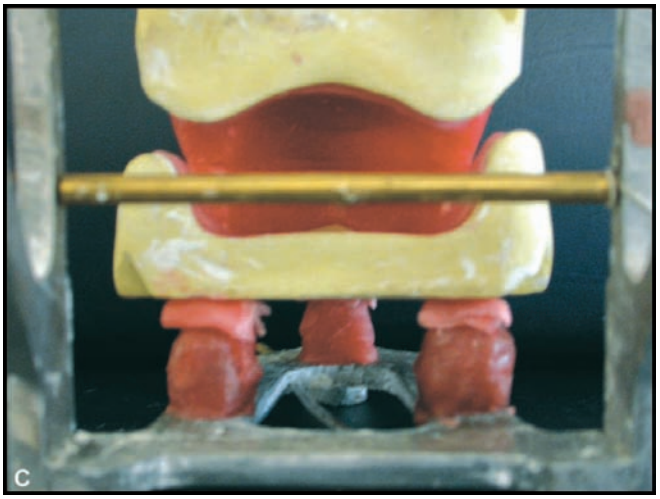
the dentures and likewise the dentures affect the health and function of the joints. Therefore, the knowledge of the interrelationship of the bony structures seems indispensable for treatment of edentulous patients.

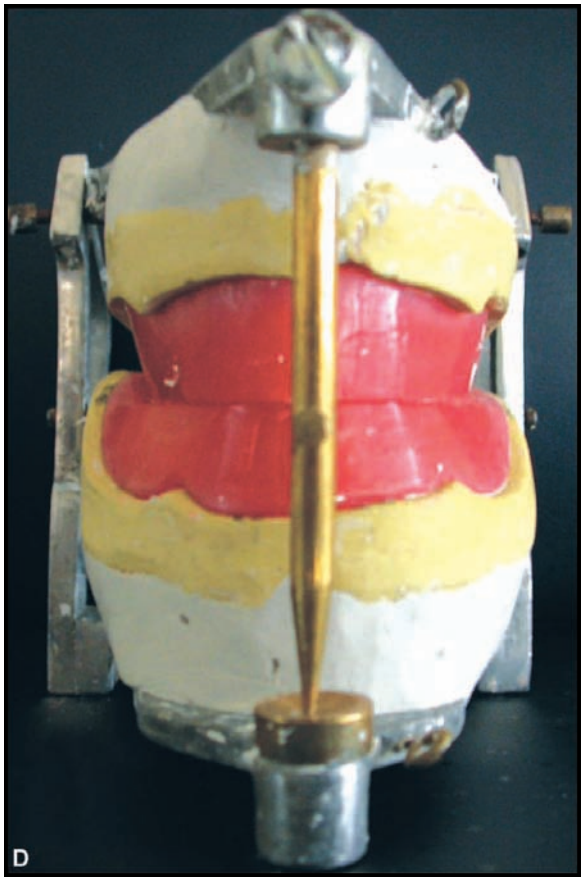
SELF-HELP QUESTIONS

1. Define jaw relation.
2. What is orientation jaw relation?

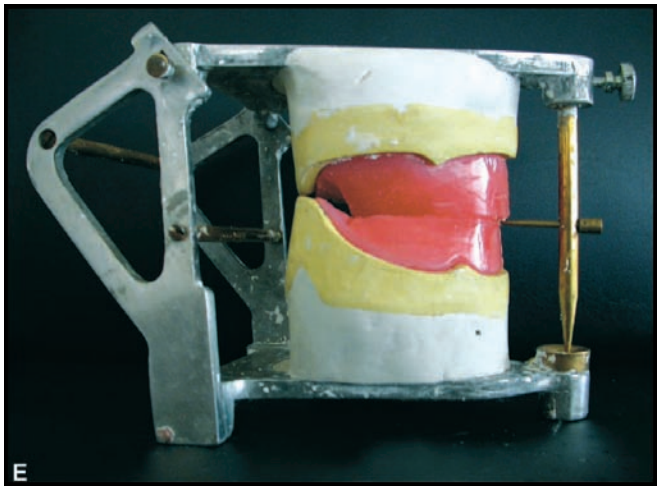








FIGURES 9.32A to D



FIGURES 9.32A to E: Transfer of jaw relation record to the mean value articulator. (A) Frontal view of the alignment of the jaw relation record on the mean value articulator (B) Incisal pin relation (C) Relation of horizontal bar to the occlusal plane (D) Jaw relation record stabilized on the articulator with dental plaster (frontal view) (E) Jaw relation record stabilized on the articulator with dental plaster (lateral view).

3. Define face bow.
4. Classify face bow.
5. What are the parts of face bow?
6. What is the significance of use of face bow?
7. Define vertical jaw relation.
8. Define physiologic rest position.
9. Mention the relevance of free way space.
10. What is the significance of marking the midline, canine line and high lip line on maxillary occlusion rim?
11. How is the occlusal plane oriented to the cranial base?
12. What are the different methods of recording vertical jaw relation?
13. Define centric relation.
14. Define centric occlusion.
15. Why should centric occlusion coincide with centric relation?
16. What are the different methods of recording centric relation?
17. What is the advantage of interocclusal method with nick-notch over direct sealing in centric relation recording procedure?
18. What are the ideal requisites of record base?
19. What are the materials used to fabricate record base?
20. Mention the advantages and disadvantages of different materials used to fabricate record base.
21. Define occlusion rim.
22. Define record base.
23. What are the uses of occlusion rim?
24. What are the materials used in interocclusal recording procedure?
25. What is Camper's plane?
26. Mention the effects of increased vertical height.
27. What are the effects of decreased vertical height?
28. What is Angular Chelitis/perleche?

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CHAPTER

10

Articulators or Simulators in Complete Denture Prosthodontics

INTRODUCTION

Articulator is a mechanical device, which represents the temporomandibular joints and jaw members to which maxillary and mandibular casts may be attached. It forms an important device in prosthodontic treatment, the uses of which can be summarized as follows:

a. To study occlusion in natural dentition.
b. To diagnose occlusal problems in natural and artificial dentition.
c. To plan occlusion and articulation in natural and artificial teeth.
d. Fabrication of occlusal surfaces for dental restorations.
e. To correct and modify completed restorations.

An articulator for successful prosthodontic treatment should attain the following requirements:

1. Should be possible to attach and remove the casts from the articulator without losing their relationship.
2. Articulators should maintain the accuracy of vertical and horizontal jaw relation records.
3. It should have incisal guide pin with anterior stop that can be adjusted.
4. It should function freely in the hinge movement.
5. It should accept the face bow record adjustable with the anterior and posterior reference positions.
6. It should be made up of rigid, non-corrosive material and moving parts should be resistant to wear.
7. Design should have adequate distance between upper and lower members to permit the view of occlusion from posterior side.
8. Condylar guides should be adjustable.
9. There should be a provision for Bennett movement.
10. Incisal guide table should be adjustable in sagittal and frontal planes.

An articulator can do no more than what the operator does with it. Hence, the effectiveness of any articulator depends upon:

a. How well the operator understands its construction and purpose.
b. How enthusiastic he is for the particular instrument.
c. How well the dentist understands the anatomy of the joints, their movements and the neuromuscular system.
d. How much precision and accuracy are used in registering jaw relations.
e. How sensitive the instrument is to these records.

BRIEF HISTORY OF EARLY DEVICES DEVELOPED FOR RECORDING CONDYLAR MOVEMENT

Plaster articulator was first described by Phillips Pfaff (1756). In this type, plaster extension on the distal portion of the mandibular cast was grooved to serve as a guide for a plaster extension of the maxillary cast. The extended casts together constituted the 1st articulator, commonly called a slab articulator (Fig. 10.1).

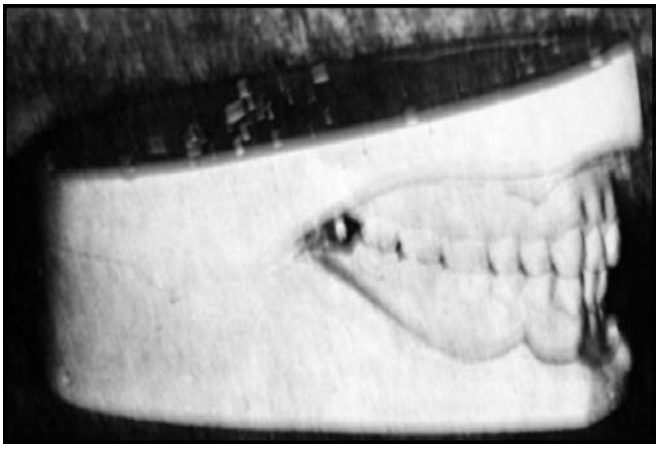


FIGURE 10.1: Slab articulator

In 1840, the first US patent for dental articulators were issued to two Philadelphia dentists James Cameron and Danial T. Evens. The Cameron articulator, primarily a hinge type device is notable both because it was the first articulator to be patented and because of its unusual pole stand design (Fig. 10.2). It had features that allowed upper and lower members to be arbitrarily adjusted. Danial T. Evens named his articulator the *Dentist's guide.*

At this point it is well worth mentioning an interesting phenomenon that affected the design of mechanical articulators almost from the beginning. The plane line articulators represent devices with lower members

designed to imitate the condyle, coronoid process and ramus of the mandible.

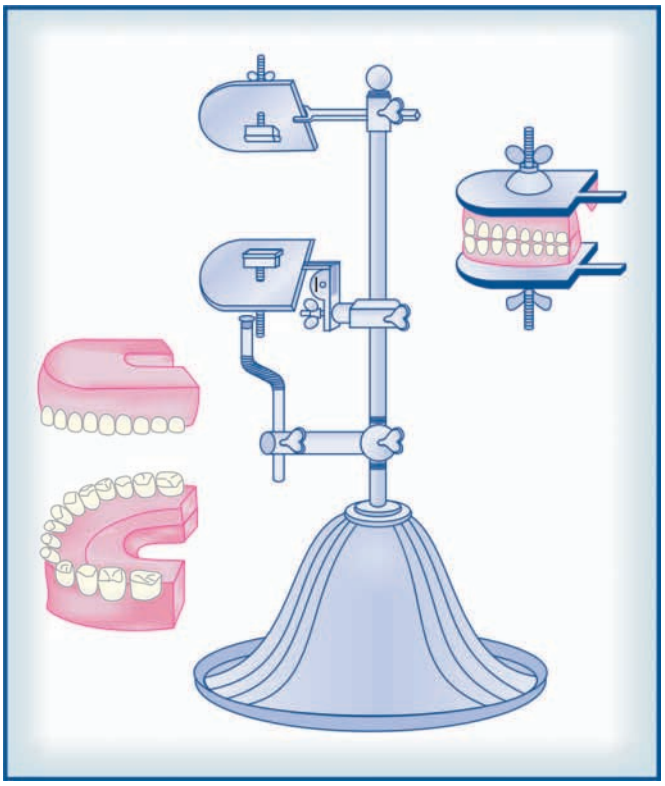


FIGURE 10.2: Cameron articulator

Balkwill, in 1866, introduced an instrument for measuring the angle formed between the plane of two lines drawn from the articulating surface of the condyles to the incisor point and the occlusal plane, which is near enough to use. He estimated this angle, now known as Balkwill's angle to be an average of 26° (Fig. 10.3). He had also constructed a bite frame by means of which (using the angle and measurements) the lower model can be placed in the same position relative to the centre of the hinge.

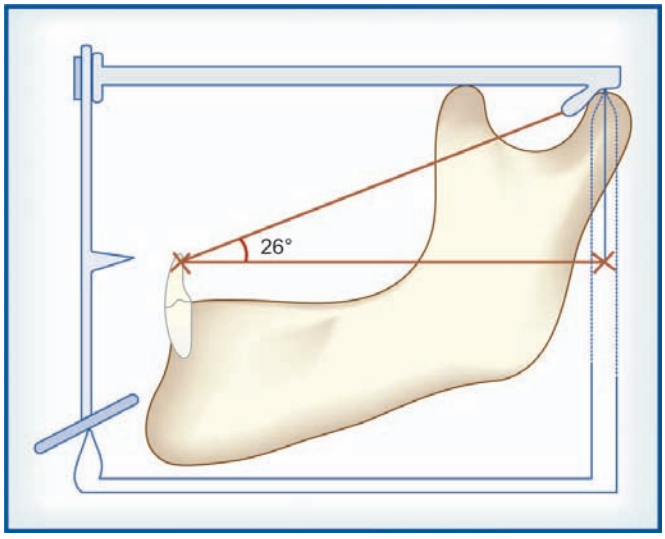


FIGURE 10.3: Balkwill's angle

In 1889, Richmond S Hayes of East Bloomfield received a patent for an articulator that was the first to incorporate a fixed descending condylar path (Fig. 10.4).

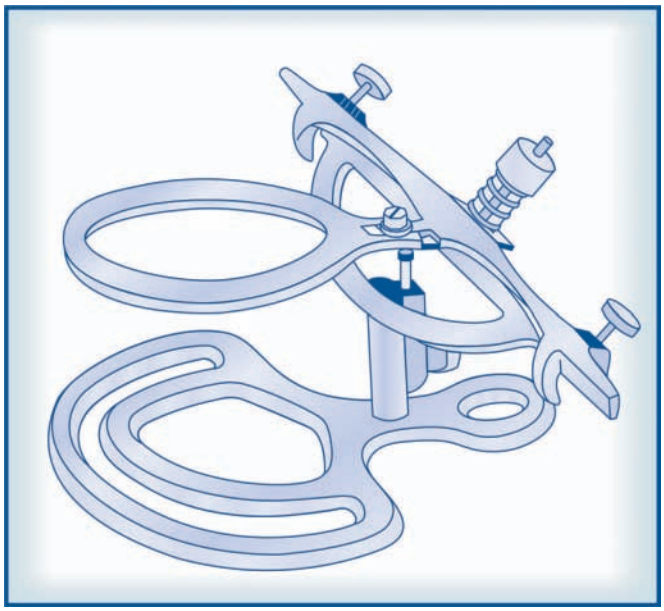


FIGURE 10.4: Hayes articulator

In 1896, William F. Walker produced the first adjustable condyle articulator. This instrument featured adjustable controls for recording the variability of the downward as well as forward movements of the individual condyles and controls for variable lateral and vertical rotation centres. He called this articulator *physiological articulator* (Fig. 10.5).

To measure the path of each condyle individually, Walker devised an apparatus that he called the *facial clinometer* and a procedure for its use (Fig. 10.6). Because it was designed to determine the angle of condylar paths on the face, it can be considered to be the origin of the extra-oral method for recording mandibular movement, although the paths were not actually scribed.

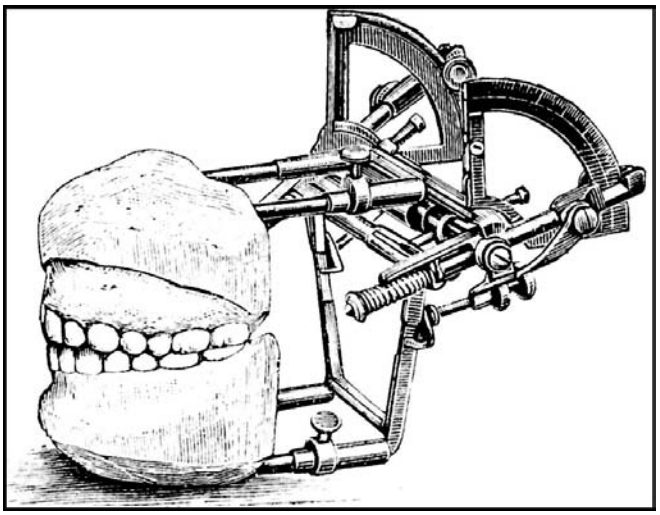


FIGURE 10.5: Physiological articulator

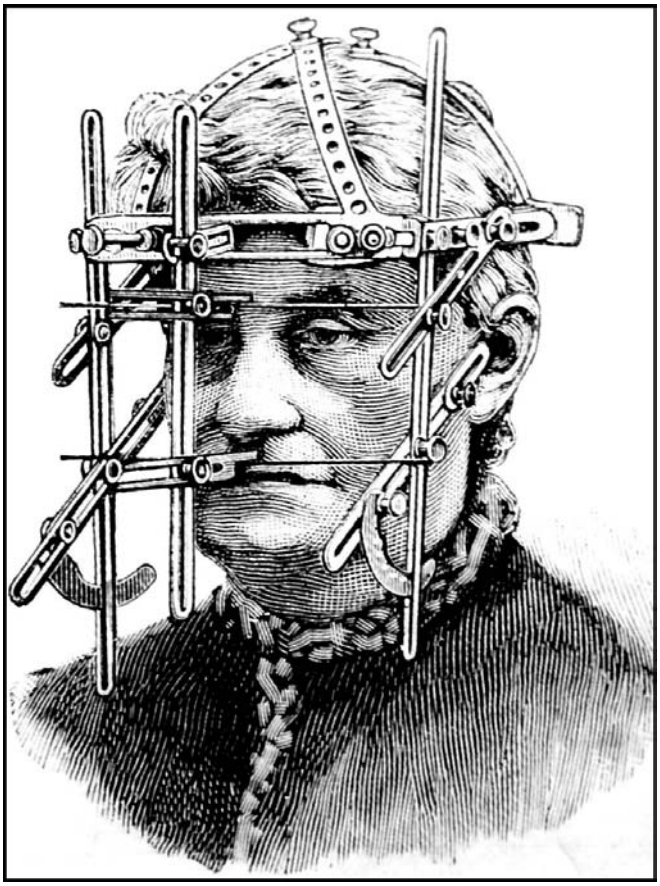


FIGURE 10.6: Facial clinometer

The *Grittman articulator* was patented and introduced in 1899 (Fig. 10.7). It featured descending condylar paths of 15°, an average determined by measurements taken from a large number of patients.

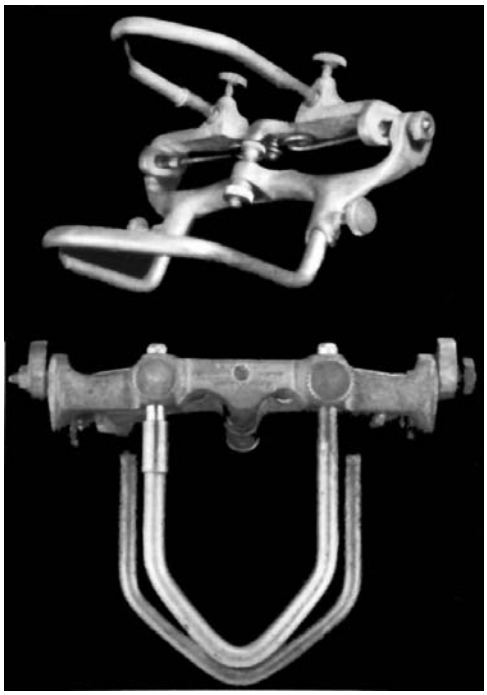


FIGURE 10.7: Grittman articulator

Snow new century articulator was essentially an improved version of the Grittman articulator (1899) with adjustable rather than fixed descending Condylar guides (Fig. 10.8). The second version of new century articulator (1909) included a more efficient central retaining spring and other improvements.

FIGURE 10.8: Snow century articulator

In 1901 and 1905, Carl Christensen reported his observations of the space that occurs between the maxilla and mandible during protrusion. Christensen introduced an adjustable articulator similar to Walker's but simpler in design. He suggested the use of protrusive interocclusal wax record to measure the angle of condylar paths that he believed correspond to the observed space and to use this record to set the condylar controls of an adjustable articulator. The space that Christensen brought to the attention of the profession is called *Christensen's phenomenon* a term coined by ULF POSSELT (Figs 10.9 and 10.10).

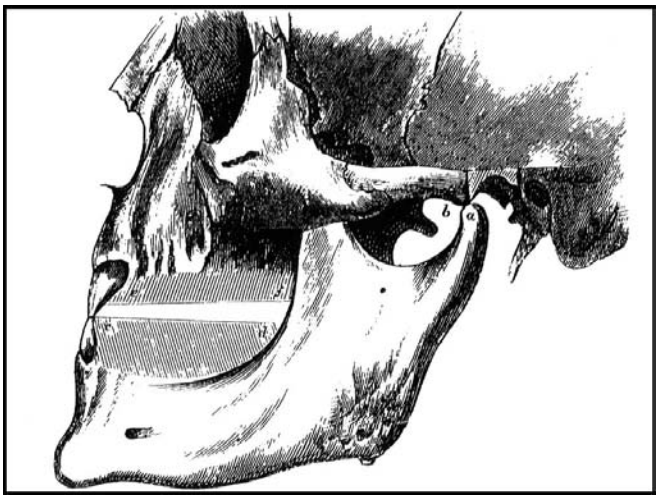


FIGURE 10.9: Christensen's phenomenon

Actually it would have been more aptly named Balkwill's phenomenon, because Balkwill had previously described it in 1866.

Alfred Gysi of Zurich, Switzerland introduced the *Simplex articulator* in 1912 (Fig. 10.11). It had condylar paths of 33° and lateral paths of 16°. The Incisal guide had the most practical upward slant. The simplex was probably the first of this type of articulator to have an Incisal pin and guide assembly.

Classification certainly aid in understanding, but problems arise in trying to make everything fit into predetermined classes. Articulators are an excellent example of this dilemma. This is simply because there are so many articulator systems available and within each system there are many variations on the theme, so

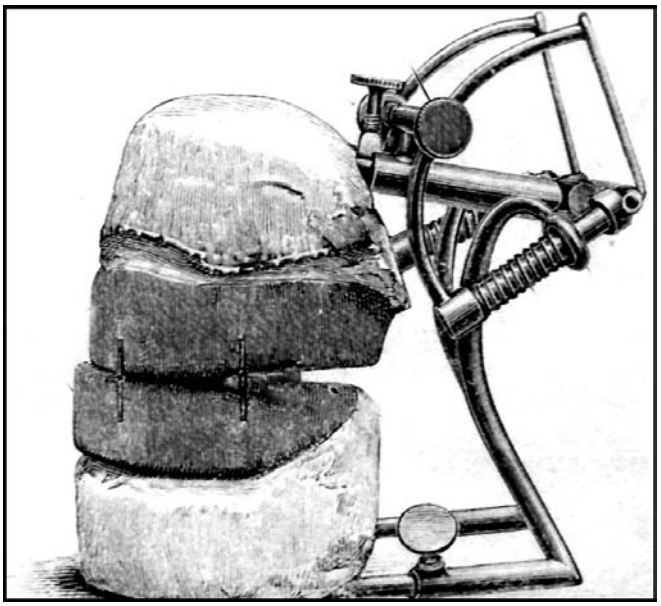


FIGURE 10.10: Christensen's articulator

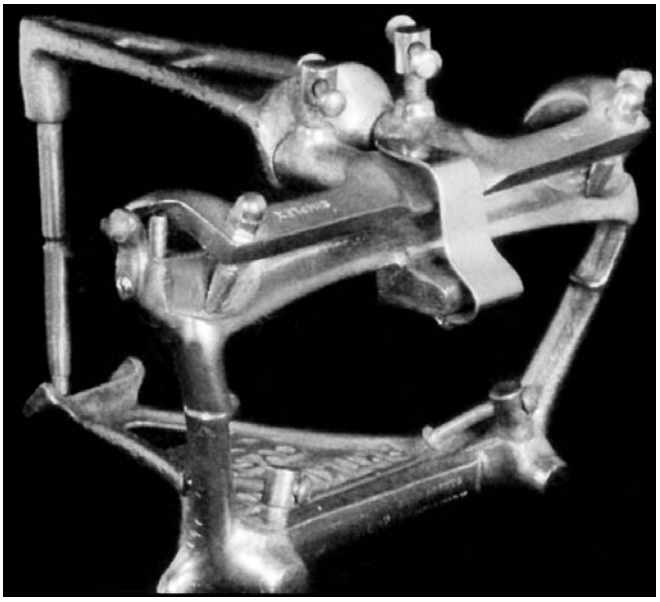


FIGURE 10.11: Simplex articulator

attempting to find a place for each is almost impossible. However, an attempt is made to broadly classify the articulators as follows:

1. Plain line/simple hinge type (Fig. 10.12).
2. Mean value type with fixed condylar path and incisal inclines.
3. Adjustable type.

FIGURE 10.12: Simple hinge articulator

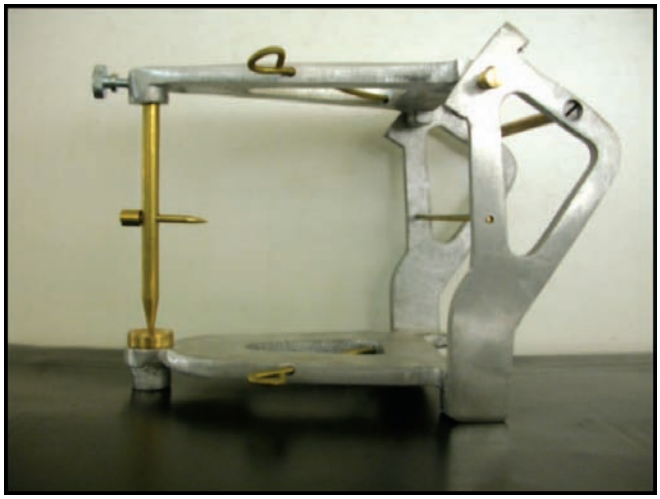


FIGURE 10.13: Mean value articulator

Adjustable articulator

a. Semi-adjustable type (Hanau, Dentatus, Whipmix)	a. Non-Arcon (Hanau wide-vue, Dentatus)
b. Completely adjustable (Denar)	b. Arcon (Whipmix, Denar)

Mean Value Articulator (Fig. 10.13)

Design

It has an *upper and lower member* to which maxillary and mandibular cast can be attached. These members

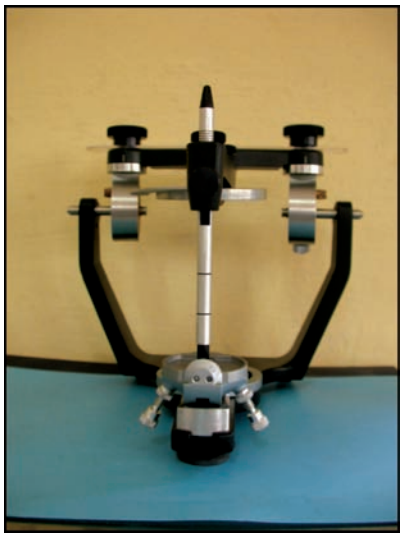


FIGURE 10.14: Semi adjustable articulator (Hanau wide-vue)

are supported together by *vertical components,* which may be designed in different shapes for reinforcement. Upper horizontal component opens and closes around the opening and closing axis. The *condylar shafts* are engaged in *condylar slots* representing the glenoid fossa. The Condylar slot is *angulated inclined at an angulation of 30° to the horizontal plane. Distance between the two condylar slots is fixed at 110 mm.* In the anterior portion the closing is regulated by *vertical pin,* which rests on Incisal table of lower component. This vertical pin maintains the vertical separation between the upper and the lower component. In this vertical pin there is a small pin placed horizontally in the center called *mid Incisal pin.* It indicates the mid Incisal point, mid-line and amount of labial inclination of upper central incisors. In the posterior segment, at the center of vertical supporting arms, an *orientation guide pin* passes along both the sides. There is an additional pin between the two vertical arms supporting and maintaining the two vertical arms. The Condylar slot has spring-loaded mechanism that pushes the Condylar rod into center position. The position of vertical pin can be removed with the help of screws. The vertical pin should merge with the top surface of upper component for maintaining the vertical distance. *The incisal guide table has angulation of 5°* to the horizontal plane in all directions.

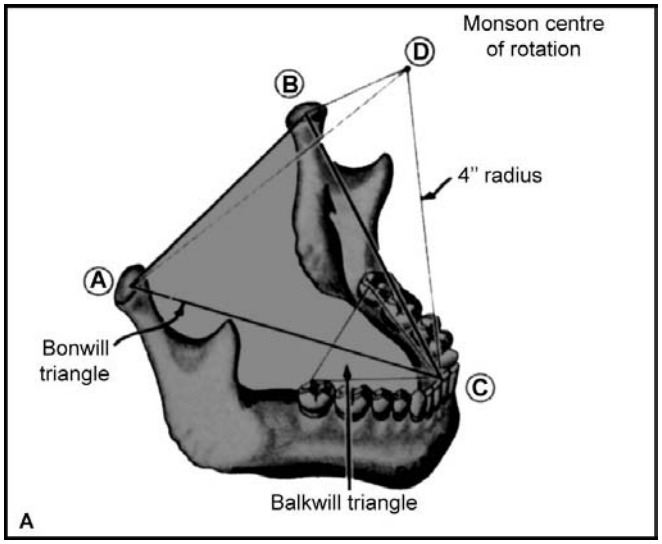
Hanau wide-vue Articulator (Figs 10.14 and 10.15)

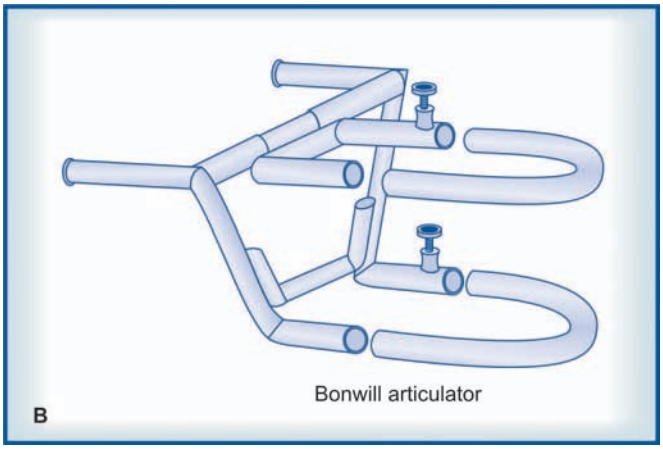
It is a *Semiadjustable* type of instrument. It consists of an *upper member* and *lower member*. The *condylar guidance elements* and the *condylar spheres* are attached to either the upper / lower member which forms the basis for the articulator to be classed into *arcon or non-arcon*. The upper and lower members are mechanically connected. Hanau articulator is classed as modified two-dimensional instrument. The upper cast is oriented to the upper member (which represents the skull) by an arbitrary face bow transfer record. The arbitrary face bow is routinely used for complete dentures. The location of the vertical axis of rotation of the patient's mandible can be approximated on either side of the articulator. The lower cast is oriented to the lower member of the articulator, representing the mandible, by relating the lower to the upper cast through an interocclusal centric relation record. An interocclusal protrusive record aids in adjusting the horizontal Condylar guidances. The lateral Condylar guidances is set arbitrarily by using the formula L=H/8+12. The articulator is provided with an adjustable *incisal guide table* that is routinely used for removable prosthodontic restorations. The angulation of the lateral plates of the table is calibrated in degrees and the plates can be positioned at the desired lateral Incisal guidance. The table is adjustable anteroposteriorly to provide the necessary guidance for protrusive movement. The articulator has a *straight Incisal guide pin* with a flat end, which permits movements on the Incisal guide table. The incisal pin on the Hanau articulator is adjustable and allows for vertical changes without change in pin position relative to the middle of the Incisal guide table.

FIGURE 10.15: Hanau semiadjustable articulator

Articulators Based on Theories of Occlusion (Fig. 10.16)

1. Bonwill theory of occlusion.
2. Conical theory of occlusion.
3. Spherical theory of occlusion.





FIGURES 10.16A and B: (A) Schematic representation of theory of equilateral triangle. (B) Bonwill articulator

1. **Bonwill theory of occlusion** proposed that the teeth move in relation to each other as guided by the Condylar controls and the Incisal point. It is known as the theory of equilateral triangle, in which there was a 4-inch (10 cm) distance between the condyles and between each condyle and the incisal point.
   W.G.A. Bonwill developed the *Bonwill articulator.*
2. **Conical theory of occlusion (Fig. 10.17)** states that the lower teeth move over the surfaces of the upper teeth as over the surface of a cone, generating an angle of 45° degrees with the central axis of the cone tipped 45° to the occlusal plane. The *Hall anatomic articulator* designed by R.E. Hall conforms to the conical theory of occlusion. It is noted that teeth having 45° cusps are necessary when dentures are made on this instrument.

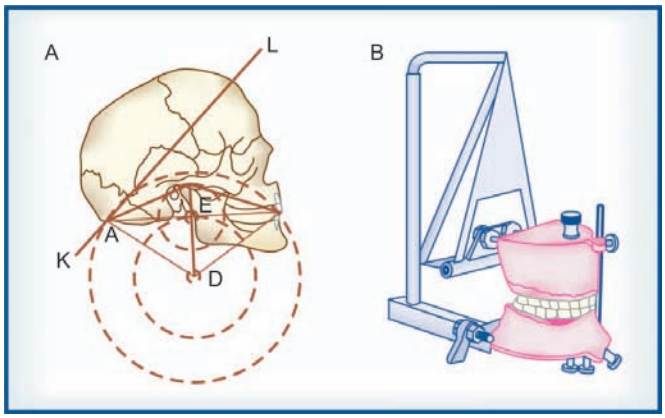
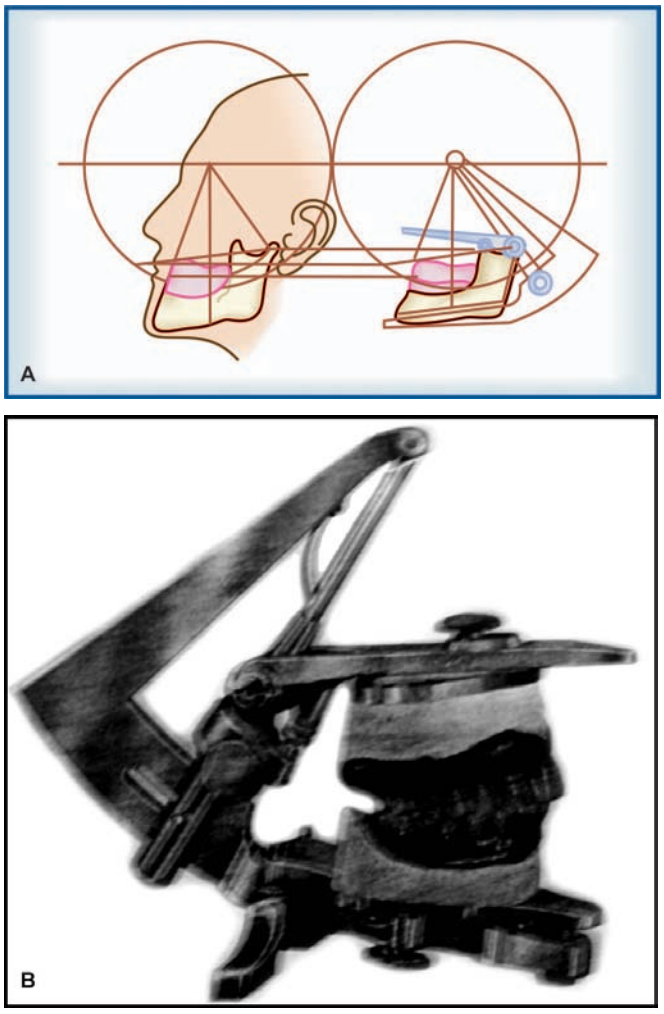


FIGURE 10.17: (A) Schematic representation of conical theory of occlusion. (B) Hall's anatomic articulator

3. **Spherical theory of occlusion (Fig. 10.18)** showed that the lower teeth move over the surface of the upper teeth as over the surface of a sphere with a diameter of 8 inches (20 cm). The center of the sphere was located in the region of the glabella and the surface of the sphere passed through the glenoid fossae along or concentric with the articulating eminences. G.S. Monson proposed the theory in 1918 based on the observations of natural teeth and skulls made by Von Spee, an anatomist. The *maxillo mandibular instrument* devised by Monsoon operated on the spherical theory of occlusion.



FIGURES 10.18A and B: (A) Schematic representation of spherical theory of occlusion. (B) Maxillo mandibular instrument

Selection of an Articulator for Complete Denture Treatment

1. If occlusal contact are to be perfected in centric occlusion only, a simple, sturdy mean value articulator without provision for lateral or protrusive movements can be selected because only one interocclusal record in necessary for its adjustment and use.
2. If denture teeth are to have a cross-arch and cross tooth balanced occlusion, the minimum requirement is a semiadjustable articulator. This may be an instrument with individually adjustable Condylar guidances in both the vertical and horizontal plane such as the simple instruments in the Hanau University series, the Whip mix articulator or the dentatus articulator.

3. If more control of the occlusion is desired, a completely adjustable three-dimensional articulator is of value. A three-dimensional articulator requires a centric relation record, at least two lateral records and some means for controlling the height and inclinations of the cusps. The means for their adjustment may be interocclusal records or three-dimensional graphic tracings made by a kinematic face bow apparatus.

SELF-HELP QUESTIONS

1. Define articulator.
2. What are the uses of articulator?
3. Mention the requisites of articulator.
4. Classify articulator.
5. "Mean value articulator" – Why is it named so?
6. What is Hanau's Quint?
7. What kind of centric relation record does mean value articulators accept?
8. What kind of horizontal jaw relation record does Hanau semi-adjustable articulator accept?
9. What is the advantage of using semi-adjustable and adjustable articulators?
10. Mention the articulators based on geometric theories of occlusion.
11. What is incisal guidance?
12. What is condylar guidance?
13. Mention the limitations of Mean value articulator.
14. What is a three point articulator?
15. What are the end control elements?
16. Which are the articulators based on geometric theories of occlusion?

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CHAPTER

11

Selection and Modification of Teeth for Aesthetics and Function

INTRODUCTION

Teeth selection is not simply a mechanical procedure but requires dexterity and knowledge of biology. Selection of teeth forms an important step before teeth arrangement.

PRINCIPLES OF SELECTION OF ARTIFICIAL TEETH

- The teeth should appear natural and life-like.
- It should serve the functional need of the patient.
- They should be easy to use in laboratory procedures.
- It should be possible to position them within the anatomical limits of the foundation.

METHODS OF ANTERIOR TEETH SELECTION

Pre-extraction Records

a. Diagnostic casts: The diagnostic casts of patient's natural teeth or restored teeth prior to extraction of remaining teeth provide a basic idea for teeth selection.

b. Recent photographs: They will often provide general information about the width of the teeth and possibly the outline form that is more accurate than information from any other source.

c. Radiographs of teeth: Radiographs, made before the natural teeth were lost, can provide information about the size and form of the teeth to be replaced. The radiographic images, however, may be enlarged and distorted because of divergence of the X-ray.

Post-extraction Examination

a. Size and form of edentulous foundation.
b. Matching teeth to face forms and arch form.
c. If patient is already a denture wearer, the mouth should be examined with the dentures in the mouth giving importance to physiological and esthetic aspects.

FACTORS OF SELECTION OF ANTERIOR TEETH

- Size
- Form
- Colour

Size of Anterior Teeth

The *length* and the *width* of the teeth determine it.

Length

Normally, the necks of anterior teeth overlap the anterior ridge by 2 to 3 mm cervically and incisal edges will show below the relaxed lip. The visibility is approximately 3 mm in young patients and half of it in old patients.

Width

i. Measuring the width of anterior teeth

$$\frac{\text{Bizygomatic width}}{16} = \text{Estimated width of maxillary central incisors.}$$

$$\frac{\text{Bizygomatic width}}{3.3} = \text{Approximate width of 6 anterior teeth.}$$

ii. Mark the corners of the mouth on the occlusal rim in the mouth and the distal surface of the upper canines can be indicated by marks made on the upper rims at the corners of the mouth. Then the distance between the marks is measured around the labial surface of the occlusal rim and anterior teeth of this width are arranged as indicated by the occlusal rim. Variations depend upon the length of the upper lip, mobility of the upper lip, vertical height of occlusion and vertical overlap.

Form of Anterior Teeth

Based on Face Form

Classification of face form by Leon Williams: It consists of two imaginary lines passing about 2.5 cm in front of the tragus of the ear and through the angle of the jaw. If lines are almost parallel, it is said to form a square face form, lines diverging at the chin contributes to an ovoid

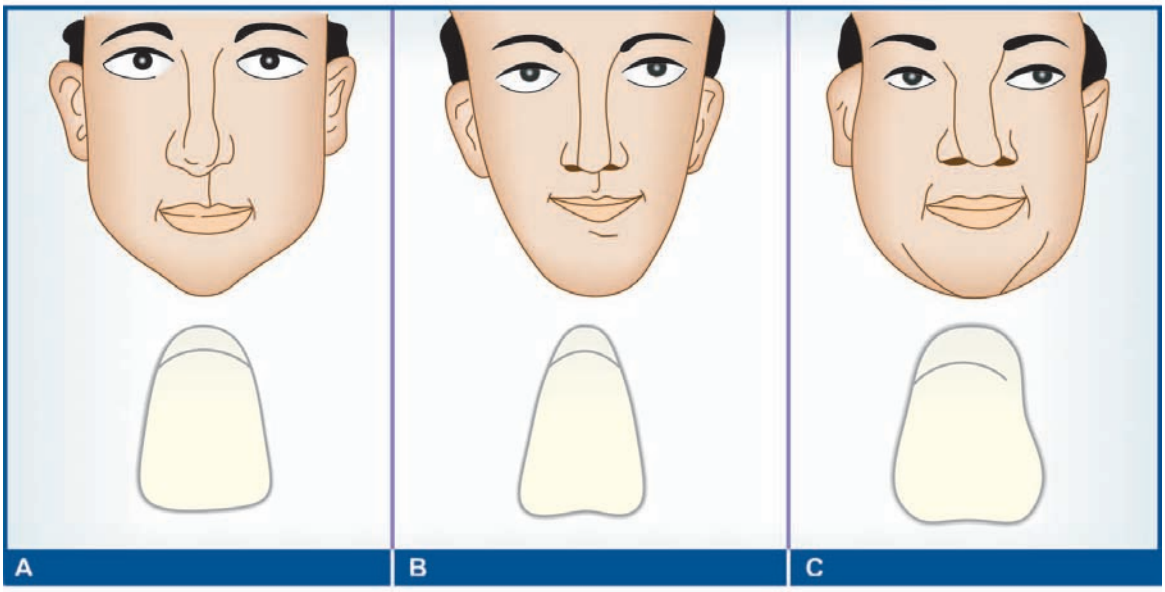

FIGURE 11.1: Shapes of anterior teeth in relation to face form

face form and lines converging at the chin form tapering face form (Fig. 11.1).

Based on Arch Form

It can be square, tapering or ovoid depending on the arch form.

Based on Profile of the Face

The labial surface of the tooth viewed from the mesial aspect should show a contour similar to that when viewed in profile. The labial surface of the tooth viewed from the incisal aspect should show a convexity of flatness similar to that seen when the face is viewed from under the chin or from top of the head.

Relationship of Upper Arch and Upper Incisors

In V shaped arches, the teeth should be narrower at the neck than the incisal edge. In rounded arch forms, ovoid teeth are indicated and in squarish arches, parallel-sided incisors are preferred.

Factors Influencing Size and Form of Anterior Teeth

1. Size of the face.
2. Amount of available interarch space.
3. Measured distance between distal of right and left maxillary cuspids.
4. Length of the lip.
5. Size and relation of arches.
6. Sex of the patient.

Colour of Anterior Teeth

Knowledge of physics, physiology and psychology of colour is valuable in the selection of colour of the teeth. The colour of teeth has four qualities–

1. *Hue:* It is the specific colour produced by a specific wavelength of light acting on the retina. The hue of teeth must be in harmony with the colour of patient's face. The factors influencing hue and brilliance are age, habits and complexion.
2. *Saturation:* It is the amount of colour per unit area of an object.
3. *Brilliance:* It is the lightness or darkness of an object. People with fair complexion generally have teeth with less saturation of colour. Thus the teeth are lighter and in harmony with the colour of the face. People with dark complexion generally have darker teeth.
4. *Translucency:* It is a property of an object that permits the passage of light through it but does not give any distinguishable image.

CHARACTERISTICS OF NATURAL TEETH

The neck of teeth has more pronounced colour than the incisal edge. The incisal edge, if unworn is more translucent than the body of the tooth. Maxillary central incisors are lightest teeth in the mouth, maxillary laterals and mandibular incisors are slightly darker while canines are the darkest. Posterior teeth are usually uniform in colour and slightly lighter than canines. However, the teeth darken with age either because of wearing of enamel or sclerotic dentine.

Suggestions for Selection of Teeth

1. Always moisten the shade guide because when in mouth, the teeth are always moist and this has an affect on the reflection and refraction of light and hence the colour.
2. Always place the teeth in the shade of the upper lip in the position they are to occupy. They will appear darker in this position than in hand.
3. Select teeth under natural light.
4. Attempt to look at the face as a whole rather than focus on the teeth.

Factors of Selection of Posterior Teeth

Shade

It should harmonise with the shade of anterior teeth. Bulk influences the shade of teeth and for this reason it is advisable to select a slightly lighter shade for the bicuspids if they are to be arranged for esthetics. They may be slightly lighter than the posterior teeth but not lighter than the anterior teeth.

Size and Number of Posterior Teeth

The size and number of posterior teeth are closely related to the function. These characteristics are dictated by the anatomy of the surrounding oral environment and physiologic acceptance of supporting tissues. The posterior teeth must support the cheek and tongue and function in harmony with the musculature in swallowing and speaking as well as in mastication.

Buccolingual width of posterior teeth: The buccolingual width of artificial teeth should be greatly reduced in comparison to the width of natural teeth they replace. Artificial teeth that are narrow in buccolingual direction enhance the development of the correct form of the polished surfaces of the denture by allowing the buccal and lingual flanges to slope away from the occlusal surfaces. This occlusal form permits forces from the cheeks and tongue to maintain the dentures in position on the residual ridges. Narrow occlusal surfaces with proper escape-ways for food also reduce the amount of stress applied on food during mastication and to the supporting tissues of the basal seat. On the other hand, the posterior teeth should have sufficient width to act as a table upon which to hold food during trituration.

Mesio-distal width of posterior teeth: The edentulous area between the distal of the mandibular cuspids and the ascending area of the mandible determine the mesio-distal width of posterior teeth. After the six mandibular anterior teeth have been placed in their final position, a point is marked on the crest of the mandibular ridge at the anterior border of the retromolar pad. This is the maximum extent posteriorly of any artificial teeth on the mandibular ridge. In well formed ridges, the apex of the retromolar pad is taken as posterior level and in resorbed ridges; the point where retromolar pad turns upward is taken as a landmark.

Vertical length of buccal surface of posterior teeth: It is best to select posterior teeth corresponding to the interarch space and to the length of anterior teeth. The length of the maxillary first premolars should be comparable to that of the maxillary canines to have the proper aesthetic effect.

TYPES OF TEETH ACCORDING TO MATERIALS

Most artificial teeth are made of air-fired or vacuum fired porcelain, acrylic resin or a combination of acrylic resin and metal occlusal surface.

Porcelain Teeth

In anterior teeth, metal pins are embedded into porcelain for mechanical retention in denture base. In posterior teeth, diatoric holes are present in the ridge lap which

when filled with denture base resin retains teeth in denture base.

Advantages

- Wear is clinically insignificant.
- Maintain comminution efficiency for years.
- Better retention of surface polish and finishing.

Disadvantages

- Cause dangerous abrasion to opposing gold crowns and natural teeth.
- Have sharp impact sound.
- Potential for marginal staining due to capillary leakage.
- Chipping of teeth.
- Difficulty in restoring surface polish after grinding.
- Cannot be used in cases where available space is minimal.

Resin Teeth

Advantages

- Natural appearance and sound.
- Ease of adjustment.
- Resistance to breaking and chipping of teeth.
- Capability to bond to most denture base resins.

Disadvantages

- Less resistance to wear
- Tendency to dull in appearance during use as a result of loss of surface lustre.
- Care should be taken when polishing the denture to prevent undesirable modifications in tooth contour.

Metal Insert Teeth

They are acrylic teeth with metal occlusal surface

Advantages

- Improved wear resistance
- Improved masticatory efficiency
- Does not produce as much sound as the porcelain teeth

Disadvantages

- Increased cost
- Not as aesthetically acceptable as other teeth

TYPES OF TEETH ACCORDING TO CUSPAL ANGULATION

The cuspal inclines for posterior teeth depend on the plan or scheme of occlusion selected by the dentist. The commonly used cuspal inclinations are 33°, 20° and 0°. The inclination is measured as the angle formed by the mesial slope of the mesiobuccal cusp of mandibular molar with the horizontal.

33° Teeth

They provide maximum opportunity for a fully balanced occlusion. However, the final effective height of the cusp for a given patient depends on the way the teeth are tipped and on the interrelation of the other factors of occlusion.

20° Teeth

They are semi anatomic in form. They are wider buccolingually than corresponding 33° teeth. They provide less cusp height with which to develop balancing contacts in eccentric jaw positions than 33° teeth.

0° Teeth

They are also called as non-anatomical/monoplane teeth. They are advisable when only a centric record is being transferred from the patient to the articulator and no effort is directed to establishing a cross-arch balanced occlusion. They are also indicated in cases where stress to the underlying bone is to be reduced.

Advantages of Anatomic Teeth

1. They are considered more efficient in cutting of food, thereby reducing the forces that are directed at the support during masticatory movements.
2. They can be arranged in balanced occlusion in the eccentric jaw positions.

3. When the cusps are making contact in the fossae at the correct vertical dimension of occlusion with the jaws in vertical relation, the position is comfortable. This position is a definite point of return, as through proprioception the jaws will return to this position.
4. They look more like natural teeth and therefore, are acceptable esthetically.
5. The contours are more like natural teeth, therefore they will be more compatible with the surrounding oral environment.
6. An attempted occlusion without cusps is disorganised because occlusion has depth; it is not a sudden closure of flat surfaces.

Advantages of Monoplane Teeth

1. When teeth are contacting in non-masticatory movements as in bruxism, the flat polished surfaces offer less resistance, therefore less force is directed to the support.
2. In cases of resorbed ridges, dislodgement by horizontal or torque forces can occur. Monoplane teeth offer less resistance to these forces.
3. These teeth will allow a greater range of movement, which is necessary in patients who do not provide a static jaw relation.
4. When neuro-muscular control is uncoordinated, the jaw relation records are not repeatable and cusp tooth cannot be balanced. Hence, monoplane teeth are indicated.
5. In Diabetic patients, where underlying bone is vulnerable to damage, these teeth are indicated.

Limitations of Anatomic Tooth Forms

1. The use of an adjustable articulator is mandatory.
2. Mesiodistal interlocking will not permit settling of the base without horizontal forces developing.
3. Harmonious balanced occlusion is lost when settling occurs.
4. The bases need prompt and frequent relining to keep the occlusion stable and balanced.
5. The presence of cusps generates more horizontal force during function.

Drawbacks of Non-anatomic Teeth

1. They occlude in only two dimensions (Length and width) but the mandible has an accurate three-dimensional movement due to its condylar behaviour.
2. The vertical component present in mastication and non-functional movements is not provided for. So this form looses shearing efficiency.
3. Bilateral and protrusive balance is not possible with a purely flat occlusion. Non-anatomic teeth set on inclines for balance require as much concern as anatomic for jaw movements.
4. The flat teeth do not function efficiently unless the occlusal surface provides cutting ridges and generous spillways.
5. They cannot be corrected by much occlusal grinding without impairing their efficiency.
6. Non-anatomic teeth appear dull and unnatural to some patients, which may create a psychological problem concerning function.

APPLICATION OF DENTOGENIC CONCEPT

According to glossary of prosthodontic terms *'denture esthetics'* is defined as "the cosmetic effect produced by a dental prosthesis which affects the desirable beauty, charm, attractiveness, character and dignity of the individual. *Dentogenics* means the art, practice and techniques used to achieve the esthetic goal in dentistry. *Frush and Fischer* advocated the concept in 1955. In prosthodontic practice the word dentogenics seeks to describe only such a denture as is "eminently suitable" in that, for the wearer the denture adds to the person's charm, character, dignity or beauty in fully expressive smile. The vital factors of dentogenics are *sex, personality and age.*

History

Origin of Dentogenics

In 1952, Frush met Wilhelm Zech during his visit to Zurich, Switzerland in whose work Frush became extremely interested. Wilhelm Zech was a master sculptor quite successful in his chosen art who began to carve teeth for his father who was a dentist. Zech's

approach was that teeth were instruments of personality and projectors of vitality rather than just geometric designs. As early as 1936 Zech experimented with molding, spacing and arrangement of teeth in artificial dentures for his father with an artist's concept of what belonged in a living human's mouth. Zech changed the standard ovoid, square, and tapering concepts and added artistic irregularity of surface, unusual proximal formation, vigorous ridges and subtle body interpretations. Zech's work inspired Frush to take new look at dental prosthetics.

Interpretation of Sex Factor in Dentogenic Restorations

Just as the sculptor, with his hammer and chisel, can create the beautiful feminine image or the masculine form, thus can the skilled dentist and technician together create the same flow of masculine or feminine lines in the denture.

Expression of Feminine Characteristics

"From her fingertips to her smile... A woman is feminine."

An excellent beginning is to select initially a mold which expresses softer anatomic characteristics or one which is highly adaptable to being shaped and formed into a delicate type of tooth by certain grinding procedures. The interpretation of the femininity will keep to the spherical form instead of circular so as to identify the third dimension. The basic feminine form should be harmonized with the individual patient. The individual interpretation of femininity in dentogenics is accomplished by definite grinding procedures where the incisal edges must follow a curve rather than a straight line.

Expression of Masculine Characteristics

"From his fists to his mouth... A man is masculine."

- A basic tooth form which expresses masculine characteristics shows vigour, boldness and hardness.
- The basic masculine form of the tooth should be harmonized with the individual patient.

The Third Dimension—Depth Grinding

The third dimension gives the effect of realism. The third dimension for women is spheroidal shape and for men is cuboidal shape. Central incisors are the widest, almost always the longest and therefore the most noticeable of the six anterior teeth. The depth grinding is done on the mesial and the distal surface of the central incisor. With a soft stone, the mesial-labial and the distal-labial line angle of the central incisor is ground in a definite and flat cut, following the same curve as the contour of the tooth in order to move the deepest visible point of tooth further lingually. A flat thin narrow tooth is delicate looking and fits delicate women (little depth grinding). A thick, "bony", big sized tooth, heavily carved on its labial face, is vigorous and to be used exclusively for men (rather severe depth grinding). For average patient, a healthy woman or a less vigorous man, the depth grinding will be average between delicate and vigorous.

Interpretation of Personality Factor in Dentogenic Restorations

We should be concerned with the personality of a patient when fabricating a denture because this is our best measure of his priceless individuality and the most reliable source of knowledge by which we may express his dignity through prosthodontic methods. The comprehensive use of personality depends upon our manipulation of tooth shapes (molds), tooth colour, tooth position and the matrix (visible denture base) of these teeth. The precise prosthodontic application of the word personality is put in three divisions of personality spectrum.

a. *Delicate:* Meaning fragile, frail, the opposite of robust.
b. *Medium pleasing:* Meaning normal, moderately robust, healthy and of intelligent appearance.
c. *Vigorous:* Meaning the opposite of delicate; hard and aggressive in appearance.

In the course of normal social activity, the smile is the primary objective personality of a human being.

Role of Individual Teeth in Personality Interpretation

The central incisors contribute to the desired strength and action of the smile. The lateral incisors, being subordinated in position to the central incisors, convey the hardness or softness, the aggressiveness or the submissiveness, the vigorous tendency or the delicate

tendency of the patient. The cuspids must dominate the lateral incisors in colour, form and position and their treatment conveys either a strong pleasant, modern accent or an ugly primitive accent of the smile. Like wise, the dentist has the possibility of conceiving his own aesthetic theme for that smile, with consideration for the individuality and personality of his patient and projecting it in the smile.

Interpretation of Age Factor in Dentogenics

"There is beauty in age as well as in youth, but in fact age has the edge and that is dignity".

Management of Age Factor

In early youth – Mamelon formations on the incisal edges of permanent incisors is prominent. Young tooth convey the brilliance of recent birth by the unabraded bluish incisal edge and unworn depth of incisal enamel. As life progresses the adolescent quality of the tissues disappears and simultaneously the complete coronal portion of tooth comes into view and the teeth have arrived at their terminal eruption position. This progressively leads to abrasion and attrition. Subsequently the pigments released from the pulp get deposited in the organic matrix of the dentine giving it a darker shade in old age. The prosthodontist should help the patient to maintain a favourable relationship between his chronologic life line and his physiologic mouth condition line.

Age in the Artificial Tooth

It is routine first to consider light shades for young people and darker shades for older ones. Age in the artificial tooth must also be accompanied by mould refinement. In the artificial tooth, we may reflect the appropriate age effects by such means as grinding the incisal edges and removing the incisal enamel at such an inclination and to such depth as to convey reality to the composition. The sharp tip of cuspid suggests youth and as age increases it should be judiciously shaped, not abruptly horizontally flattened but artistically ground so as to imply abrasion against opposing teeth. The erosion imparted to the artificial tooth by careful grinding and polishing very effectively, conveys the illusion of vigour and advanced age. A condition common in natural teeth is the diastema. It is more commonly present in the mouth of the adult in advancing years, because of drifting of teeth resulting from premature loss of permanent teeth.

There are no definite guidelines for selection of teeth, but it depends on the type of patient and the condition of the supporting tissues. Hence, the selection and modification of teeth is the responsibility of the dentist, which he acquires through knowledge and experience.

SELF-HELP QUESTIONS

1. What are the factors, which influence selection of anterior teeth?
2. What are the factors, which influence selection of posterior teeth?
3. How does pre-extraction photographs aid in selection of teeth?
4. What are anatomic teeth?
5. What are non-anatomic teeth?
6. What are the synonyms for non-anatomic teeth?
7. Mention the indications for the use of non-anatomic teeth.
8. What are the advantages of anatomic and non-anatomic teeth?
9. What is dentogenic concept?
10. What is squint test?
11. Differentiate between acrylic and porcelain teeth
12. What significance do Hue, Chrome and Saturation have in relation to selection of artificial teeth?
13. What are the guidelines to be followed in selection of shade of the teeth?
14. What is the mode of retention of porcelain teeth to acrylic denture base?
15. Mention the mode of retention of acrylic teeth to acrylic denture base.
16. What are the drawbacks of porcelain teeth?
17. What are the drawbacks of acrylic teeth?
18. Mention the advantages of porcelain teeth.
19. Mention the advantages of acrylic teeth.
20. What is the significance of using metal insert teeth?
21. What depicts the cuspal angulation?

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CHAPTER 12

Principles of Arrangement of Teeth

DEFINITION

In Prosthodontics, the term "arrangement" would refer to a procedure of locating, tilting, rotating and spacing artificial tooth/teeth in relation to the plane of reference and to each other with the objective of creating a natural appeal and based on biomechanical requirements of complete denture treatment.

PRINCIPLES OF ARRANGEMENT OF MAXILLARY ANTERIOR TEETH

1. **General position:** The general position of each tooth is such that the imaginary root passes through restored ridge contour of maxillary foundation.
2. **Relation of tooth to the frontal plane (Fig. 12.1):**
   a. Central incisor should have slight labial inclination.
   b. Lateral incisor reveals a little more/relatively more labial inclination compared to central incisor revealed by cervical depression of the tooth.
   c. Canine is located in upright manner with the cervical third of the tooth revealed in a bold manner.

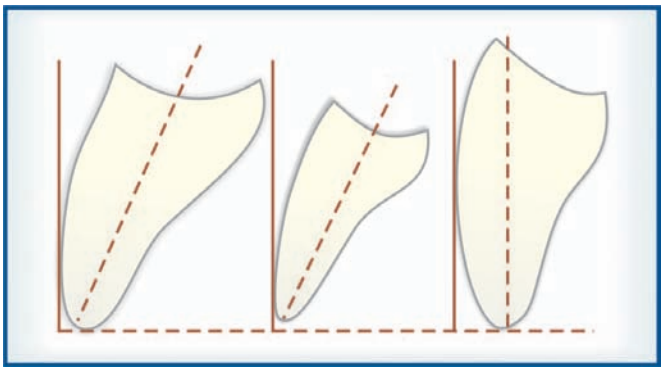

FIGURE 12.1: Relative position of maxillary anterior teeth to frontal plane

3. **Relation of tooth to clinical midline (Fig. 12.2):**
   a. Central incisor reveals very slight mesial inclination.
   b. Lateral incisor shows relatively more mesial inclination than central incisor.
   c. Canine is placed in an upright manner.
4. **Relation of incisal edge to mid-sagittal plane:**
   a. Central incisor reveals an angle little less than 90° to the sagittal plane.

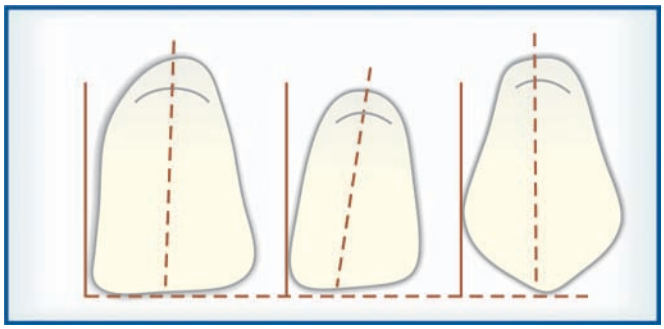

FIGURE 12.2: Relative position of maxillary anterior teeth to clinical midline

   b. Lateral incisor reveals an angle of 30° to the sagittal plane.
   c. Canine reveals an angle of 45° to sagittal plane.
5. **Relation of incisal edge to occlusal plane (Fig. 12.3):**
   a. Central incisor is in contact with the occlusal plane.
   b. Lateral incisor remains 0.5-1 mm away from the occlusal plane.
   c. Canine tips remain in contact with the occlusal plane.

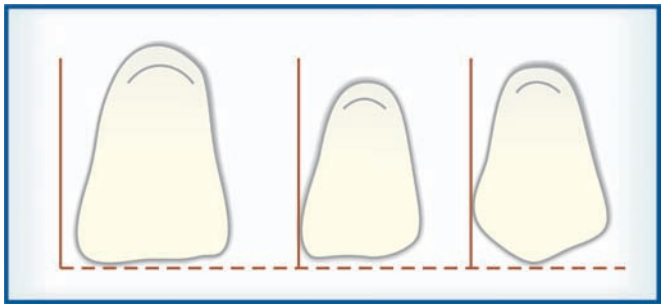

FIGURE 12.3: Relative position of incisal edge of maxillary anterior teeth to occlusal plane

APPLICATION OF DENTOGENIC CONCEPT

Positioning of the teeth is necessary in further conveying sex characteristics to a denture. To enable us to simplify and clarify this point we will consider some of the various positions of the six maxillary anterior teeth.

Central Incisor

The positions of the two central incisors set in perfect symmetry are the starting positions for conventional tooth setups. By bringing the incisal edge of one central incisor anteriorly, we create a position which is evident but harsh.

If we move one of the central incisors from the starting position out at cervical end, leaving the incisal edges together, we can create a harmonious lively position. The more vigorous position is to move one central incisor bodily anterior to the other. Combined rotation of the two central incisors with the distal surface forward with one incisor depressed at the cervical end and the other depressed incisally. These three positions can be treated either very softly or more vigorously. However, the softer positioning would be more favorable for women and the vigorous more favorable for men.

Lateral Incisors

They being generally narrower and shorter than the central incisors are less apparent; however they can impart a quality of softness or hardness to the arrangement by their positions.

a. The lateral incisor rotated to show its mesial surface whether slightly overlapping the central incisor or not, gives softness or youthful coquettishness of the smile.
b. By rotating the lateral incisors mesially the effect of the smile is hardened.

Cuspid Teeth

The three positions for cuspids adopted are:

a. Out at the cervical end, as seen from front.
b. Rotated to show the mesial surface.
c. Almost vertical as seen from the side.

It is evident that a prominent cuspid eminence gives to the cuspids greater importance and therefore gives to the smile a vigorous appearance more suitable to the masculine sex.

PRINCIPLES OF ARRANGEMENT OF MANDIBULAR ANTERIOR TEETH

Central and lateral incisors are placed upright. Canines are mesially tilted-sleeping canines (Fig. 12.4).

The mandibular teeth are placed in a mesial relation to the maxillary teeth (Fig. 12.5).

There should be a vertical overlap of 2-3 mm and a horizontal overlap of 1-2 mm (Fig. 12.6).

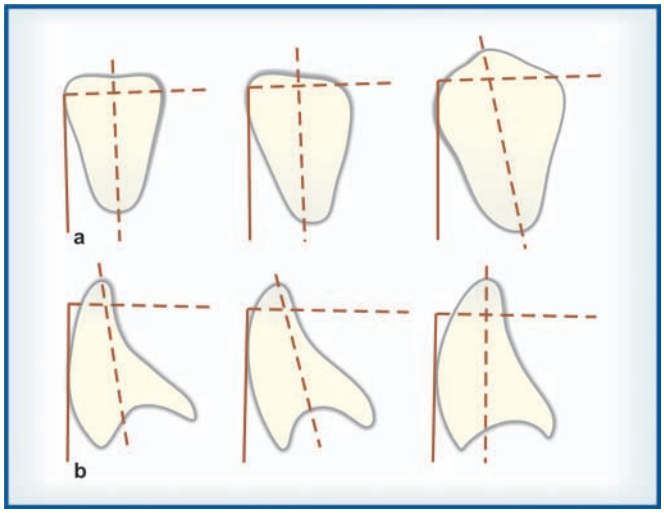

FIGURE 12.4: Relative position of mandibular anterior teeth to (a) Occlusal plane and midline. (b) Frontal plane

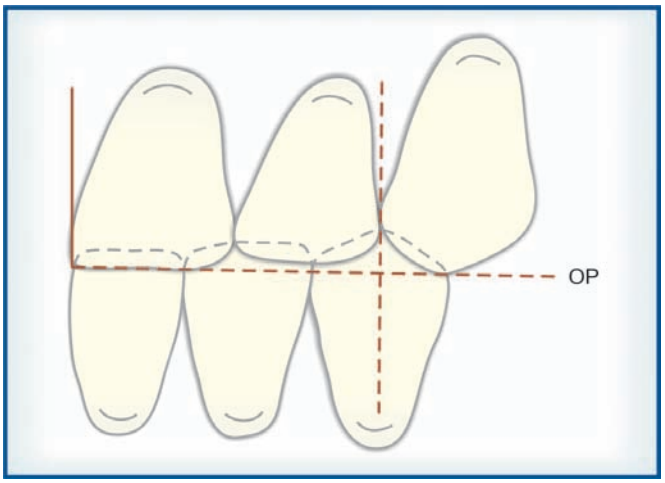

FIGURE 12.5: Relative position of maxillary anterior teeth to mandibular anterior teeth

Arrangement of Posterior Teeth

It is based on the following principles:

1. General position of teeth.
2. Buccopalatal relation.
3. Relation to clinical midline.
4. Relation to occlusal plane.

It is governed by *mean crest line.* All the mandibular posterior teeth should be located in a position, so that mesiodistal grooves or central grooves of all teeth joined together should coincide with average crest line of mandibular foundation.

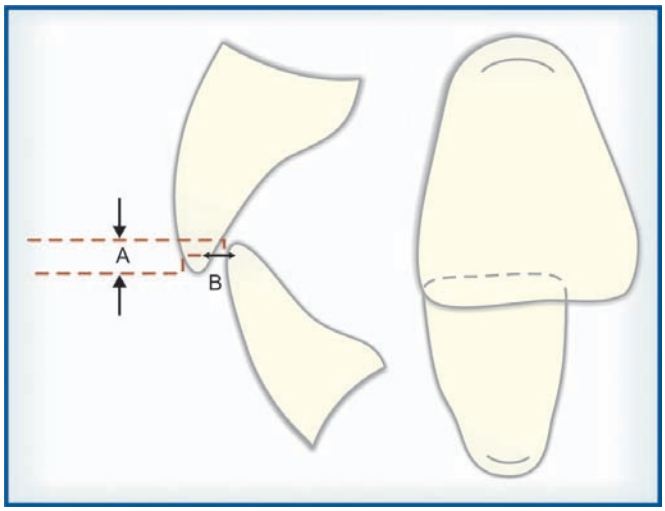

FIGURE 12.6: Relative position of maxillary anterior teeth to mandibular anterior teeth. (A) Overbite (B) Overjet

Maxillary First Premolar

It should be placed upright with the tip of buccal cusp contacting the occlusal plane. Palatal cusp is rudimentary/ nonfunctional (Fig. 12.7).

Maxillary Second Premolar

It should be placed upright with buccal and palatal cusp tip contacting the occlusal plane (Fig. 12.7).

Maxillary First Molar

It is inclined buccally in buccopalatal relation and inclined buccodistally in clinical midline relation with the mesiopalatal cusp in contact with occlusal plane (Fig. 12.7).

Maxillary Second Molar

It is inclined buccally in buccopalatal relation inclined distally in clinical midline relation. None of the cusps contact the occlusal plane (Fig. 12.7).

The mandibular teeth are placed in a mesial relation to the maxillary teeth. The maxillary teeth should overlap the mandibular teeth and the mesio-buccal cusp of the maxillary first molar should coincide with the mesiobuccal groove of the mandibular first molar, which forms the key of occlusion (Figs 12.8 and 12.9).

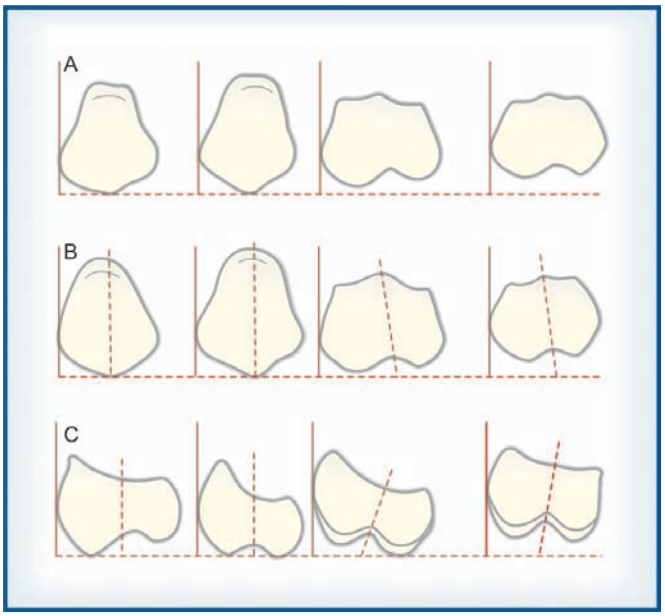

FIGURE 12.7: Relative position of maxillary posterior teeth to (A) Occlusal plane. (B) Clinical midline. (C) Frontal plane

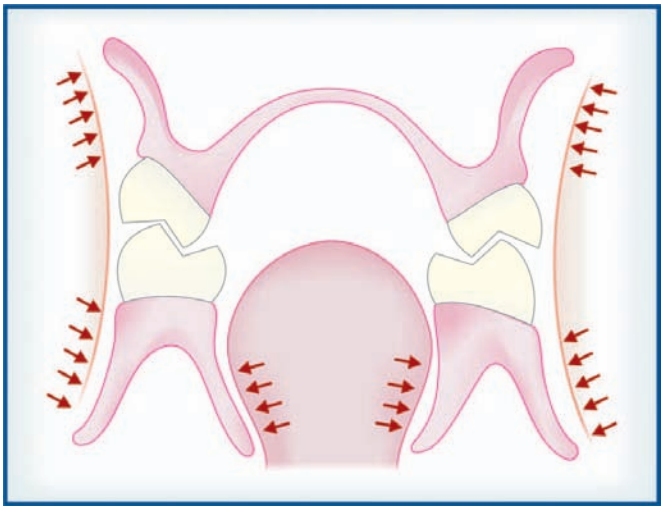

FIGURE 12.8: Relative position of mandibular posterior teeth to maxillary posterior teeth

Compensating Curves

It is a biomechanical requirement. It compensates for the lateral and posterior space created on protrusive and lateral excursions for the stability and harmony of dentures.

1. Lateral curve: It is called the Monson's curve (Fig. 12.9)
2. Antero-posterior curve: It is called the curve of Spee (Fig. 12.9)

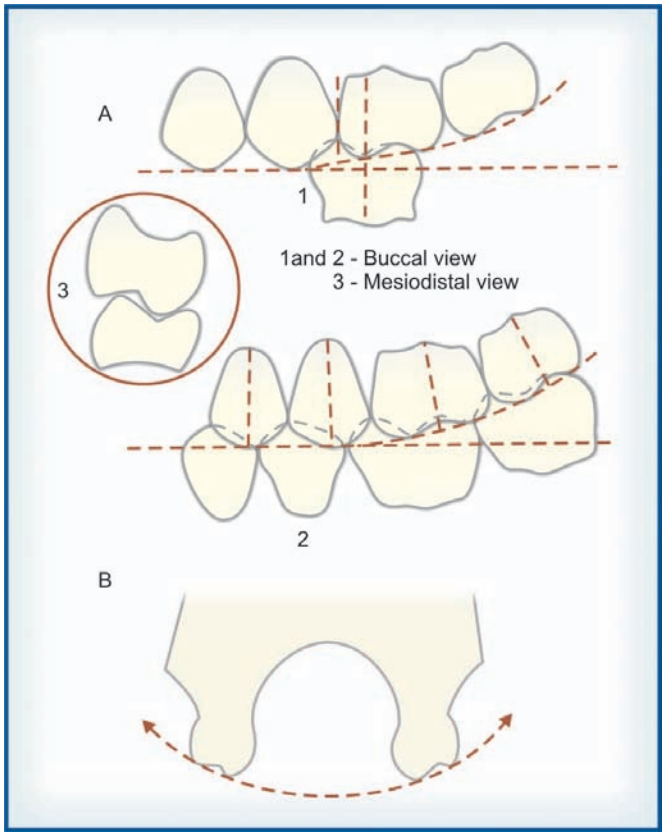

FIGURE 12.9: Relation of maxillary posterior teeth to mandibular posterior teeth with compensating curves. (A) Antero-posterior curve. (B) Lateral curve

Arrangement of Noncuspal Teeth

It is indicated in cases of malrelated jaws, crossbites, resorbed ridges and uncontrolled jaw movements for whom it is difficult to obtain a valid centric relation record.

The mid crestal line of the lower ridge is marked over the mandibular occlusal rim. The maxillary teeth are arranged such that their centers lie approximately over the line scribed on the mandibular occlusal rim. The mandibular teeth are then arranged to occlude with the maxillary teeth. In normal jaw relation, there will be buccal overjet of the upper teeth. However, in some situations in which there is a small upper arch and a large lower arch, it is possible to position the posterior teeth in an end-end occlusal surface relationship. Additionally if the upper and lower space available for arranging teeth antero-posteriorly is mismatched, it is possible to arrange premolars to oppose molars, since there is no interdigitation of cusps.

It is advisable when using 0°posterior teeth to select or modify the canines so that they tend to have a blunt incisal edge rather than a pointed one. Usually, optimal contact and/embrasure between a canine and a 0°premolar can be obtained more easily with a somewhat blunted canine than with a pointed one. It is important to pay special attention to see that there is good occlusal contact in the set up when viewed from different aspects, especially the lingual aspect.

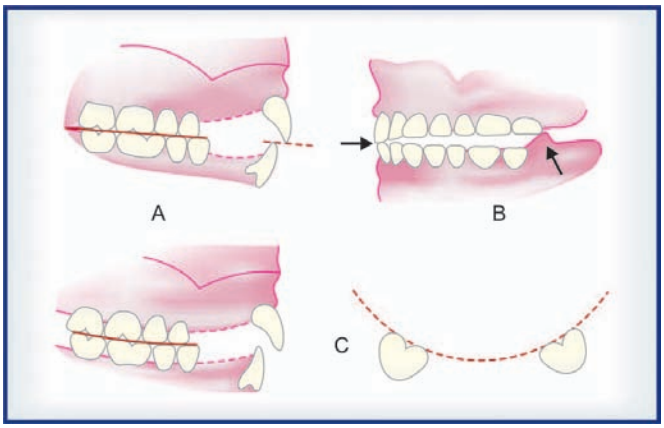

FIGURE 12.10: Arrangement of non-cuspal teeth (A) Flat occlusal plane (B) Balancing ramp (C) With compensating curves

Arrangement of Teeth in Abnormal Ridge

Mandibular Retrusion

Anterior teeth

The management of such situations can be attempted in any of the following ways:

1. If the retrusion is not too extreme, the simplest way is to select the lower anterior teeth of a narrower mesiodistal width and try to achieve the normal canine relationship.
2. If esthetics permits, a little crowding of the lower anterior teeth by overlapping may solve the problem well.
3. Another solution, which is effective at times, is creating slight spaces between the upper anterior teeth to attain normal canine relations. However, such a procedure is esthetically limited.
4. In situations where the discrepancy is not too great, grinding of the distal surface of lower canine is sufficient to restore the normal canine relationship.

This procedure can however be extended to all of the lower anterior teeth by grinding their mesial and distal surfaces to narrow their total mesio-distal width. But this grinding should be done very judiciously so as not to mar the esthetics of the anatomic forms of the teeth.

In situations where the discrepancy is excessive and cannot be managed by the manipulation and modification of the lower anterior teeth, the lower anterior teeth must be left as they are and the lower first premolars must be eliminated from the dental arch. If the distal incline of the lower canine is entirely posterior to the distal surface of the upper canine tooth, the situation is ideally selected for such a procedure, and a satisfactory posterior setup can be developed.

Posterior Teeth

1. If the discrepancy is minimal, the upper teeth are moved slightly in a palatal direction to provide a working occlusal contact with the lower teeth.
2. If the upper arch is much wider than the lower, any of the following methods can be used:

a. The lower posterior teeth are correctly placed on the crest of the ridge. The upper teeth are then arranged so that they occlude with the lower teeth. Then the buccal contours are built on the upper teeth in wax, which is later replaced by tooth coloured acrylic resin to fulfill esthetic requirements and to provide support for cheek.

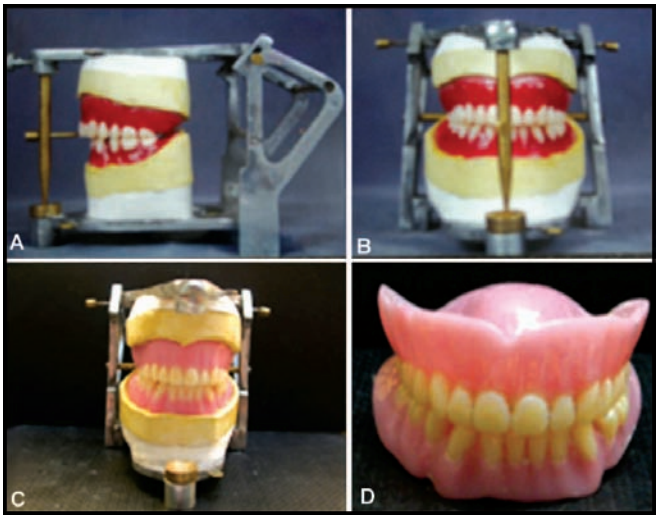

FIGURE 12.11: Arrangement of teeth in retrognathic mandible

b. The upper posterior teeth are arranged first to meet requirements of esthetics. The lower teeth are arranged on the crest of the ridge. In order to establish a functional occlusal contact between the upper and lower teeth, wax is added on the palatal aspect of the upper posterior teeth. This wax is later replaced by tooth-coloured acrylic resin.

Arrangement of Teeth in Prognathic Mandible

Anterior Teeth

1. If the ridges are in edge-to-edge relation the incisal edges of upper and lower anteriors will also meet in edge-to-edge relation. This can be done by:
   a. Inclining the upper anterior teeth labially
   b. Inclining lower anterior teeth lingually
2. In extreme protrusion of the mandible, a negative or reverse horizontal overlap can be established;
   a. Use slightly larger lower tooth mold than that suggested for normal use with upper teeth, which will compensate for greater lower arch width.
   b. Use a slight overlapping arrangement on the upper anterior teeth, if esthetically acceptable which will automatically narrow the lower arch space and may eliminate spacing.
   c. Create some space between the lower anterior teeth. This is especially true when the lower jaw is already prominent and patients with this condition must have had some spacing between their natural mandibular teeth.

Arrangement of Posterior Teeth

Arrangement for posterior crossbite relationship will depend on the severity of its deviation from normal.

One of the following three procedures can be used:

a. If the difference in size is slight and the upper ridge is well formed, the upper posterior teeth can be set slightly buccal to the crest of the upper ridge in such a way that correctly placed mandibular posterior teeth can make effective occlusal contacts with their antagonists.
b. Non-anatomic teeth may be used. These teeth allow more freedom in their buccolingual placement and still provide an adequate occlusal contact between upper and lower teeth.

c. The mandibular teeth can be placed buccal to the maxillary teeth. After the arrangement of teeth, the buccal aspect of the tooth should be trimmed and polished in order to decrease the occlusal table.
d. Maxillary first premolar may be eliminated.

Figure 12.12: Arrangement of teeth in prognathic mandible

SELF-HELP QUESTIONS

1. Define teeth arrangement.
2. Mention the principles of arrangement of teeth.
3. Define overjet.
4. Define overbite.
5. What is the ideal overjet?
6. What is the optimal overbite?
7. What is buccal corridor? What is its importance?
8. Mention the reference planes for the arrangement of teeth.
9. What is compensating curve?
10. What are the lateral curves?
11. What is curve of Wilson?
12. What is curve of Monson?
13. What is curve of spee?
14. What is Christensen's phenomenon?
15. What is the need for incorporation of compensating curve?

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CHAPTER

13

Try-in Procedure in Complete Denture Treatment

INTRODUCTION

Try-in procedure in complete denture prosthodontic treatment refers to the insertion of trial waxed dentures in the mouth of the patient for assessing the success of treatment plan and for verification of the records made during the treatment procedure. Try-in procedure offers yet another chance for communication with the patient. The operator would better know the psychological reactions of the patient in respect of accepting his/her responsibility and attitude of the patient towards treatment at this stage. At the same time, even the mistakes that may have occurred during clinical procedures would be better understood and corrected.

OBJECTIVES OF TRY-IN PROCEDURE

- To observe the appearance and reaction of the patient in respect of selected teeth for their size, shape and arrangement. Any modification required is to be made at this stage and patient's acceptance should be considered.
- To examine the contours of trial dentures in relation to surrounding tissue like lip support, buccal support and adequate tongue space.
- To make any additional interocclusal records for further adjustments to the articulator if required.
- To evaluate the location of plane of occlusion and freeway space.
- To check centric and eccentric occlusion.

EVALUATION OF TRY-IN PROCEDURES

Evaluation of Maxillary and Mandibular Trial Dentures Individually

The peripheral outline is checked to ensure that it is within the functional limit.

Buccal and Labial Periphery

The buccal and labial periphery is checked by holding the denture in place with light pressure on the occlusal surface of the teeth. The cheek is then moved on either side alternately in upward and inward direction for the upper denture and in a downward and inward direction for the lower denture, thus simulating the action it makes when chewing. If the denture rises from the ridge, it indicates that the periphery is beyond the functional limit. Similar movement is done for the lip.

Lingual Periphery

The lingual periphery is evaluated by placing the denture in place with light pressure and instructing the patient to protrude the tongue sufficiently to moisten the lips. If the denture rises at the back, it is beyond the functional limit in the disto-lingual region. On the contrary, if the anterior part of the denture rises when the patient places the tip of the tongue as far back on the palate as possible, it indicates overriding of function in the anterior region.

Posterior Extension

The posterior extension of the maxillary denture is checked by delineating the hamular notch and the vibrating line. This is transferred to the denture. The posterior limit of the mandibular denture is checked by dropping a perpendicular from the base of the retromolar pad. If the denture is not extending upto functional limit, as shown by the gap between it and the functional position of the surrounding mucous membrane, the denture has to be replaced on the cast and checked. If the denture extends to the fullest extent, the inaccuracy is attributed to the impression procedure, which must be remade before proceeding further. An alternative is to proceed to the final stage and then reline the denture to rectify the peripheral error.

Retention

Although the *retention* is said to depend on psychological acceptance and adaptability, retention has to be ensured. It is checked by seating the denture on the denture-bearing area and then attempting to remove the denture at right angles to the occlusal plane. Load is then applied upwards and outwards in the region of the anterior teeth to check for retention.

Stability

Stability under occlusal load is used to determine the favourable distribution of occlusal stresses. Apply pressure lightly with finger in the premolar-molar region at right angles to the occlusal surface on each side alternately. If pressure on one side causes the denture to tilt and rise from the ridge on the other side, it indicates that the teeth on the side of pressure are set too far outside the ridge. It may also indicate lack of adaptation of the base on the side being loaded or the flanges on the side, which rises, are not extending upto functional limit.

Tongue Space

Tongue space is checked by instructing the patient to relax and raise the tongue after seating the denture on the ridge. If the tongue is cramped, the denture will begin to rise immediately. This immediate reaction of the denture tends to differentiate the movement caused by a cramped tongue from the movement caused by the lingual flange not extending upto functional limit. Movement due to the latter does not occur until the tongue has risen some distance. If the tongue is cramped by the denture, lateral pressure will be exerted producing instability when the tongue moves. The causes of lack of tongue space are:

- Posterior teeth arranged far too lingually
- Molar teeth which are broad lingually
- Teeth inclined lingually.

Height of the Lower Occlusal Plane

The height of the lower occlusal plane should be very slightly below the bulk of the tongue, so that the tongue performs the majority of its movements above the denture and thus tends to prevent the denture from rising. The patient should be instructed to relax and place the tip of the tongue comfortably and without strain behind the lower front teeth which is the normal relaxed position of the tongue and then open his mouth without moving his tongue. If the height of the occlusal plane is correct, the tongue will be seen to be on top of the lingual cusp of the lower posterior teeth. If the lower denture still tends to rise unduly after the lingual periphery has been checked and adequate lateral space has been provided, it may be necessary to rearrange the teeth completely lowering the occlusal plane. This may be especially necessary in those patients having low tongue position. The height of the occlusal plane is also important for the reason being: The greater the height of the lower denture, the longer will be the lower anterior teeth and greater the surface exposed to the unfavorable pressure of the lower lip.

Evaluation of Trial Dentures Placed Together

Evaluation of appearance at the trial stage is more a matter of individual judgment and sometimes the patient's ideas.

Clinical Midline of the Face

The midline of maxillary and mandibular dentures should coincide. This is checked by standing in front of the patient.

Anterior Plane

This is also observed from the same position and any tendency for this plane to slope markedly up or down should be noted and corrected.

Shape of the Anterior Teeth

The shape of teeth in the trial denture should be rechecked to ensure its harmony with the facial form. This is also influenced by wax around the teeth and requires checking and altering before consulting the patient.

Size of Teeth

The size of teeth should be in accordance with the size of the face, arch form, visibility, and the canine and high lip line marked during the jaw relation procedure. Subtle irregularities during teeth arrangement may look more natural in some cases.

Shade of Teeth

The shade of teeth should be checked by keeping in mind that the shade is affected by the color and density of the surrounding wax which is entirely a different environment compared to acrylic in the finished denture.

Profile and Lip Form

The patient should be carefully examined for profile and excessively distended or unduly sunken lips. Removing wax from the labial flange or placing the teeth further palatally can correct excessive distension. If the lips are sunken and inverted, consideration should be given to rearrange the anterior teeth further forward.

Visibility of Teeth

The patient should be involved in conversation as the dentist observes. A smiling person usually reveals the upper teeth. If lower teeth are excessively visible, occlusal plane alteration or altering the lower teeth should be considered. It is always wise for the dentist to obtain the patient's approval of the appearance of trial dentures. It is also recommended that the patient should be accompanied by his or her relative for the approval of the appearance.

Evaluation of Maxillomandibular Relations

Vertical Jaw Relations

Strained appearance of the patient with closely-approximated lips indicates increased vertical dimension. Decreased vertical dimension will be associated with large freeway space and when the teeth are in occlusion, the lips will be seen to be pressed too firmly together with some loss of vermillion border. Replacing posterior teeth with wax blocks and establishing proper vertical height with suitable freeway space as a guide can correct vertical height. These record blocks should be chilled in cold water to resist overclosure due to occlusal load while registering the retruded contact position with registration paste.

Horizontal Jaw Relation

The mandibular denture should be held in position on the ridge and the patient should relax and close the teeth together gently and maintain them in occlusion while the examination is carried out. If the registration is accurate, the teeth will interdigitate in the mouth in exactly the same manner as they do on the articulator. But if the registration is wrong, the teeth will not interdigitate correctly and may even occlude cusp to cusp on one or both sides. The clinician must make quite certain that occlusion in the mouth is not due to movement of dentures on the ridges, tilting of either denture or lowering of the upper denture. This is best tested by instructing the patient to keep the teeth together and then trying to separate the posterior teeth by means of a thin spatula. This is carried out on either side alternately. The teeth should be brought into occlusion by using any registration aids which makes certain that the position of occlusion is correct or, if incorrect to ascertain the type of error i.e;

- Inaccurate centric relation recording
- Lateral deviation
- Premature contact.

Observation of the upper and lower mid-lines in relation to each other with the dentures on the articulator and then in the mouth will indicate a lateral deviation if present. When errors of occlusion are detected at this stage, they must be corrected by re-recording the position of occlusion.

Rerecording of Horizontal Relation

The posterior teeth in one of the trial dentures is replaced by soft wax which should occlude with the posterior teeth of the opposing trial denture without altering the vertical dimension as set on the articulator. The centric relation is correctly recorded by guiding the mandible. This results in impression of the teeth in the softened wax, which acts as a guide to transfer the corrected jaw relation record back on to the articulator.

PHONETICS

Phonetics is used as one of the aids for verifying the accuracy of denture base and the placement of teeth. It indicates proper placement of teeth. The use of *fricatives* acts as an aid in determining the proper position of maxillary incisors. When the patient says "five, fifty-five" maxillary incisors make contact with lower lip. If teeth are placed superiorly, lower lip contacts upper lip. If they are inclined lingually the lower lip will contact the labial surface instead of incisal edges. If they are inclined

labially, the lip will contact the lingual surface instead of the incisal edge.

Silverman's Closest Speaking Space

During pronunciation of sibilants like "z, s, ch", teeth will come close together but do not touch. Silverman's closest speaking space is used for determining proper vertical dimension. Clattering of teeth indicates excess vertical height. "S" resembles "Sh" or whistling sound when there is insufficient degree of jaw separation.

Defects in pronunciation of *linguodental sounds* or linguo-alveolar plosives "T, D" indicates placement of maxillary anterior teeth palatally. It can also be distorted due to increased thickness of the denture base in the anterior region.

Palatolingual sounds like "K & G" are also helpful. If the posterior border of maxillary denture is over-extended or excessively thick "K" will sound more like "kh" sound.

Interocclusal rest space is checked with help of pronunciation of "M". It is a valuable aid in placing the jaw at rest position.

The labial plosives "P", "B", "M" help in determining the correct degree of jaw separation. When the vertical dimension is too high, the patient will not be able to purse his lips together and consequently the articulation of these sounds may be distorted.

In addition to all these methods of rechecking during the trial stage, the dentist must constantly anticipate the thoughts and attitudes of the patient and interpret them. The patient approval at the end of this appointment is very important because any changes to be done should be accomplished before it is ready for the final fabrication.

SELF-HELP QUESTIONS

1. What is the importance of tryin procedure?
2. What are objectives of try-in procedure?
3. How do you evaluate the maxillary and mandibular waxed up denture for retention?
4. What role does phonetics play in evaluation of the trial waxed up denture?
5. What is the significance of Silverman's closest speaking space?
6. How should the stability of the waxed up denture be evaluated?
7. How do you check for the lingual periphery of the denture?
8. What is the significance of checking the level of mandibular occlusal plane?
9. What does the reduced tongue space indicate?
10. How do you correct the unacceptable vertical relation at the try in appointment?
11. What corrective measure will you undertake if centric occlusion does not coincide with centric relation at the tryin appointment?
12. Does centric occlusion coincide with centric relation in natural dentition?

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CHAPTER

14

Laboratory Procedures Following Try-in Procedure

INTRODUCTION

The clinical procedures that are accomplished should be supported by appropriate laboratory procedures for the success of complete denture treatment. Hence, knowledge about the basic procedures is mandatory which has been simplified in this chapter.

WAXING (WAX-UP)

It is defined as the contouring of the wax base of a trial denture into the desired form. The procedure of waxing involves contouring the wax on the trial denture to produce a denture base form that reproduces the contours of the original tissues in the dentulous mouth.

Waxing Procedure

Maxillary Trial Denture

Wax should be adapted onto the trial denture base to cover the necks of the teeth. Root prominences that are developed in the wax should blend into the peripheral border without producing additional thickness of the border. Slight depression/fossae should be carved between the root of the central incisor and canine. The gingival bulge above first premolar should be nonexistent and should increase gradually towards the molar. Carving a slight depression above the premolar extending it from the canine eminence posterior to the molar should highlight canine fossae. Gingival papillae are carved so that they will be convex mesiodistally and occlusogingivally in complete denture. Subtle gingival roll can be placed above anterior teeth. There should be sharp delineation between denture tooth and wax.

Mandibular Trial Denture

The buccal and lingual flanges should be waxed in such a way that it slopes towards the sulcus so that the buccinator and the tongue muscles on the labial surface brace the final denture. A small gingival bulge should be developed below the gingival margins of the four incisor teeth and canine eminence below each canine tooth. The gingival bulge should be convex in shape but extreme root prominence should not be present.

PREPARATION OF MOULD

Metal Flask

It is a metal case used in investing procedure. It also can be defined as, *a sectional metal case in which a sectional mould is made of artificial stone or dental plaster for the purpose of compressing and processing dentures* (Fig. 14.1).

FIGURES 14.1A to C: Dental flask (A) Lower chamber (B) Middle chamber (C) Lid

Flasking

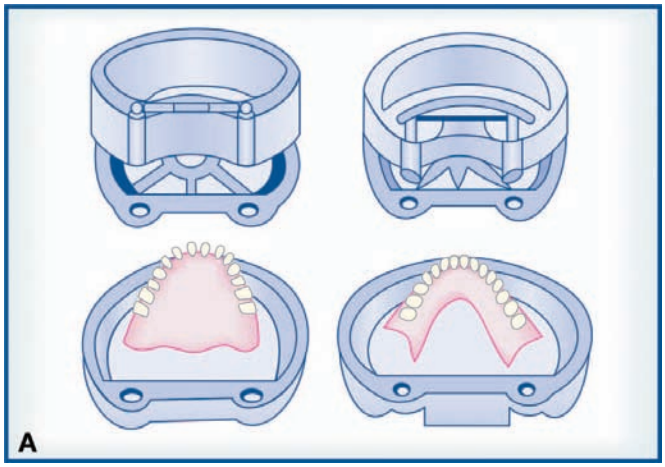
It is the process of investing the cast with the waxed denture in a flask to make a sectional mould used to form the acrylic resin denture base.

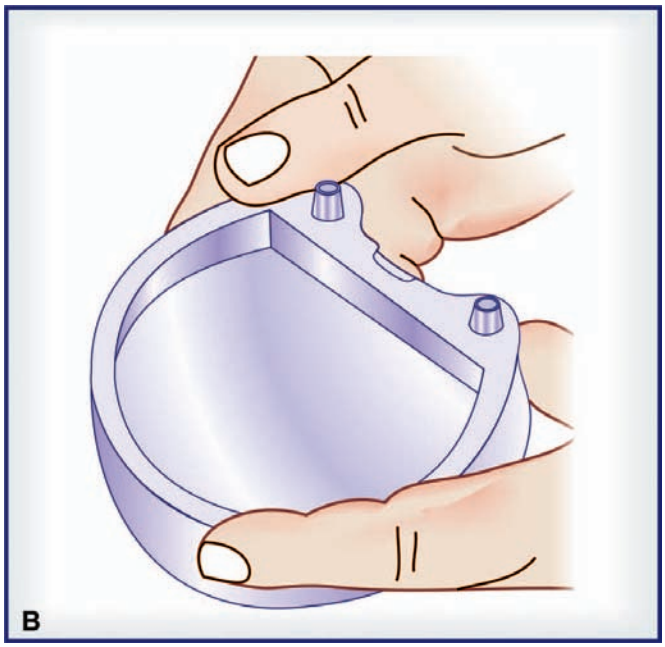
Procedure

Seal the waxed-up denture to the cast in occlusion. Lubricate the inner aspect of the flask and the cast. Waxed-up denture is invested in one section of the flask. A mix of plaster secures the cast with waxed-up denture in one section of the flask. The maxillary cast should be dipped anteriorly and the mandibular cast should be dipped posteriorly. Invested plaster should slant from the cast to the outer rim of the flask. When the second half of the flask is placed on the lower half, there should be metal-to-metal contact. Separating media is painted over the invested plaster in the lower half of the flask. A mix of dental stone is placed over the surface of the teeth in the invested trial denture, which is referred to as **coring**. A mix of dental plaster and dental stone or dental plaster is filled into the flask and the lid is closed. The flask is clamped till the investment material completely sets (Figs 14.2 and 14.3).

Wax Elimination

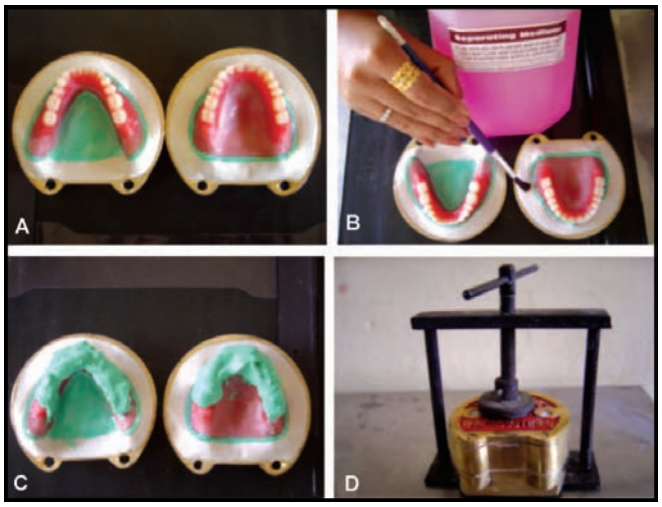
After the investment has set, the flask is placed in boiling water. Wax elimination requires softening and flushing



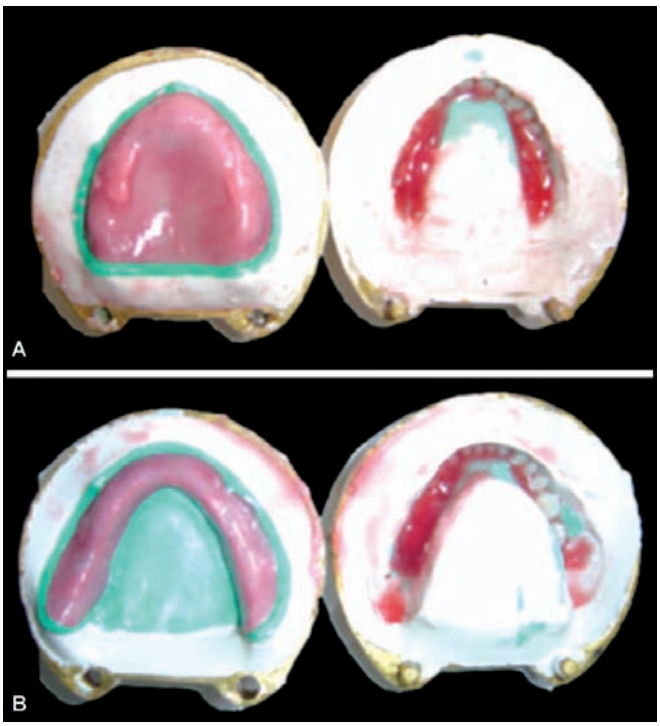


FIGURES 14.2A and B: Illustration of investing (flasking) procedure (A) Waxed-up denture in lower chamber of the flask (B) Final pour in flasking

out and not melting. Hence the dental flask should be immersed in boiling water for just 3-4 minutes. If the wax melts, the wax gets into the pores in the mold, which cannot be eliminated. The wax in the pores will prevent the complete wetting of the surface of investment material by tinfoil substitute leading to tenacious adherence of the investment material to the cured denture base. The two sections of the flasks are then flushed with detergent in boiling water followed by flushing with clean water. The water is allowed to drain by placing the halves of the flask upright and cooled (Figs 14.4 and 14.5).



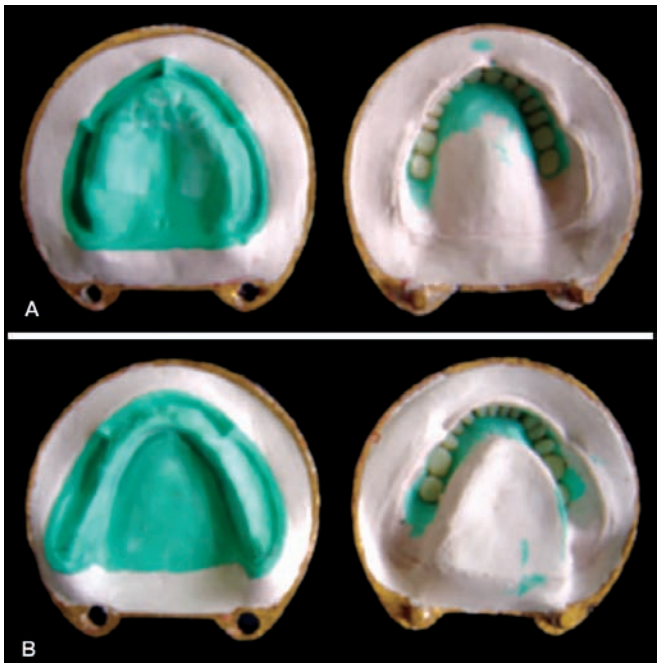
FIGURES 14.3A to D: Investing (Flasking) procedure (A) 1st pour (B) Application of separating media (C) Coring (D) Clamped flask



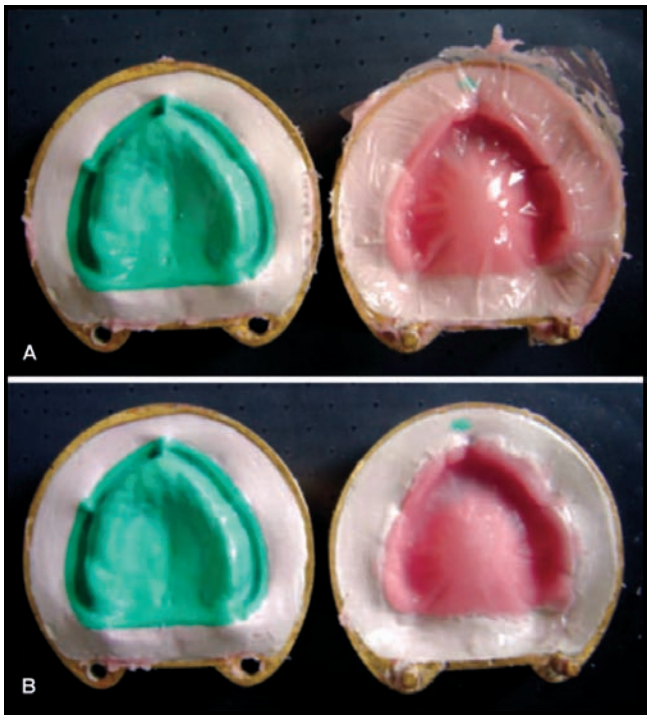
FIGURES 14.4A and B: Softened wax during wax elimination (A) Maxillary (B) Mandibular

Application of Tin Foil Substitute

Tin foil substitute is applied to the surface of the cast and the investment. Care should be taken to prevent painting on the tooth surface, failure of which will prevent bonding of teeth to denture base. Care should be



FIGURES 14.5A and B: Investment mould after wax elimination (A) Maxillary (B) Mandibular

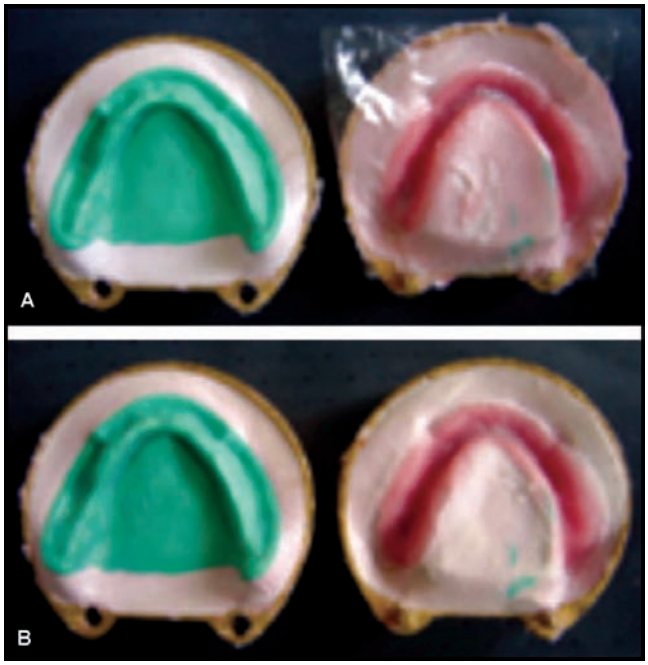


FIGURES 14.6A and B: Trial closure procedure for maxillary denture: (A) Extrusion of excess acrylic (B) Removal of extruded acrylic

emphasized to avoid dipping the brush directly into the main container to prevent contamination of the tinfoil substitute.

PACKING THE DENTURE BASE MATERIAL

The resin should be mixed in a clean jar and packed when it reaches the dough stage. Trial closures should be done till no flash is apparent on opening the flask. After the resin has reached the dough stage, it should be adapted to the mould with a cellophane sheet on it and closed slowly under a bench press to permit the flow of acrylic resin into the minute intricacies of the mold. The cellophane sheet should be moistened to make it stretchable and polyethylene sheet need not be moistened because it is stretchable. The mold should be completely filled and flash extruded during initial trial packing. Failure to fill the mold or under packing can result in a denture with porosity. Ideally, the flask should be allowed to bench cure overnight to avoid porosities (Figs 14.6 to 14.8).



FIGURES 14.7A and B: Trial closure procedure for mandibular denture (A) Extrusion of excess acrylic (B) Removal of extruded acrylic

FIGURE 14.8: Bench press

Acrylization

The denture can be cured by either *long curing cycle* or the *short curing cycle (Fig. 14.9)*.

Short Curing Cycle

The denture is placed in water at room temperature and the curing temperature is programmed to 74°C for 1½ hours followed by 100°C for one hour.

Long Curing Cycle

The curing temperature is programmed to 100°C for 8 hours.

FIGURE 14.9: Acrylizing unit

Recovery of the Denture (Deflasking)

After the denture has been cured, it is removed from the curing unit and allowed to bench cool. The denture is then ready for recovery from the investment mould. The denture should be retrieved along with the cast.

Laboratory Remount

The denture should be remounted on the articulator as dictated by the indices with sticky wax (Fig. 14.10). The incisal pin discrepancy should be noted. If the discrepancy is less than 2 mm, it is acceptable (Fig. 14.11). If the discrepancy is between 2-5 mm, occlusal correction can be accomplished. If the discrepancy is more than 5 mm, the entire treatment should be repeated. Articulating paper should be placed between the occluding surfaces of the teeth and the teeth tapped against each other. The bull's *eye* appearance (Figs 14.12 and 14.13) should be noted for modification. The "BULL" principle should be adopted which means that only the nonfunctional cusps should be modified (buccal cusps of maxillary denture and lingual cusps of mandibular denture). If the functional cups are indicated for modification, the opposing fossae should be modified.

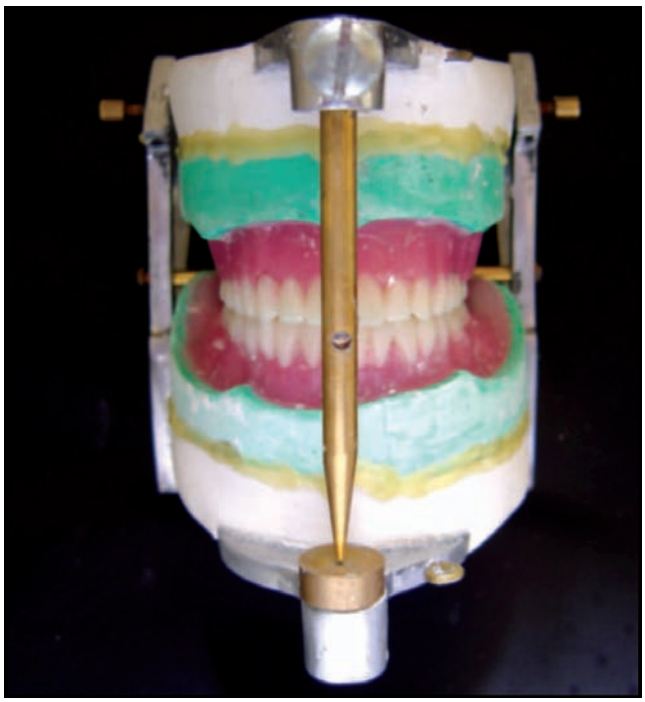


FIGURE 14.10: Denture reoriented on the articulator

FIGURE 14.11: Incisal pin relation to incisal table

FIGURE 14.12: Marking on teeth for selective grinding

Finishing and Polishing of Dentures

1. Remove excess with large acrylic bur on lathe (Figs 14.14 and 14.15).
2. Clean the surface of denture to remove dental stone plaster with a hand instrument.
3. Smooth the nonanatomical surfaces of denture using wet pumice on a cone or rag wheel. Use slow speed on lathe and keep the denture surface moist (Fig. 14.16).
4. Polish the resin around the teeth with soft brush wheel at slow speed.

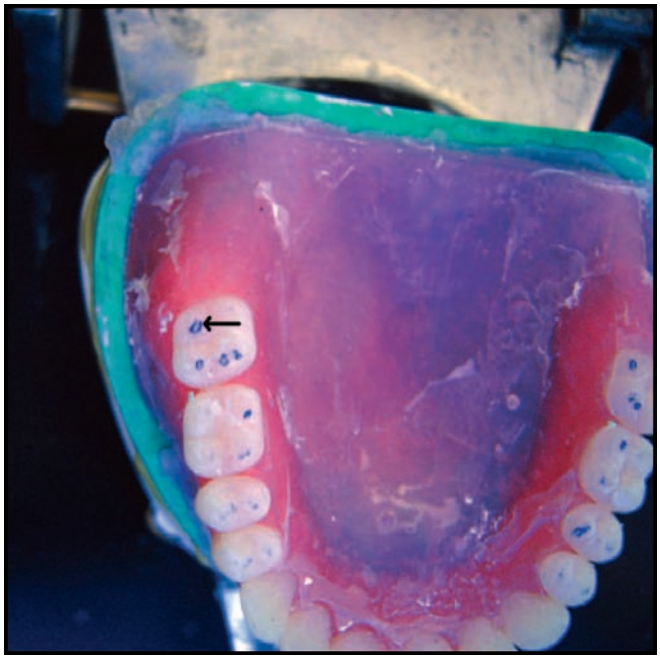


FIGURE 14.13: Bull's eye appearance

FIGURE 14.14: Trimming of the denture

5. Apply polishing compound on a buff or rag wheel and polish the dentures to a high gloss.

SELF-HELP QUESTIONS

1. What is the need for waxing and carving?
2. What are the methods of reproducing tissue morphology on wax?

FIGURE 14.15: Use of sandpaper

FIGURE 14.16: Denture polishing procedure

3. What is dental flask?
4. What are the parts of dental flask?
5. What is flasking?
6. Which material is used for occlusal care in flasking and why?
7. How do you proceed with Wax elimination (Dewaxing)?
8. At what stage is separating media applied to the plaster molds?
9. What is the mode of action of separating media ?
10. In which stage is the acrylic resin packed into the mold space?
11. What are the curing cycles employed to process the acrylic resin?
12. What is polymerization?
13. How do you correct processing changes in occlusion?
14. What is remount procedure?
15. What is BULL's law?
16. What are the disadvantages of correcting occlusion in mouth with articulating paper?
17. What is finishing of denture?
18. What is polishing of denture?
19. Why is it necessary to finish and polish dentures?
20. Discuss the differences between bench curing and bench cooling?
21. How would you prevent porosity in the denture?
22. What is the effect of porosity on strength of denture base?
23. Describe the abrasive and polishing agents used in polishing of heat cure denture base.

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CHAPTER

15

Denture Insertion and Patient Education

INTRODUCTION

The insertion of the complete maxillary and mandibular dentures represents the culmination of a carefully planned and executed sequence of technical procedures. The insertion of new dentures in a patient's mouth involves more than seating the dentures. The inaccuracies in the final denture should be recognised and eliminated before the patient is advised to use the complete dentures.

ELIMINATION OF ERRORS ON BASAL SURFACE

The denture borders and flanges should be carefully examined to ensure appropriate thickness, smooth rounded borders with no obvious overextension. If the impressions were accurately moulded, the denture should require no gross alterations unless the laboratory operations have disregarded the effort made by the clinician. The denture surface should be critically examined for small projections caused by imperceptible discrepancies in the cast or in the investing materials. The examination can be carried out digitally or by passing cotton fibres over the surface of the denture which will aid in detecting the irregular areas on the tissue surface. Uniformly painted pressure indicator paste on denture surface aids well in detecting the undercuts interfering with initial placement of dentures and also the pressure spots by being displaced. The borders are carefully relieved to accommodate the frenum attachments. Hamular notch region must be carefully rounded before the initial placement of dentures.

CORRECTION OF ERRORS IN OCCLUSION

The errors in occlusion may be due to a number of factors. They include inaccurate maxillomandibular relation records by the dentist, errors in the transfer of maxillomandibular relation records to the articulator, failure to seat the occlusal rims correctly on the casts, ill fitting temporary bases, failure to use the face bow, incorrect arrangement of the posterior teeth, failure to close the flasks completely, use of too much pressure in closing the flasks or warpage of the dentures by overheating them during polishing. Indifference towards correction of occlusal errors will be at the expense of bone, because bone is a more plastic tissue than mucosa. Bone, in time, will change to relieve soft tissues of excess pressure. Thus, failure to correct occlusion before the patient wears the dentures can cause destruction of the residual alveolar ridges.

It is a general practice to correct occlusal errors in the patient's mouth. However, if articulating paper is used in the mouth to locate interceptive or deflective occlusal contacts, shifting of the denture bases or eccentric closures by the patient as well as the presence of saliva will prevent the articulating paper from recording errors. Hence, occlusal errors are easily detected and corrected on the articulator. The same articulator used in arranging the teeth should be used again for the adjustment of the occlusion after the dentures have been processed. One method provides for transferring the denture back to the articulator without separating them from the cast by securing them with sticky wax to the articulator. Another method involves the use of mounting index which will retain the facebow. This method may be used when the master casts have been destroyed before the occlusion can be adjusted. If the separation of dimension between incisal pin from Incisal table is 2 mm or less, it is acceptable. If the occlusal discrepancy is more than 5 mm, no occlusal correction should be attempted and the procedure has to be repeated. Selective grinding is done to eliminate occlusal interferences as described in chapter on occlusion.

PATIENT EDUCATION RELATED TO COMPLETE DENTURE TREATMENT

Patient education is the prosthodontic service that refers to giving complete information and instruction to a patient in the use, care and maintenance of the prosthesis.

Information and Instructions Relating to Complete Denture

Limitations of Usefulness of Complete Denture

Loss of natural teeth is a misfortune which artificial teeth can reduce but never fully eliminate. Problems created by loss of natural teeth will not be solved just by replacing

with the complete denture because efficiency of natural teeth and dentures vary. Limited function of oral tissues will be restored and established with the dentures, but extreme non-functional movements cannot be performed. Prosthodontic service needs continuous follow-up check-up which includes occlusal correction, relining or rebasing.

Understanding the Nature of Denture Foundation

Placement of dentures in the mouth provide unnatural environment to the oral tissues and bone. Soft tissue suffers compression between bone and denture base. Pressure and compression in excess of physiological limit of tolerance causes bone resorption and gradual overgrowth of the tissues creating excessive denture movement.

Oral and General Conditions Complicating Use of Cmplete Dentures

The common complicating conditions are:

a. The condition of the supporting structures dictating surgical intervention, where surgery is either contraindicated or surgery cannot be performed, complicate use of dentures.
b. Patients presenting with horizontal and vertical loss of alveolar bone.
c. Patients with uncontrollable tongue and jaw movements.
d. Patients who do not accept their responsibility inspite of excellent prosthodontic treatment.
e. Patients with adverse mental attitude.
f. Lack of mental ability to adjust to the treatment.

Adjustment Period of Dentures and Tissue Reactions

Soon after the insertion of dentures, salivary flow is stimulated which declines after 2-3 days. At times there is a feeling of crowding of the tongue. Feeling of soreness and discomfort may also be an additional feature.The patient should be made aware of the limitation to tissue movements and function in advance of the treatment. Otherwise, he will not trust the operator and the quality of service. He should also be advised against carrying out adjustments to the dentures. Speaking normally with dentures requires practice. Patients should be advised to read aloud and repeat words or phrases that are difficult to pronounce.

Learning to use the Dentures Correctly

Successful and efficient use of dentures is a learned process and patient has to train his musculature in holding the denture. Patients should be told that the position of the tongue plays an important role in the stability of a lower denture, particularly during mastication. Patients whose tongue normally rest in a retracted position relative to the lower anterior teeth should attempt to position the tongue further forward so it rests on the lingual surfaces of the lower anterior teeth. This will help develop stability for the lower denture. The lips and cheek should be relaxed and not tensed. Learning to chew with new dentures usually requires at least 6 to 8 weeks. Use of dentures for chewing should be avoided for the first 3-4 days. Patients should begin with liquid diet followed by relatively soft food in small morsel. If the chewing can be done on both sides of the mouth at the same time, the tendency of the dentures to tip will be reduced. Patients should be advised to avoid tearing food with the anterior teeth. Patients, who have been edentulous without prosthesis for a long time and have learned to crush food between the residual ridges or perhaps between tongue and the hard palate, will usually take a longer time for adjustment.

Rest to the Supporting Tissues

It is desirable that oral tissues should not remain under continuous stress and therefore it is important to provide rest and natural ventilation by removing dentures from the mouth. It is advisable to remove dentures during sleeping hours which would allow tissue to recover from effect of stress. Those patients who suffer discomfort and loss of sleep after removal of dentures may provide short period of rest to oral tissues during the day.

Mouth and Denture Hygiene

It is important to know that successful use of dentures also depends on the maintenance of oral and denture hygiene. Mouth should be rinsed after every meal with water and dentures should be gently cleaned using

suitable brush. Warm saline rinses permit penetration of heat causing dilation of blood vessels which would in turn bring fresh nutrients locally contributing to accelerated repair and regeneration of tissues. Patients should be discouraged from using tooth pastes, since most contain the abrasive material that will wear away the surface of acrylic resin. Instead using of soft brush with mild toilet soap is advisable. The dentures should be left overnight in the cleanser which releases nascent oxygen to release denture plaque and stains caused due to smoking, high usage of condiments, pan and high intake of greasy food. The dentures should be brushed over a basin partially filled with water or covered with wet wash cloth to prevent breakage in case they are dropped. Sterilization of dentures with phenol containing liquids like Dettol should be avoided because it has softening effect on acrylic. The dentures should be placed in water when not in use in order to prevent shrinkage.

Recall Visits and Their Importance

The objective of recall visits is to offer continuing health service by ensuring the status of supporting tissues. Through recall visits, one can observe the development of undesirable situations before more damage occurs. Recall visits may be fixed after every five to six months or one year.

SELF-HELP QUESTIONS

1. What are post denture insertion instructions to be given to the patient?
2. Hygiene of denture affects the general health of patient. Discuss.
3. How would you help the patient get accustomed to new dentures?
4. What measures should be followed to enable the patient to get habituated to the new denture?
5. Why should the denture always be placed in water, when not in use?
6. How do you check for the imperceptible discrepancies on the tissue surface of the denture?
7. What do you understand by patient education?
8. What is the diet regime that has to be prescribed to a patient with new denture?
9. What is the need of rest to the tissues?
10. What is the need for warm saline rinse in complete denture patients?

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CHAPTER

16

Sequelae of Ill Fitting Dentures

INTRODUCTION]

Problems of complete denture relate to tissue injury and impaired function. Tissue injury commonly occurs in three of the following areas:

a. Supporting tissue
b. Tissues in contact with borders
c. Tissues that contact the polished surface of the teeth

TISSUE INJURY

Injuries to the Supporting/Stress Bearing Tissue

These include mucosa of the crest and slopes of ridges and mucosa of palate. The injuries can be caused by fault in impression, damage to the master cast and/or disharmony in occlusion. The injuries may be seen as *small circumscribed or whitish areas.* Some *lesions may be punched out* because of imperfection in denture base/ trauma from hard food particles. Some lesions may be hyperemic and painful because of pressure on the sharp bony projections or on the bony exostosis. At times, the bony undercuts in mylohyoid region, tuberosity area and cuspid eminence cause difficulty in denture insertion resulting in *irritation* and *detachment of overlying mucosa. Hyperemic painful spots* may also be created by disharmony of occlusion. *Hypertrophy* and *inflammation* may also be a characteristic feature.

Inflammatory reactions may be due to:

i. Lack of rest to the tissue.
ii. Lack of stability of dentures.
iii. Insufficient free way space.
iv. Poor oral hygiene.
v. Nutritional deficiency.
vi. Systemic debilitating disease contributing to poor tissue resistance.
vii. Allergic reaction.

Hypertrophy of oral mucosa can result from excessive relief in the midpalatine suture area, which looks like small nodules defined as papilloma-like Hypertrophy. Incisive *papilla* of the basal seat may also reveal the change by the presence of enlargement or detachment of tissue on account of pressure over it.

Injuries that Occur to the Tissues in Contact with the Borders

The lesions usually appear as *slit-like fissures or ulcers.* The fissures vary in length and depth and are painful. These are caused by overextensions of denture borders and from sharp thin, unpolished borders of the denture. The overextension refers to interference with tissue functions and is commonly seen in the following areas:

i. Frenum attachment.
ii. Retromylohyoid tissue.
iii. Retromolar pad.
iv. Massetric notch.
v. Hamular notch.
vi. Floor of the mouth.
vii. Soft palate.

Injuries that occur to the Tissue in Contact with Polished Surface of the Denture Base and Teeth

These may be caused by:

i. Cheek biting.
ii. Rough margins of the teeth.
iii. Tongue biting.
iv. Unpolished denture bases.
v. Porous dentures.

IMPAIRMENT OF FUNCTION

Functions that can be impaired due to ill-fitting dentures can be broadly related to the following:

1. Esthetics
2. Phonetics
3. Mastication
4. Retention
5. Stability
6. Gagging.

Esthetics

The patient may be dissatisfied with the appearance if proper care has not been taken during jaw relation recording procedure followed by teeth selection and arrangement. The lip support, visibility and plane should

be adjusted accurately during jaw relation recording procedure that contributes to esthetics. Teeth selection and arrangement should be done to restore natural look of the patient.

Phonetics

Problems in speech may be caused by excessive thickness of the denture base or improper arrangement of teeth.

Mastication

The problem in mastication is mainly due to wrong selection of posterior teeth and or improper arrangement of posterior teeth.

Retention

Lack of retention is mainly due to improper recording of impression with failure to record the denture bearing and peripheral-limiting structures.

Stability

Stability may be lost due to improper impression procedure and arrangement of teeth.

Gagging

It may be caused by overextension of the denture or unhygienic procedures followed during the treatment.

MANAGEMENT OF POST DENTURE INSERTION PROBLEMS

Pain in the Labial, Buccal and Lingual Sulcus and Frenum

- Localized reduction of the overextended flange.
- Create allowance for frenum movement.
- Rounding off the sharp margins and smoothening the borders.

Localized Tender or Painful Area on the Denture-bearing Surface

- Identify and eliminate the blow out nodules, spikes and sharp ridges.

Wide Painful Areas on the Residual Ridge and Palate

- The premature contact area of teeth should be corrected.
- If it is due to increased vertical dimension, the entire procedure should be repeated.
- If vertical dimension and centric relation is correct, denture relining can be accomplished.

Burning Sensation in the Anterior Region of the Lingual Sulcus

- The overextension in the lingual sulcus should be identified and corrected.

Difficulty in Swallowing

The overextension in the distolingual sulcus should be corrected.

Cheek, Lip and Tongue Biting

This can be caused due to decreased vertical dimension, inadequate overjet of posterior teeth and increased overjet in anterior teeth, which should be identified and corrected.

Gagging

- The overextended posterior border and distolingual flange should be corrected.
- The excessive thickness of the palatal aspect of the denture should be reduced.
- Maintenance of hygiene.
- Posterior palatal seal area should be corrected.
- Topical anesthetics can be advised.
- Psychological counselling.

Loss of Retention

- The under extended borders and inadequate adaptation of denture base to the denture-bearing tissues can be corrected by relining procedure.

Loss of Stability

- The procedure should be repeated in order to correct the occlusal discrepancy.

- If it is due to faulty denture adaptation, relining should be done.

Reduced Masticatory Efficiency

- Occlusal correction should be accomplished.

Poor Appearance

- If there is excessive bulk on the buccal or labial aspect, it can be reduced.
- The treatment should be repeated. in case of other problems like midline off-center, faulty vertical dimension, improper selection of teeth.

Difficultly in Speech

The patient should be educated that since denture is a foreign body it will take some time for the patient to get accustomed to it. Patient should be instructed to read newspaper or magazines aloud to get accustomed to the new denture. If the patient still complains of speech problems, the thickness of the palatal aspect should be reduced. If it is due to faulty arrangement of teeth, the treatment will need to be repeated.

SELF-HELP QUESTIONS

1. Which are the common areas of tissue injury in a complete denture patient?
2. What is the common cause for hypertrophy of oral mucosa?
3. What is Epulis fissuratum?
4. What are the causes for loss of retention and stability in complete dentures?
5. How should localized tender and painful area on denture bearing surface be managed?
6. What may be the cause of wide painful areas on the residual ridge and palate?
7. What is the cause of burning sensation in the anterior region of lingual sulcus?
8. How should the difficulty in speech in complete denture patient be managed?
9. What may be the cause of pain in the labial,buccal or lingual sulcus?

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CHAPTER 17

Gagging

INTRODUCTION

The phenomenon of gagging has been responsible for many embarrassing situations both for the patient and the clinician on account of sudden, violent, and uncontrolled retching—a *hypersensitive reaction* to dental treatment. The normal gag reflex is an adaptive, vital mechanism for survival controlled primarily by the parasympathetic division of the autonomic nervous system. It is present from birth and comparable to the swallowing reflex, gagging movements alter the shape of the pharynx and its various sphincters to eject foreign bodies from the mouth and pharynx. Gag reflexes that are hypersensitive, present a problem in clinical procedures during examination of the oral cavity, impression procedures, making jaw relation records and denture insertion. Fortunately, the patient with a severe gagging reflex is uncommon. However, when such a patient presents for treatment, it matters little to the patient or the dentist just how infrequently serious gagging problems present. A search through the literature has opened vistas on a number of causative factors and the related approaches to the management of patients. These reports reveal a lot of diversity in the understanding of success or failure of an approach to ward off this exasperating reflex. It has, therefore, been the objective of this chapter to underline and understand this complex reflex and throw some light on some of the clinical situations encountered with possible etiological factors. This would hopefully enable an operator to reach a rationale of management of patients presenting with an enigma in prosthodontic service. Concern of the dentist in respect of the difficulties encountered consequent to the gag reflex in Prosthodontic service is well reflected in the literature. Most of the time when every other method to combat this menace failed, the patient was labeled neurotic or psychotic. However, with more clinical material being reported, greater insight to this problem has been reached.

PHYSIOLOGY OF THE GAG REFLEX

Schole in 1959 related the gag reflex to the vomiting reflex and described the neurophysiology of the vomiting reflex. He refers to Best and Taylor when stating that the vomiting center lies in the dorsal portion of the lateral reticular formation of the medulla oblongata and to some extent, includes tractus solitarius.

Means and Flenniken in 1970 stated that the physiologic mechanisms of gagging and swallowing are closely related, that is, the same afferent nerve pathways, brain centers and efferent nerve pathways transmit the respective stimuli.

Conny and Tedesco in 1983 also compared the gag reflex with the swallowing reflex. They stated that, stimulation of the mouth, palate or pharynx (that is, *the five "trigger areas", regions of maximum sensitivity - the fauces, base of the tongue, palate, uvula and posterior pharyngeal wall)* can set into motion muscular response of the mouth, tongue, palate, pharynx, larynx and respiratory system. Swallowing occurs when the muscle action is smooth and coordinated whereas gagging occurs when it is uncoordinated and spasmodic.

Stimulation of the so-called "trigger areas" causes the transmission of afferent impulses to a centre in the medulla oblongata which is very close to the vomiting, salivating and cardiac centers, explaining why gagging may be accompanied by additional reflex activity. Also, there are fibers that pass from the centre and in the medulla oblongata to the cerebral cortex, so the reflexes can be modified by the control of the cerebrum.

The sensory nerves involved in the afferent pathway are the Trigeminal (V), Glossopharyngeal (IX) and Vagus (X) nerves.

To be noted is the fact that the Glossopharyngeal nerve is peculiar in that its afferent fibers include fibres that both elicit and inhibit the reflex. The clinical significance of this is that there is less likelihood of gagging if a region innervated by the glossopharyngeal nerve is stimulated.

The motor nerves for the efferent pathways from the reflex center in the medulla oblongata are the Trigeminal (V), Facial (VII), Pharyngeal plexus (IX, X, XI), Vagus (X), Hypoglossal (XII) and various other sympathetic and parasympathetic nerves.

MANAGEMENT PROCEDURES

Effective management of the "severe gagger" demands sincere interest in the problem and compassion for the patient. Numerous approaches to managing the severe gagger appear in the dental literature. They fall into the categories of:

1. Clinical techniques.
2. Prosthodontic management.
3. Pharmacologic measures.
4. Psychological intervention.

Clinical Techniques

Surgical

Leslie reported a surgical technique to relieve gagging for the patient unable to tolerate complete dentures. The basis for this technique stems from the observation that persistent gagging results from an atonic and relaxed soft palate, which is found in nervous patients. In such cases, the uvula touches the tongue and the soft palate rests back on the pharyngeal wall. This produces a tendency to gagging and nausea that often results in vomiting. To correct this situation, Leslie advocated a surgical intervention to shorten and tighten the soft palate on healing; the surgery also involved the removal of the uvula, which was a little longer than normal.

Prosthodontic

To avoid substandard impressions because of gagging, Borkin outlined an impression technique for edentulous patients. It provides greater control of setting time and discrepancies can be corrected easily. A primary impression is made by use of a stock tray and red modeling compound. The secondary impression is obtained by pouring Kerr impression wax (Kerr Mfg. Co, Romulus, Mich) in the tray. The pliable nature of the wax allows reseating of the tray and border molding until desirable results are obtained.

A technique that employs ordinary marbles was reported by Singer as an effective approach to overcome a patient's inability to tolerate complete dentures. At the first appointment the patient is asked to place five marbles in the mouth; He is further instructed to keep the marbles in his mouth continuously for one week except when eating and sleeping. At the second appointment after 1 week, the patient's ability to tolerate the marbles is evaluated, and he is reassured that he would be able to tolerate dentures. At the third visit, primary impression is made. At the fourth visit, the mandibular tray is inserted along with three marbles in the mouth, and a "training bead" is placed on the lingual aspect of lower tray to maintain proper tongue position. During the fifth visit, the use of marbles is discontinued, and at the sixth visit, jaw relations are recorded. While the dentures are being fabricated, the patient continues to wear the upper and lower trays in lieu of carrying marbles. The complete dentures are inserted in the seventh visit. According to Singer, marble technique improves the patient's motivation.

Radiographic

To minimize problems in obtaining dental radiographs in gagging patients, Richards suggested the use of fast speed film; preset the timer, moisten the film pack, and the patient is advised to rinse the mouth with cold water.

Psychological

Effective method to reduce gagging is diverting the patient's attention from the gagging stimuli. Landa recommended manipulating the oral and facial tissues during impression making for psychological reasons rather than for border molding. He also recommended talking to the patient and explaining the critical nature of accurate impressions.

When inserting new dentures, Landa suggested that the dentist (1) engage the patient in conversation on some topic of special interest, (2) have the patient count rapidly upto 50 or 100 and (3) have the patient read a loud.

Kovats reported a technique that has the patient breathe audibly through the nose and at the same time, rhythmically tap the right foot on the floor. By concentrating on these activities the patient's attention may be diverted away from the gagging stimuli.

A similar technique was described by Krol. To divert attention, the patient is instructed to raise his / her leg and

hold in the air. As the patient's muscles become increasingly fatigued, more and more conscious effort is required to hold the leg up and the patient's concentration is diverted to carry on intraoral procedures.

Faigenblum discussed that evidences exists that vomiting is impossible during apnea. To control gagging, the patient is instructed to prolong the expiratory effort at the expense of inspiration. This will produce a state of apnea and discourage gagging. Faigenblum also proposed that a well-rested and relaxed patient with an empty stomach is less likely to gag.

Prosthodontic Management

Prosthodontic approaches to the patient with the gagging problem involve technique modifications to render the prosthesis more acceptable to the patient. No alterations, in fixed or removable partial prosthesis, to solve a gagging problem have been reported in the literature. Excess thickness, over extension or inadequate postdam should be corrected before more radical modifications in the prosthesis are made.

The smooth, shiny surface of a complete denture is objectionable to some patients. From his clinical experience, Jordon suggested that matte finish dentures are more acceptable to patients than glossy surfaced/ well polished dentures. In contrast to Jordans recommendation, Feintuch described a technique that after extractions, the smoothly polished base tray was given to the patient to insert at home. After 2 weeks of tolerating the toothless base tray, impressions are made. Subsequent appointments were uneventful.

Krol discussed the importance of "free way" space (interocclusal distance) to the gag reflex. He determined that the interocclusal distance was inadequate in more than 100 patients with serious gagging problems. The interocclusal distance was increased by either remounting and grinding the teeth or remaking the dentures when the discrepancy was gross. In all instances, an increase in the interocclusal distance resolved the gagging problem.

In hypersensitive palate of prosthetic patient, Bay combined the over denture principle with a modification in the shape of the denture base. Soft reline material was used to engage threaded post in the overlaid teeth. Additionally, the palatal section of the upper denture remained open. Bay claimed excellent retention, reduced bulk and resolution of the patient's gagging problem.

Pharmacologic Measures

When clinical and prosthodontic procedures are ineffective, a number of pharmacologic agents have been described as useful in controlling and limiting the gag reflex. Of therapeutic significance is the fact that the reflex is a function of the parasympathetic portion of the autonomic nervous system. Drugs that selectively depress this system are therefore useful. Examples of such drugs are—sedatives, antihistamines, parasympatholytics and central nervous system depressants.

The drugs used to control gagging may be classified as peripherally acting or centrally-acting.

Peripherally-acting Drugs

Peripherally acting drugs are topical and local anesthetics. They may be applied in the form of sprays, gels, or lozenges or by injection. The effectiveness of these agents is limited to use in those patients who demonstrate only a minor gagging problem. Success is unlikely with the severe gaggers. The rationale for the use of these drugs is that if the afferent impulses from sensitive oral tissues are eliminated, the reflex of gagging will not take place. This procedure / approach may work well to help a gagging patient through a particular procedure, such as radiographs or impressions. It must be recognized that use of these locally-acting agents does not provide a long term solution.

Korats experienced success in making a maxillary impression by spraying the entire palate with a topical anesthetic.

Lincoln injected 10 minims of 190 proof alcohol into the soft tissues approximately 4 mm distal to the lesser palatine foramen. This causes a slight sensation of fullness in the pharyngeal wall. The effect of the alcohol is reported to wear off after a few months.

Appleby and Day reported that common table salt can minimize the gag reflex. Salt is placed on the tongue or in liberal amounts on the palatal region of the denture; salt may help gagging patients tolerate complete dentures.

Centrally-acting Drugs

Centrally-acting drugs, which eliminate or reduce the gag reflex, may be categorized as antihistamines, sedatives and tranquilizers, parasympatholytics and central nervous system depressants.

Saunder reported the use of intravenous valium for the problem gaggers. Kramer and Braham recommended the intramuscular injection of Phenergan (Wyeth Lab's Philadelphia) and Nisentil (Roche Laboratories).

The Phenergan exerts a strong antihistaminic, antisalivary and antiemetic effect. Nisentil provides a strong sedative effect.

Only one clinical evaluation of a drug (Tigan, Beecham Laboratories, Bristol) as an antigagging agent was found in the dental literature. Prior research on this drug indicated successful relief of nausea and vomiting in a number of conditions including pregnancy, motion sickness, labyrinthitis. A controlled study on the antigagging effect of Tigan was conducted under conditions simulating those of routine dental practice.

Psychological Intervention

Some patient's difficulty with gagging may be the result of psychological stimuli.

Hypnosis

Hypnosis has been used as a tool to deal with the psychologic etiology of gagging. Results are described as generally successful. One study reported that a patient (gagger) underwent nine hypnosis sessions before a prosthetic treatment. Because of the time involved, hypnosis would not be considered a practical approach by many practitioners or patients.

Behavioral Therapy

Behavior modification techniques have been used to treat and control a variety of hysterical disorders including gagging.

SELF-HELP QUESTIONS

1. What do you understand by the term gagging?
2. Mention the trigger areas of gag reflex.
3. What is marble technique?
4. What procedure should be followed to minimize the gag reflex in radiographic procedures?
5. What role does psychological management play in minimizing gag reflex?
6. Mention about the prosthetic management of gag reflex?
7. Will the locally acting drugs have a long term effect on the gag reflex?

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CHAPTER

18

Immediate Complete Denture

INTRODUCTION

Immediate complete denture is defined as a complete denture constructed for insertion immediately following removal of natural teeth. It is a dental prosthesis to be used for a short interval of time for reasons of esthetics, mastication, occlusal support, convenience or to condition the patient to the acceptance of an artificial substitute for missing natural teeth until more definite prosthetic treatment can be provided.

ADVANTAGES OF IMMEDIATE DENTURES

1. Natural teeth present during the process help in establishing the vertical dimension of occlusion.
2. The remaining natural teeth guide arrangement of artificial teeth.
3. Patient does not face the embarrassment of edentulous period.
4. Patient regains function of speech and mastication faster.
5. It acts as a splint or bandage to control bleeding and protects the wound.
6. Muscles of facial expression do not collapse because of presence of natural teeth.
7. Patients are prepared to have the teeth removed when assured of replacement immediately.

DISADVANTAGES OF IMMEDIATE DENTURES

1. Resorption of bone and shrinkage of unhealed soft tissue makes it necessary for the dentures to be relined
2. Esthetics cannot be checked since there is no anterior try–in procedure.
3. Procedures are precise and time consuming.
4. Treatment is more expensive because of the need to reline it or repeat the procedure at a later stage.
5. Retention is less on account of rapid changes occurring in the tissues.
6. More care of surgical site is necessary during healing.

CONTRADICTIONS FOR IMMEDIATE DENTURE SERVICE

1. Patients suffering from debilitating diseases.
2. Patients for whom multiple extractions are not advisable e.g. patients with cardiac disturbances, endocrine gland disorders, blood discrasias and patients with slow healing potential.
3. Patients whose mental capacity does not allow them to accept the responsibility.
4. Indifferent or unappreciative patients.
5. Patients with acute periapical or periodontal pathosis.

DIAGNOSIS AND TREATMENT PLANNING

Prior to commencement of treatment, a thorough diagnosis must be completed and a treatment plan decided. The patient's medical and dental history should be reviewed. A clinical examination of hard and soft tissues should be performed including an evaluation of the periodontal status of the remaining dentition. A full mouth radiographic series (periapical and bite wing) is useful in evaluating the extent of bone loss due to periodontal disease. A panoramic radiograph can be used to determine the presence of impacted teeth, retained roots, foreign bodies, exostoses, osteoporosis, cysts and other pathology. Mounted diagnostic casts are a valuable aid in the evaluation of tooth position, jaw relationships and occlusal plane discrepancies. Diagnostic casts also help to reveal and analyze undercuts.

TREATMENT PROCEDURE

Surgical Procedure

The posterior teeth are extracted first leaving bilateral centric stops on the retained natural teeth, usually the incisors, canines and first premolars (Fig. 18.1). If any preprosthetic surgery is required, it should be performed at the initial surgery appointment. A healing period of 6-8 weeks should be maintained prior to commencement of the prosthdontic procedure. The other surgical procedures that may have to be performed are:

a. Elimination of broken / left over roots / root stumps.
b. Surgical correction of bony projections / exostosis that would interfere with the insertion of denture
c. Surgical resection of soft flabby tissue.
d. Closely attached frenal attachments.

FIGURE 18.1: Mandibular partially edentulous arch for immediate denture treatment

Periodontal Therapy

Thorough prophylaxis of anterior teeth should be done in order to permit quick healing after extraction of teeth.

Preliminary Impression of Jaw Foundation

Impression is made using alginate material in stock perforated tray which is modified with boxing wax on the borders. The centre of the palatal surface of maxillary tray is also covered with wax, to effect a closer approximation of the tray to the palatal tissues. The wax border extensions ensure proper extension of the impression and adequate support of the alginate impression material. Wax stop should be placed at widely separated areas. Even if the wax shows through the first impression surface because of tissue contact, it will not harm the impression since it is soft and exerts minimal pressure (Fig. 18.2).

Impression Procedure

Three final impression procedures are explained as follows:

First Procedure

Single thickness of modeling wax is placed to cover palatal surface of the maxillary foundation including the palatal

FIGURE 18.2: Tray modification

surfaces and incisal edges of the teeth to form a ledge or seat for the tray anteriorly.

First part of final impression includes all the areas except labial sections and the second part includes labial vestibule along with labial surfaces of the teeth which is divided into two sections to facilitate proper removal from the mouth. Borders of the tray are perfected by using low fusing compound. Material for the first part of the impression may be either zinc oxide eugenol or rubber base impression material. Stops are used for correctly locating the tray in the mouth. Second part of the impression is made with quick setting plaster for the labial surface and vestibule. Small groove is cut in the anterior section of plaster to permit clean fracture of the set impression plaster for easy removal. All the three sections are joined together in their proper alignment and master cast is poured.

Second Procedure—Single Impression Technique

The peripheral tissues should be recorded with low fusing compound. Impression of the entire edentulous foundation is made with rubber base impression material using custom tray.

Third Procedure—Dual Impression Technique

Self-cure acrylic resin tray is fabricated to conform to the edentulous segments only. The trays have positive stops on the lingual surfaces of the remaining teeth and in the buccal shelf area and posterior palatal seal areas. The peripheral tissues are recorded with low fusing

impression compound. The tray is relieved by placing escape vents and an impression is made with zinc oxide eugenol impression paste / rubber base impression material. This sectional impression is checked in usual manner and all excess material is removed. The impression is placed back in the same position in the mouth and irreversible hydrocolloid impression is made with a perforated stock tray. When the hydrocolloid impression has set the impression is retrieved from the mouth along with the sectional impression and the cast is poured.

JAW RELATION RECORDS

Well adapted record bases are made and occlusal rims fabricated. Face bow record and centric relation are recorded in the usual manner and transferred to the articulator.

SELECTION AND ARRANGEMENT OF POSTERIOR TEETH AND TRY-IN

This is based on the observation of remaining natural teeth. Anterior teeth are selected and shaped to look like natural teeth. Posterior teeth are arranged on the trial bases and try in is made without anterior teeth (Fig. 18.3). Anterior teeth from the master cast are cut one at a time. Each tooth is reduced to the level of gingival margin with a rotary instrument or sharp knife and remaining ridge is smoothed with a hand instrument (Fig. 18.4). Artificial teeth are placed in their position to simulate natural arrangement. However, some changes can be made in the arrangement in order to improve esthetics. Dentures are waxed as usual followed by flasking, packing, curing, finishing and polishing.

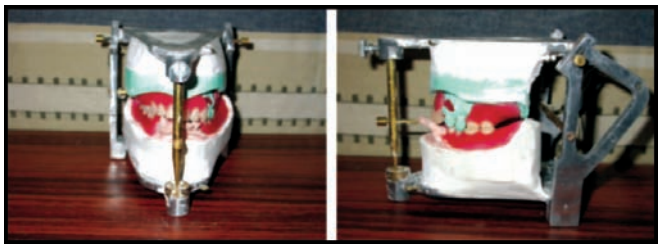
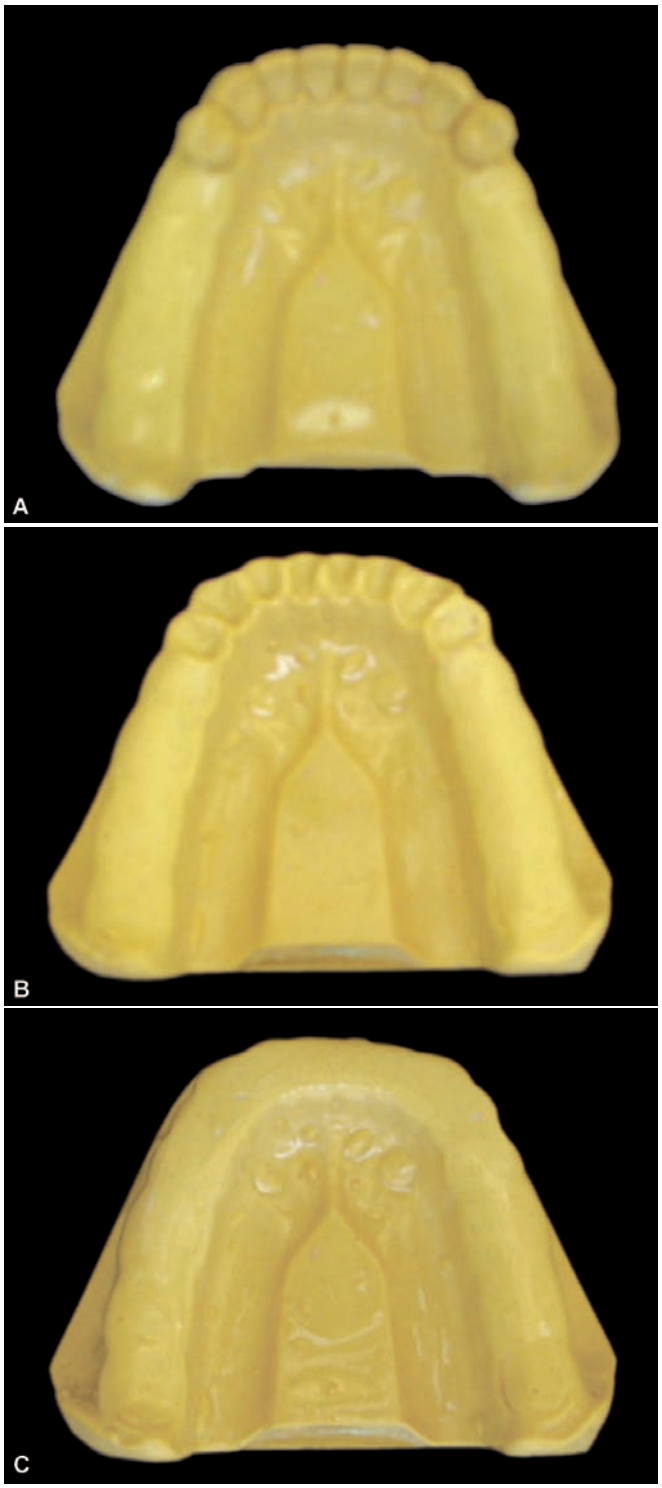


FIGURE 18.3: Arrangement of posterior teeth



FIGURES 18.4A to C: Procedure for elimination of teeth on cast (A) Partially edentulous arch for immediate denture treatment (B) Elimination of teeth maintaining the gingival margin (C) Rounding off the ridge

EXTRACTION OF TEETH AND INSERTION OF DENTURES

Dose and rate of administration of anesthesia is controlled to avoid volume changes in the tissues. The remaining teeth should be removed with minimum of trauma (Fig. 18.5). Bony spicules and sharp edges of bone are carefully smoothed. Conservative surgery is preferable to preserve as much alveolar bone as possible. If sutures are necessary, use as few as possible and avoid excessive tension. The dentures can be inserted after the initial control of bleeding (Fig. 18.6). The denture borders and surfaces should be examined and adjusted for any overextensions and areas of tissue surface projecting into the sockets. Once the denture is seated, gross occlusal prematurities can be eliminated while the patient is still under local anesthesia. The denture should be manipulated as little as possible to avoid further trauma to the extraction sites. Final corrections of the denture can be done at a later stage.

Care and Instruction

Denture should not be removed for first 24 hours. Recall appointment should be after 24 hours. Later corrections can be done as and when required. Tissue changes are corrected with reline after 6 months. In case of gross discrepancy the treatment will have to be repeated as for a conventional complete denture.

FIGURE 18.5: Extraction of anterior teeth

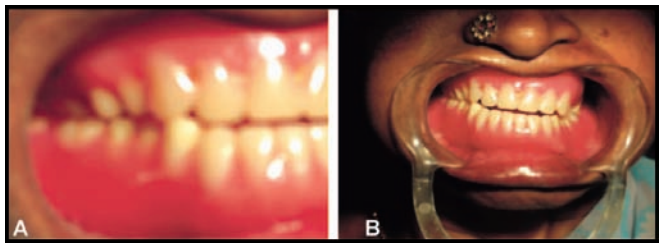


FIGURE 18.6: Immediate denture insertion

SELF-HELP QUESTIONS

1. Define immediate complete denture.
2. What are the advantages of immediate dentures?
3. Mention the disadvantages of immediate dentures.
4. What are the contraindications for immediate complete denture?
5. What care should be taken during the surgical procedure?
6. What are the techniques used for final impression in immediate complete denture treatment?
7. What is the method of removing the teeth on the master cast after posterior try-in procedure?
8. What is the post denture insertion care for an immediate denture patient?
9. Why should the immediate denture be relined / repeated at a later stage?

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CHAPTER

19

Overdenture

INTRODUCTION

The dental profession has expanded the preventive dentistry concepts into prosthodontics by treatment with overdenture. The drawbacks of conventional complete dentures can be masked by the use of overdentures, which dictates the preservation of tooth structure or placement of implants. *The overdenture is defined as denture that may be supported by soft tissue, bone, root of a tooth or a modified tooth. Tooth supported complete denture* is a dental prosthesis that replaces the lost or missing natural teeth and associated structures of maxilla and/ mandible and receive partial support and stability from one or more modified natural teeth.

The basic principles of overdenture are to prevent resorption of alveolar bone, maintain sensory feedback and provide retention and stability.

PRINCIPLES TO BE OBSERVED IN CONSTRUCTION OF OVERDENTURES

1. Retained teeth should be reduced to obtain a favorable crown root ratio.
2. To minimize the vertical movement of the denture, the retained teeth should be used.
3. The overdenture should be partially tissue borne.

INDICATIONS FOR OVERDENTURE TREATMENT

1. Oral condition dictating poor retention like *xerostomia, decreased height of residual alveolar ridge, partial loss of maxilla or mandible and congenital deformity (e.g.: cleft palate)*
2. Patients with poor prognosis for complete dentures which may involve *poorly defined sublingual fold space, knife edge ridge that will provide inadequate retention and stability*
3. *Requirement for pronounced vertical overlap* of the anterior teeth to produce good esthetic results
4. Complete maxillary denture opposed by retained mandibular anterior teeth to *prevent combination syndrome.*
5. Patients with *widely distributed retained teeth.*
6. Patients who are *mentally and physically prepared* and accept the responsibility of maintaining good oral hygiene.

CONTRADICTIONS FOR OVERDENTURES

1. *Uncooperative and under motivated patients* who insist on removal of their remaining teeth or are considered unable to maintain oral hygiene and regular office procedures.
2. Patients who cannot psychologically accept any type of removable denture.
3. *Mentally and physically handicapped* patients for whom plaque control and good oral hygiene are difficult.
4. *Economically unsound* or patients who cannot afford treatment for reasons of financial constraints unaffordable patients.

ADVANTAGES

Overdentures have proved to be advantageous in respect of the following:

1. **Greatly Enhanced Stability**: Anteroposterior and lateral slipping and sliding are eliminated, as is the associated ridge trauma.
2. **Positive Retention**: This is facilitated by the greatly reduced crown root ratio which lodges into the slot in the tissue surface of denture base.
3. **Proprioception**: This unique sensitivity seems to reside to a large extent in the tissues of periodontuim and provides an awareness of jaw space relationship and protection from accidental injuries due to over closure of the jaws.
4. **Psychological Benefits**: As long as the roots are preserved, the patient is spared of the emotional trauma associated with the total loss of their dentition.
5. **Post Extraction Comfort:** The common denture sore spots that often follow total extraction are greatly diminished because the overdenture is resting on tooth structure during this post operative period.
6. **Positive Support and Comfort:** The patient is much more comfortable than the complete denture

wearer because positive support is provided by dental structures designed to resist occlusal forces.
7. Horizontal and torque forces are reduced.
8. **Preservation of Aveolar Bone** through tensile stimulation of periodontal ligament.

DISADVANTAGES

The overdentures have proved to be disadvantageous for the reasons of:
1. Being more *expensive* than conventional dentures because of periodontal and endodontic therapy followed by restoration of abutment with coping.
2. *Increased bulk* in comparison with fixed and removable partial denture.
3. *Progression of caries and periodontal disease* if oral hygiene is not maintained.
4. Encroachment of interocclusal distance.

TYPES OF OVERDENTURES

Retentive Type

This type of overdenture involves the use of devices that would aid in retention. The procedure needs more of clinical time, laboratory time and expense than for the non retentive type of overdenture.

Nonretentive Type

This method utilizes endodontic therapy and the retained teeth are drastically reduced. Overdentures are then constructed to cover these reduced teeth. This type of denture gives vertical support to the denture. This method is less expensive.

PROPOSED TREATMENT SEQUENCE FOR TOOTH SUPPORTED OVERDENTURE

Treatment planning includes:
1. Endodontic consideration.
2. Periodontal therapy.
3. Caries management.
4. Location, distribution and preparation of abutment.
5. Denture fabrication.

Endodontic Consideration

The main advantages of treating the abutment teeth endodontically are:
i. The crown root ratio can be made more favorable
ii. Reduction of the clinical crown provides a *favorable interocclusal distance* for the placement of the artificial tooth in an esthetically acceptable position and in a more favorable relation to the opposing teeth.
iii. For securing attachments

Endodontic treatment is contraindicated in conditions of vertical fracture of the root, mechanical perforation of root canal, internal resorption that has perforated through the side of the root, broken instrument in the root canal and horizontal fracture of the root below the bony crest. Teeth that are grossly malposed will be difficult to use especially posterior teeth that are tilted more than 25°. Single rooted teeth with only one canal that is easily negotiable are the best candidates although multirooted teeth can also be used. A 2-4 week interval before commencing further treatment on the tooth is helpful to determine any endodontic complication.

Periodontal Therapy

Periodontal inflammation, pocket formation, bony defects and poor zone of attached gingiva must be eliminated before commencing the treatment. A common periodontal requisite with overdenture abutment teeth is that an adequate zone of attached gingiva is mandatory. The ideal teeth should have no mobility and if present, should be minimum with acceptable bone support and amenable to periodontal therapy. It should be understood that the reduction of clinical crown root ratio will be favorable in reducing any existing mobility.

Caries Management

The presence of high caries index and the situation that will create a carious environment are the devastating sequel to improper selection of patient for overdenture

treatment. Frequent recall checkup and treatment of the abutment with periodic fluoride application should be done to insure against any further breakdown.

Location, Distribution and Preparation of Abutment

Two teeth in each quadrant present an ideal situation in which stress is distributed over a rectangular area. For example, cuspid and first molar in each quadrant. The tripod is the next most favorable form for support and stability (Figs 19.4 to 19.6). It is recommended that it is better to use isolated teeth as abutments rather than adjacent teeth because they return to a state of good health more rapidly and are easier for patient to maintain hygiene.

The upper anterior teeth should be retained if opposed by natural lower anterior teeth to prevent the destruction of the anterior maxillary ridge. Depending on the condition and the distribution of abutment teeth, preparation can be done using the following methods:

a. Non-coping with simple teeth modification with or without endodontic treatment (Fig. 19.1).

FIGURE 19.1: Simple tooth modification of abutment

b. Placement of coping following endodontic treatment and tooth reduction (Fig. 19.2).
c. Endodontic treatment followed by placement of attachments (Fig. 19.3).

The selected abutment teeth with or without endodontic therapy are merely reshaped to eliminate undercuts and reduce the vertical height if necessary to create more inter ridge space for the overdenture. In case of abutment teeth requiring coping, preparation is done with a dome shaped surface and chamfer gingival finish line. The objective of the use of any attachment is to improve retention of the denture base. Most attachments are secured to the abutment by a cast

FIGURE 19.2: Abutments with coping

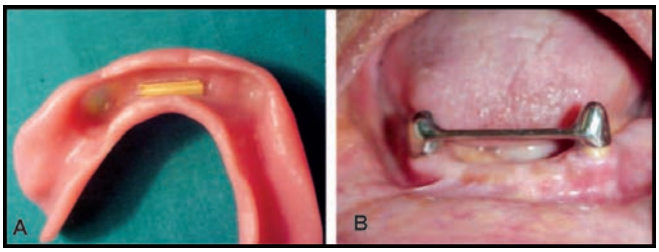


FIGURE 19.3: Abutments with bar attachment

FIGURE 19.4: Tripod location of abutments with coping in the mandibular arch

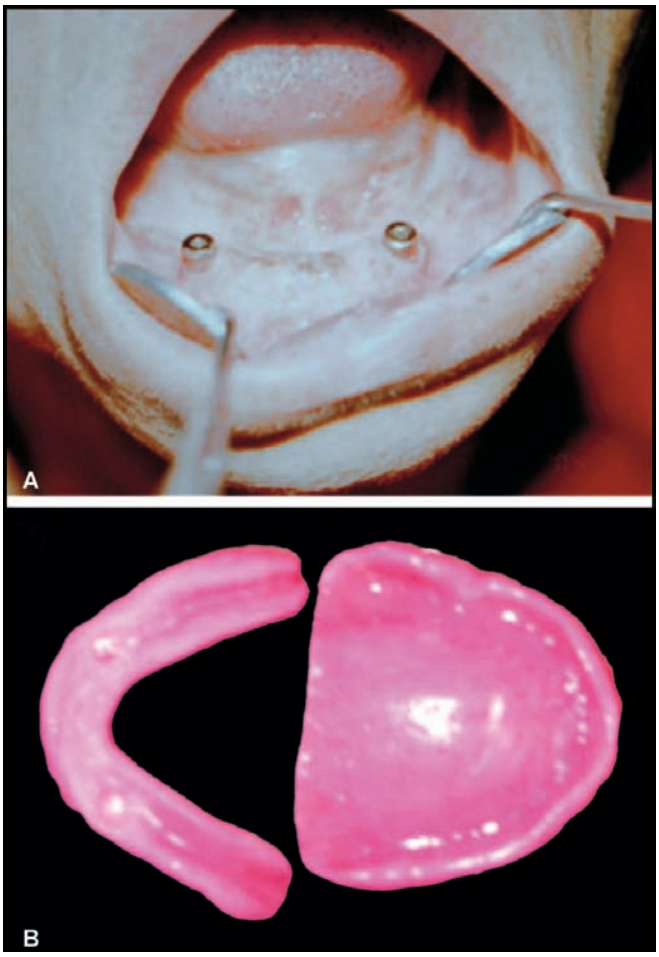
coping. Because of the factors like time, cost and risks the procedure should be reserved for patient with favorable prognosis. Here the low caries index, proper home care, optimum periodontal health and adequate inter ridge distance are absolutely necessary. The final denture fabrication includes the procedures that are followed for conventional complete dentures.

FIGURE 19.5: Slot in the tissue surface of the mandibular denture for lodging the abutment

FIGURE 19.6: Mandibular complete denture seated on the abutment

Implant Supported Overdenture (Figs 19.7 and 19.8)

This is one of the treatment options in treatment with placement of implants. Refer to chapter No. 22 for details.

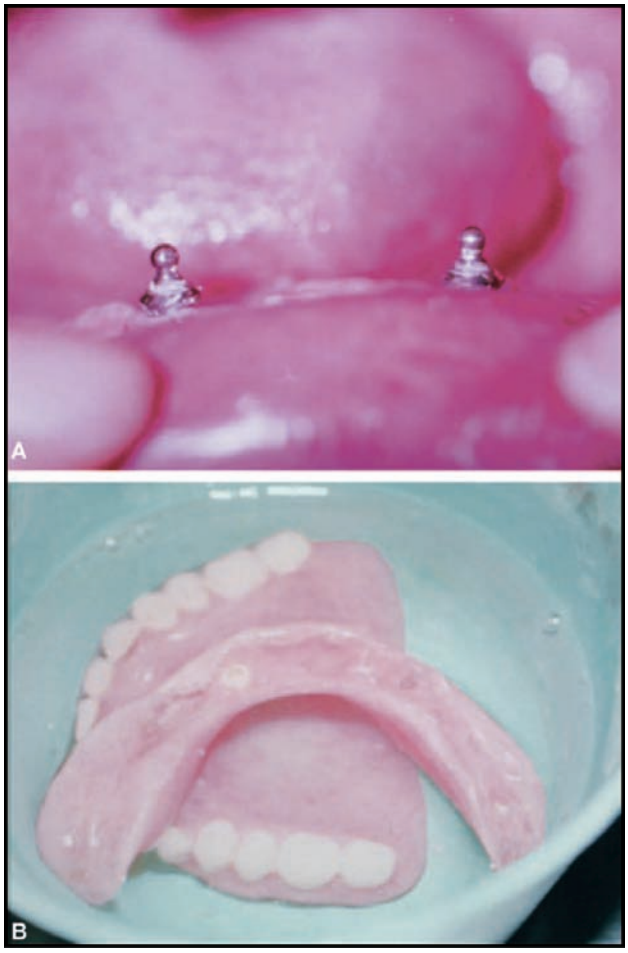


FIGURES 19.7A and B: Implant supported overdenture

The overdenture treatment commands meticulous consideration to details and also proves to be economically expensive. Hence, care should be taken in selecting cases with good prognosis.

SELF-HELP QUESTIONS

1. What are the basic principles of overdenture treatment?
2. What are the indications for overdenture?
3. What are the contraindications for overdenture?
4. What are the advantages of overdenture?
5. What is the proposed sequence of treatment for overdenture?
6. What is the importance of endodontic therapy of abutment teeth?



FIGURES 19.8A and B: Implant supported overdenture with anchor attachment

7. What is the ideal location of abutment teeth for overdenture treatment?
8. What is a coping?
9. What is the importance of coping on abutment teeth?
10. What is the significance of attachments in overdenture treatment?
11. What are the types of overdentures?
12. What is the advantage of implant supported overdenture?

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CHAPTER 20

Single Complete Denture

INTRODUCTION

In the treatment involving the fabrication of both maxillary and mandibular dentures, the operator has complete control over the articulation of teeth. But the prosthetic occlusion of a single complete denture opposing natural or restored dentition poses a technical challenge, since the dentist's control over the occlusal design and arrangement is reduced and may sometimes be compromised. Hence, the opposing dentition should be modified to reasonably eliminate the factors that may contribute to the failure of the single denture and result in forces that may exceed the physiologic tolerance of the residual foundation.

The mandibular complete edentulous arch opposing maxillary dentition is a challenging situation. The force of jaw closure with natural teeth is greater than that with complete dentures. This acts as a contributing factor to bone resorption of mandibular foundation thus adding to other factors that compromise the stability of the mandibular denture. Hence, it is advisable to convince the patient for extraction of all the maxillary teeth followed by replacement with both maxillary and mandibular dentures. However the compromised treatment of single mandibular denture may have to be done due to unwillingness of the patient, to avoid mental trauma of the patient due to loss of maxillary teeth which is more prominent or the need to retain maxillary teeth for retentive purpose as in case of a maxillary defect. A single complete denture may oppose any one of the following:

a. Natural teeth that is sufficient in number.
b. A partially edentulous arch in which missing teeth have been or will be replaced by a removable partial denture.
c. An existing complete denture.

PROCEDURES TO OBTAIN OCCLUSAL HARMONY

The impression procedure is completed to obtain a master cast and an occlusal rim is fabricated for the edentulous foundation. The casts are transferred on to a semiadjustable articulator by a face bow registration. The condylar guidances are set to an average value. The incisal guidance is set more nearly horizontal in order to reduce the inclines of the teeth, thus aiding in stability of the denture. The teeth are arranged for best possible occlusal balancing contacts. However, it may be found that the natural teeth will prevent this balancing, and it will be then necessary to grind the stone cast to remove these interferences. After the arrangement is completed, grinding of the interferences of the mandibular teeth on the stone cast is done by moving the maxillary teeth over the mandibular stone teeth. The processed denture is tested for retention and peripheral extensions followed by comparison of the natural teeth with the stone cast for the surfaces to be modified. The surfaces of the teeth are modified as indicated on the stone cast. The articulating paper is used to check the interferences in centric relation by an opening and closing movement and simulated excursive movements. The discrepancy is corrected by reducing the interfering surface and is refined.

Stanbury described the first functional chew in technique (1928) for an upper complete denture opposing lower natural teeth. His procedure involved fabrication of maxillary occlusal rim with freedom in lateral excursions. Carding wax was then added to the compound rim and patient instructed to perform eccentric chewing movements. The generated occlusal rim obtained by moulding of carding wax to functional movements was used to obtain lower chew in cast record by vibrating stone into it. The denture teeth were arranged in relation to the lower cast followed by the tryin procedure in patient's mouth. The lower cast was then replaced with chew-in cast record to remove all interfering spots by grinding, until the incisal pin prevented further closure.

TREATMENT PLANNING FOR SUCCESSFUL SINGLE COMPLETE DENTURE

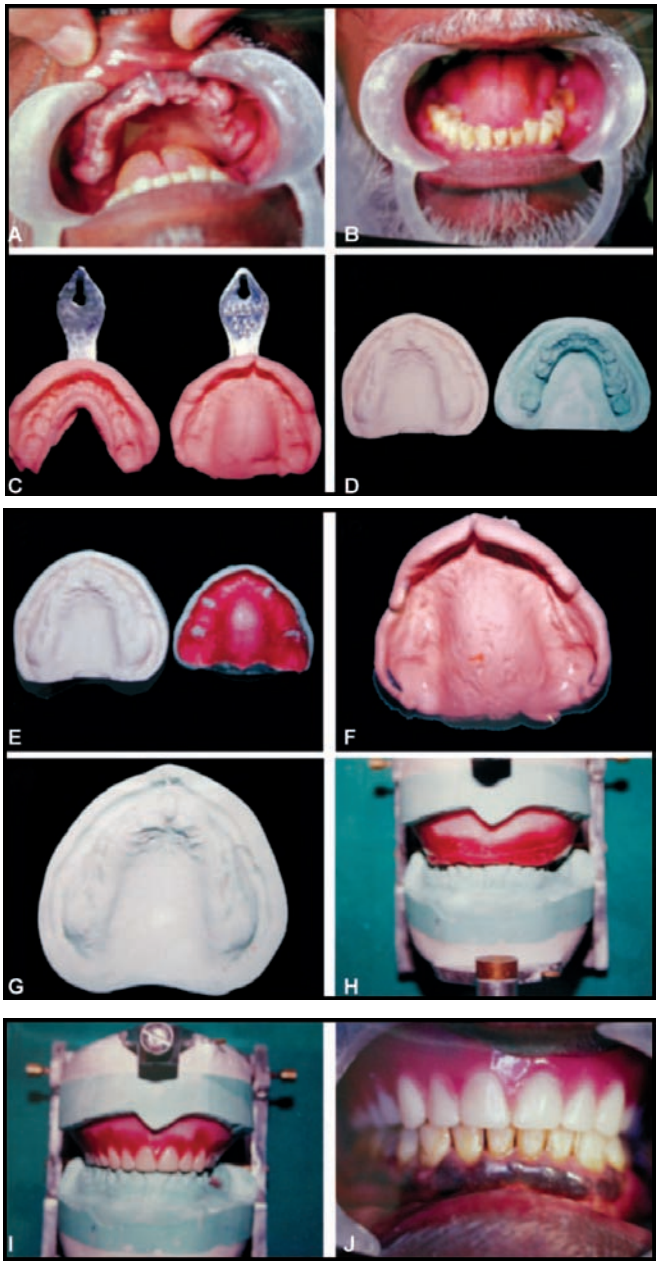
For a successful single complete denture treatment, optimal condition of the oral environment is the primary necessity. Hence the conditions that comprise the treatment should be outlined and corrected before the actual treatment is planned.

In a single complete maxillary denture to oppose natural mandibular teeth (Fig. 20.1), the number of

mandibular teeth, considered sufficient should include the first molars in jaws that have a class I or class III relation. In class II related jaws the anterior teeth and premolars bilaterally may suffice. The absence of the posterior teeth in this case will lead to the excessive stress on the maxillary anterior ridge by the lower anteriors. This will gradually lead to loss of bone, flabby tissue and inflammation in the anterior region of the maxillary ridge.

Although cusp form posterior teeth enhance stability of dentures through balanced occlusion abraded natural teeth which are not restored, dictate the use of monoplane form of posterior teeth. Sometimes the anterior teeth may have to be repositioned with orthodontic procedures in order to aid in aesthetic placement of artificial teeth. When the occlusal surfaces of the natural teeth and the food tables, are considered to be too large in the bucco-lingual dimension, they can be altered by removing some but not all of the enamel from both buccal and lingual surfaces. After the grinding, the enamel should be polished with flour of pumice in a rubber cup. An edentulous arch may present with different planes of occlusion due to loss of teeth at irregular period. This may also have led to supra eruption of teeth in the opposing arch. To prepare this mouth to receive a single complete maxillary denture requires extensive restorative procedures in the dentulous arch and possible surgery in the edentulous foundation. The choice of material composition for the replacement teeth should be carefully considered. Porcelain teeth against natural teeth will lead to wear of opposing natural teeth. Porcelain will also cause wear of gold occlusal surface and silver alloy restorations. Hence, acrylic teeth are mostly preferred in single complete dentures. Gold occlusal surface of single complete denture is preferred when it has to oppose gold restorations in the opposing arch. The patient should be evaluated periodically to check for the wear of teeth.

When a complete denture is to oppose an existing denture, the denture should be evaluated for retention, stability, hygiene and the occlusal surface and only if the condition of existing denture is satisfactory should an attempt be made to fabricate a denture on the opposing arch. If the condition of the opposing denture is not satisfactory, the denture should be repeated with the case being considered to be conventional maxillary and mandibular dentures.



FIGURES 20.1A to J: Maxillary single complete denture opposing mandibular natural dentition (A) Complete edentulous maxillary arch (B) Complete dentulous mandibular arch (C) Primary alginate impression (D) Diagnostic cast (E) Maxillary custom tray (F) Final impression (G) Master cast (H) Jaw relation transferred to articulator (I) Teeth arrangement (J) Final denture

When the complete maxillary denture has to oppose a removable partial denture in the mandibular arch, the

FIGUERS 20.2A to D: Combination syndrome (A) Maxillary complete denture opposing mandibular posterior removable denture (B) Maxillary complete denture and mandibular removable partial denture (C) Inflamed maxillary arch (D) Mandibular natural teeth and flabby maxillary anterior ridge

remaining mandibular teeth should be in an acceptable state of dental health. The partial denture must meet the requirements of an acceptable occlusal plane, tooth arrangement for occlusion, aesthetics and the material composition of the teeth. A removable partial denture which is not in optimum condition should be refabricated. When the opposing partial edentulous foundation is not restored, the treatment plan should be formulated for both arches at the same time. A maxillary complete denture should never oppose mandibular posterior removable partial denture with only remaining anterior teeth. A sequel of this condition is *combination syndrome (Fig. 20.2)* caused by the excessive force on the anterior part of the maxillary edentulous foundation by the mandibular anterior natural teeth. The acrylic teeth that are commonly used wears off over a period of time leading to decreased vertical dimension. Hence if the existing condition has to be restored, metal occlusal should be used.

The main consideration in restoration of edentulous foundation with single complete denture opposing fixed partial denture is the material composition. When the occlusal surfaces of the fixed prosthesis are porcelain, the choice of artificial teeth should be porcelain. When the occlusal surface of fixed partial denture is metal, the choice of occlusal surface of artificial teeth is metal / acrylic.

SELF-HELP QUESTIONS

1. What do understand by the term "single denture?"
2. Why is a mandibular complete denture opposing maxillary natural dentition considered to be a compromised condition?
3. What are the procedures followed to accomplish occlusal harmony?
4. What is combination syndrome?
5. What is the significance of metal occlusal surface in single complete denture?

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CHAPTER

21

Relining, Rebasing and Repair of Complete Dentures

INTRODUCTION

Relining is the procedure used to resurface the tissue side of a denture with a new base material thus producing an accurate adaptation to the denture foundation area.

Relining is indicated when there is loss of retention or stability due to alteration or loss of correct relationship to the supporting tissues. It cannot be done in the absence of optimum vertical and centric relation and correct occlusal form of teeth.

Rebasing is the laboratory process of replacing the entire denture base material on an existing prosthesis.

Rebasing is indicated for porous denture base and incase of deficient acrylic during fabrication. However, it is contraindicated in case of incorrect jaw relation

RELINING PROCEDURE

Direct Method

The relining procedure can be done directly in the patient's mouth using self-cure acrylic resin. Petroleum jelly is applied to the tissue surface and acrylic is lined on the tissue surface of the denture and stabilized in the mouth. The denture with the relining acrylic material is retrieved before the acrylic completely sets in order to prevent the damage to the oral tissues due to the heat generated. The relined denture is trimmed to remove any excess material followed by finishing and polishing of the borders. This procedure is, however, proved to be a failure for the following reasons:

- The relining material often produces a chemical burn.
- The resulting reline is often porous and subsequently produces a bad odour.
- If the denture is not positioned correctly the material cannot be easily removed in order to start again.
- Since the denture with the relining material is retrieved from the surface before the complete curing of the acrylic, the denture may be distorted.

Indirect Method

The indirect relining procedure consists of the *functional impression* and *static impression*.

In the *functional impression procedure,* the denture flanges and the tissue surface are reduced by 1-2 mm with stops at the canine and the molar regions. Border molding is done with low fusing impression compound. Tissue conditioning material is used for recording the impression. Patient is instructed to close in occlusion with light pressure and patient is allowed to wear the denture for 24 hours. The denture with the tissue conditioning material is used to pour a cast followed by flasking and packing as in for laboratory procedure in conventional complete dentures.

Static impression is more advantageous compared to the functional impression because of the following reasons:

- Impression is better controlled using selective pressure technique.
- Impression is not affected by the occlusion of remaining teeth.

In the *static impression procedure,* the denture is kept out of the mouth for 24 hours. The denture flanges and the tissue surface are reduced by 1-2 mm with stops at the canine and the molar regions. Border molding is done using low fusing stick compound followed by zinc oxide eugenol or rubber base impression in occlusion. The cast is poured and denture is flasked and packed in the usual manner. The denture is inserted after minor occlusal corrections (Fig. 21.1).

Rebasing Procedure

The borders of the denture and the tissue surface is reduced by 1-2 mm. Border molding and final impression is made with zinc oxide eugenol or rubber base impression material as for the relining procedure and the impression is poured in dental stone. The cast with the denture is mounted on the articulator. Plaster index is made on the opposing member of the articulator. The denture is separated from the cast. The base is trimmed away from teeth and the string of teeth is maintained intact. The intact string of teeth is placed back in the index and the articulator is closed. Wax up is done on the mounted cast to incorporate the string of teeth placed in the opposing index. The cast with the waxup is flasked, dewaxed and acrylic is cured in place of wax.

FIGURES 21.1A to I: Relining of mandibular complete denture (A) Denture flanges and tissue surface reduced by 2mm with stops in the canine and molar region (B) Border molding with low fusing stick compound (C) Final impression (D) The cast along with denture invested in the dental flask (E) Removal of low fusing compound and impression material (F) Acrylic packed on the tissue surface of the denture (G), (H), (I) Relined denture

Finishing and polishing of denture is done and inserted into patient's mouth after occlusal correction (Fig. 21.2).

REPAIR OF DENTURE

Replacing a Fractured Tooth/Teeth

Fractured Porcelain Teeth

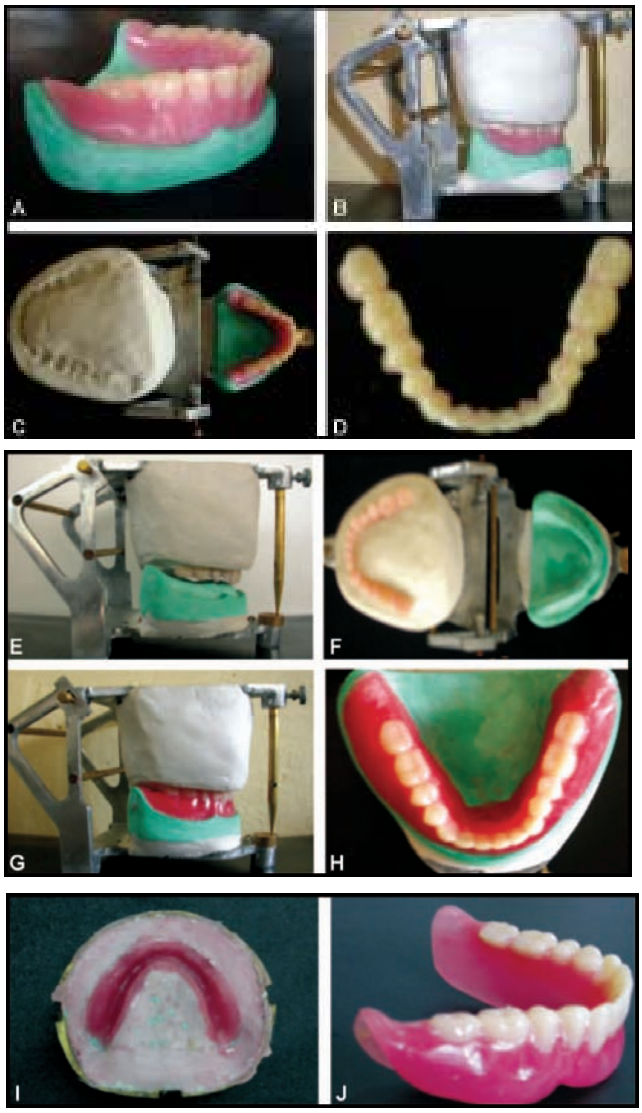
The denture base material should be cut away from the lingual surface of the fractured tooth. The tooth fragment should be pushed into lingual space and easily removed. This maintains the buccal / labial contour intact.

Fractured Acrylic Teeth

The remaining fragment of the acrylic teeth is ground away carefully with grinding limited to the tooth material. The buccal / labial contour should be maintained intact. Self-cure acrylic is used in order to eliminate the reheating of old denture base. The selected teeth should be modified to fit into the space of fractured tooth and self-cure acrylic is used to attach it to the denture base (Fig. 21.3).

Repair of Fractured Dentures

The main causes of denture fracture may be by accidental dropping of the denture or due to resorption of the

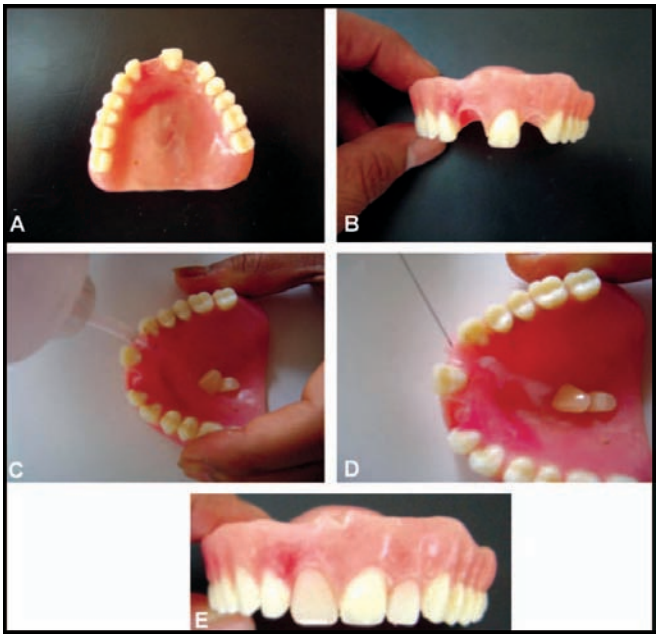


FIGURES 21.2A to J: Rebasing of mandibular denture. (A) Porosities in the mandibular denture (B),(C) Index of occlusal surfaces of the mandibular denture (D) String of teeth cut away from the denture base (E),(F) String of teeth placed in the index (G),(H) Waxup of new denture base (I)(J). Rebased mandibular denture

residual alveolar ridge which causes instability of the denture with the mid palatine area acting as fulcrum. The common area of fracture is the midline fracture, which extends from the labial frenum area to the palate.

Procedure

The two fractured segments of the denture should be held together with sticky wax and small wooden supports.

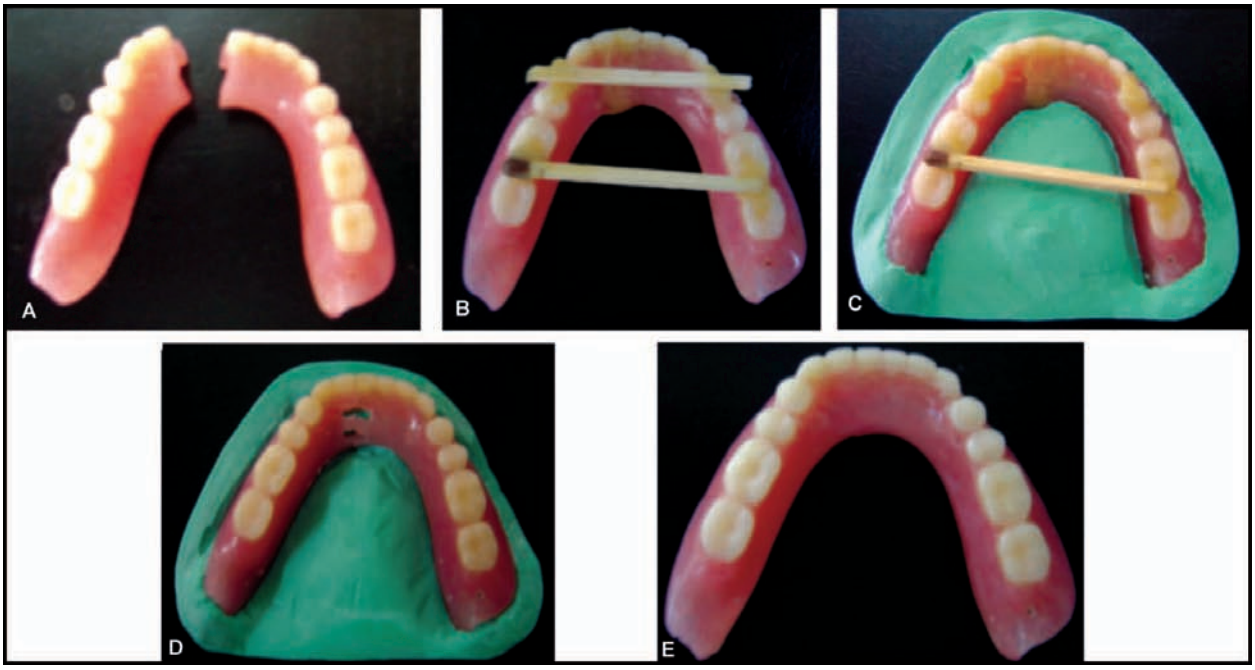


FIGURES 21.3A to E: Tooth replacement in complete denture (A)(B) Denture for tooth replacement (C)(D) Tooth replacement by sprinkle on method (E) Replaced teeth in the denture

The undercuts have to be blocked except 2 mm on each side of the fracture line and the cast poured. Tin foil substitute should be applied on the surface of the cast after separation from the denture. Grooves have to be placed on either side of the fracture line and replaced on the cast. Self-cure acrylic resin is added in the grooves. The denture is finished and polished after trimming the excess (Fig. 21.4).

SELF-HELP QUESTIONS

1. Define relining.
2. Mention the methods of relining.
3. What are the indications for relining?
4. Define rebasing.
5. What are the indications for rebasing?
6. What is the advantage of static indirect method over functional indirect method?
7. Describe the relining procedure.
8. Describe the rebasing procedure.
9. Mention the causes of fracture of denture.
10. Describe the procedure of repairing the fractured denture.



FIGURES 21.4A to E: Repair of fractured denture (A) Fractured mandibular denture (B) Fractured segments of denture approximated with sticky wax and match stick (C) Cast (D) Grooves in the fractured site (E) Repaired mandibular denture

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CHAPTER

22

Osseointegrated Implants in Complete Denture Prosthodontics

HISTORICAL REVIEW

Osseointegration is a direct bone anchorage of an implant body, which can provide a foundation to support prosthesis. *Dr Per-Ingvar Branemark,* Professor at the institute for applied Biotechnology, University of Goteborg, Sweden developed the concept of osseointegration and coined the term. In his study, microcirculation, Prof. Branemark surgically inserted the titanium chamber into the tibia of a rabbit. The initial concept of Osseointegration stemmed from vital microscopic studies of the bone marrow of the rabbit fibula, which was uncovered for visual inspection in a modified intravital microscope at high resolution in accordance with a very gentle surgical preparation technique. The studies that followed involved titanium implants placed into jaws of dogs. Teeth were extracted in dogs and replaced by Osseointegrated screw shaped titanium implants. Fixed prosthesis was connected after an initial healing time of 3 to 4 months without loading. In this manner, the fixtures were allowed to heal under a mucoperiosteal flap, which was then pierced for abutment connection and subsequent prosthetic replacement. Radiographic and histological analysis of the anchoring tissues showed that integration could be maintained for 10 years in dogs with maintained healthy bone tissue and without progressive inflammatory reactions. Basic research was done in the years that followed and clinical use began in May 1965. The history of the Branemark system can be categorized into three stages: (i) The early stage (1965-1968), (ii) The developmental stage (1968-1971), and (iii) The production stage (1971-present). The system in use includes surgical components and drilling equipment that were established in early 1971. In January 1986, the Branemark clinic for osseointegration implant treatment was established within the school of dentistry at Goteborg University. In 1980, *Dr George A Zarb* at University of Toronto, Canada began clinical use of the system and a scientific meeting on the osseointegration concept was held in Toronto in 1982. Osseointegrated implant treatment was originally designed for the edentulous patient to support a full arch prosthesis using four to six fixtures. This type of full arch prosthesis was called **Toronto denture**, but better termed a fully bone anchored prosthesis and is cantilevered through the second premolar areas.

INDICATIONS OF IMPLANT DENTURE

1. Edentulous patient with history of difficulty in wearing removable dentures.
2. When there is severe change in complete denture bearing tissues.
3. Poor oral muscular coordination.
4. Para-functional habits that compromise prosthesis stability.
5. Unrealistic patient expectations for complete dentures.
6. Hyperactive gag reflex.
7. Low tissue tolerance of supporting mucosa.

CONTRADICTIONS OF IMPLANT DENTURE

1. High dose irradiated patients.
2. Patient with psychiatric problems such as psychosis, dysthorphobia.
3. Hematological systemic disorders.
4. Pathology of hard and soft tissues.
5. Patient with drug, alcohol or tobacco chewing abuse.

CHARACTERISTICS OF THE OSSEOINTEGRATED IMPLANT

- The most important characteristic of this osseointegrated implant is that the direct bone anchorage can support a freestanding fixed prosthesis.
- Occlusal forces generated by patients with fully bone-anchored prosthesis are said to approximate the forces recorded in patients with natural dentitions.
- The patient with fully bone-anchored prosthesis has masticatory functions similar to natural dentition.
- This kind of implant can be retrieved in case of failure and another fixture placed at a later time.

BASIC GUIDING FACTORS OF OSSEOINTEGRATION

Biocompatibility of Implant Material (Table 22.1)

Materials used for fabrication of dental implants can be categorized in two different ways. From a fundamental chemical point of view, dental implants fall into one of the following three primary groups: *(a) Metal (b) Ceramics (c) Polymers.* In addition biomaterials can be classified based on the type of biologic response they elicit when implanted and the long-term interaction that develops with the host tissue. Three major types of biodynamic activity are *(a) Biotolerant (b) Bioinert (c) Bioactive*. The different levels of biocompatibility emphasize the fact that no material is completely accepted by the biologic environment. To optimize biologic performance, artificial structures should be selected to minimize the negative biologic response while ensuring adequate function.

Biotolerant materials are those that are not necessarily rejected when implanted into living tissue, but are surrounded by a fibrous layer in the form of a capsule. *Bioinert materials* allow close apposition of bone on their surface, leading to osteogenesis. *Bioactive materials* also allow the formation of new bone on to their surface, but ion exchange with host tissue leads to the formation of a chemical bond along the interface (bonding osteogenesis). Bioinert and bioactive materials are also called *osteoconductive* meaning that they can act as scaffolds allowing bone growth on their surfaces. *Osteoconductive* should not be confused with *osteoinductive* materials such as recombinant human bone morphogenetic protein 2 (rhBMP2), which refers to "capacity to induce bone formation". Biotolerant, bioinert and bioactive materials are all biocompatible by definition and result in a predictable host response in specific application. *Biomimetics* are tissue integrated materials designed to mimic specific biologic processes and help optimize the healing/regenerative response of the host microenvironment.

Metals

Metals for implants have been selected based on a number of factors: their biomechanical properties, previous experience with processing, treating, machining, finishing and suitability for common sterilization procedures. Titanium (Ti) and its alloys (mainly Ti-6Al-4V) have become the metals of choice for endosseous parts of currently available implants. However abutment screws, abutments, cylinders, prosthetic screws and various attachments are still made from gold alloys, stainless steel, cobalt chromium and nickel chromium alloys. Implants made of *commercially pure titanium*

Table 22.1: Classification of dental implant materials

Biodynamic activity	*Chemical composition*		
	Metals	*Ceramics*	*Polymers*
Biotolerant	- Gold - Cobalt chromium alloys - Stainless steel - Zirconium - Niobium - Tantalum		- Polyethylene - Polyamide - Polymethyl methacrylate - Polytetrafluro ethylene - Polyurethane
Bioinert	- Commercially pure titanium - Titanium alloy (Ti-6Al-4V)	Aluminium oxide Zirconium oxide	
Bioactive	- Hydroxyapatite - Tricalcium phosphate - Tetracalcium phosphate - Calcium pyrophosphate - Fluroapatite - Bioglass - Carbon silicon		

have established a benchmark in osseointegration. The Branemark fixture is made of commercially pure titanium which is *Ti–99.75 percent , Fe–0.05 percent , O–0.10 percent , N–0.03 percent , C–0.01 percent and others 0.06 percent.* Traces of other elements such as nitrogen, carbon, hydrogen and iron have also been detected and added for stability or improvement of the mechanical and physicochemical properties. Iron is added for corrosion resistance and aluminium is added for increased strength and decreased density, while vanadium acts as an aluminium scavenger to prevent corrosion.

When the titanium fixture comes into contact with the atmosphere, an oxide layer 50-100 Angstroms thick immediately forms and provides corrosion resistance. When the fixture has healed properly in bone, a glycoprotein layer followed by calcified layer approximately 100 angstroms thick surrounds the oxide layer. Prior to insertion of the fixture into bone, the surface of the titanium fixture must be kept sterile and contact with any other metal or protein substance should be strictly avoided. Titanium interacts with biologic fluids through its stable oxide layer, which forms the basis for its exceptional biocompatibility. Because of the high passivity, controlled thickness, rapid formation, ability to repair itself instantaneously if damaged, resistance to chemical attack, catalytic activity for a number of chemical reactions and modulus of elasticity compatible with that of bone, Ti is the choice for intraosseous applications.

Related materials such as niobium are able to produce a high degree of osseointegration and in addition clinical results are reported for some titanium alloys and hydroxyapatite coated implants

Ceramics

Hydroxyapatite [$Ca_{10}(PO_4)_6(OH)_2$] (HA), *tricalcium phosphate* [$Ca_3(PO_4)_2$] and *bioglass* are some of the more commonly used bioactive ceramics, which possibly develop a chemical bond of a cohesive nature with bone. Ceramics can make up the entire implant, or they can be applied in the form of a coating onto a metallic core. Low flexural strength and various degrees of dissolution/solubility of an all ceramic implant make coating, the application of choice in the field of implant dentistry. Hydroxyapatite coated implants are preferred in cases where more rapid and enhanced bone implant contact is needed, such as in type IV bone, grafted bone sites, or when short implants are indicated. However, the degradation of ceramic coatings has been a point of controversy and concerns have been expressed about their long-term stability and success.

Polymers

A variety of polymers, including *ultra high molecular weight polyurethane, polyamide fibers, polymethylmethacrylate resin, polytetra fluoroethylene and polyurethane* have been used as dental implant materials. Inferior mechanical properties, lack of adhesion to living tissues and adverse immunologic reactions has eliminated the application of these materials as a coating layer. Today polymeric materials are limited to manufacturing of shock absorbing components incorporated into the suprastructures supported by implants.

Implant Design

Implant design refers to the 3-dimensional structure of the implant, with all the elements and characteristics that compose it. Endosseous dental implants exist in a wide variety of designs with the main objective in every instance being the long-term success of osseointegrated interface and uncomplicated function of the prosthetic replacement. It has great influence on initial stability and subsequent function. The main design parameters are:

Implant Length

Implants are generally available in lengths from about 6 mm to as much as 20 mm. The most common lengths employed are between 8 and 15 mm, which correspond quite closely to normal root length.

Implant Diameter

A minimum diameter of 3.25 mm is required to ensure adequate implant strength. Implant diameter is more important than implant length in the distribution of load to the surrounding bone.

Implant Shape

Hollow cylinders, solid cylinders, hollow screws or solid screws are commonly employed shapes, which are designed to maximize the potential area for osseointegration and provide good initial stability. Screw shaped implants also offer good load distribution characteristics in function. Dental implants are also categorized into threaded and non-threaded, cylindrical or press fit. The threaded screw implants are threaded into a bone site and have obvious macroscopic retentive elements for initial bone fixation. The press fit implants depend on microscopic retention and or bonding to the bone, and usually are pushed or tapped into a prepared bone site.

The fixture with threaded surface has larger surface area and the threads also help to balance the force distribution into the surrounding bone tissue. The threads created in the bone site play an important role in initial implant fixation. Precision fit of the fixture called primary stability is an essential element for osseointegration, the failure of which leads to soft tissue proliferation between the fixture and bone rather than direct bone interface.

Surface Characteristics

The quality of the implant surface influences wound healing at the implantation site and subsequently effect osseointegration.

Smooth surface: Wennerberg and Coworkers suggested that smooth be used to describe abutments, whereas the terms minimally rough (0.5 to 1 μm), intermediately rough (1 to 2 μm) and rough (2 to 3 μm) be used for implant surfaces. However other literature reports that average surface roughness (Sa), surfaces with Sa≤1 μm are considered smooth and those with Sa>1 μm are considered as rough.

Rough surface: Plasma spray coating is one of the most common methods for surface modification. *Plasma spraying* is used for the application of both Ti and HA on metallic cores with a coating thickness of 10 to 40 μm for Ti. Thickness depends on particle size, speed and time of impact, temperature and distance from the nozzle tip to the implant surface area. The surface roughness value (Ra) for Ti plasma spray is 1.82 μm and for HA plasma spray Ra=1.59 to 2.94 μm. Another method used in surface alteration is by *blasting with particles.* In this approach, the implant surface is bombarded with particles of aluminium oxide (Al_2O_3) or titanium oxide (TiO_2) and by abrasion; a rough surface is produced with irregular pits and depressions. Roughness depends on particle size, time of blasting, pressure and distance from the source of particles to the implant surface. *Chemical etching* is another process by which surface roughness can be increased. The metallic implant is immersed into an acidic solution, which erodes its surface, creating pits of specific dimensions and shape. Concentration of the acidic solution, time and temperature are factors determining the result of chemical attack and microstructure of the surface. Another mode of surface treatment is *sandblasting* with large grit and *acid etch.* This surface is produced by a large grit (250 to 500 μm) blasting process followed by etching with hydrochloric sulfuric acid. The average Ra for acid etched surface is 1.3 mm and for sandblasted and acid etched surface, Ra=2.0 μm.

Porous: Porous sintered surfaces are produced when spherical powders of metallic or ceramic material become a coherent mass with the metallic core of the implant body. Lack of sharp edges is what distinguishes these from rough surfaces. Porous surfaces are characterized by pore size, pore shape, pore volume and pore depth, which is affected by the size of spherical particles, temperature and pressure conditions of the sintering chamber.

Prosthetic Interface

It is the *level at which the superstructure or the abutment connects to the implant body.* It can be either *external* or *internal.* The most common external connection is the *hexagonal ("hex") type.* The 0.7 mm high, 2.7 mm wide, straight external hex on a 4.1 mm diameter platform is considered the industry's standard. Due to its strength and stability limitations, however, variations in the hex and platform have evolved. The standard external hex allows 4.0° to 6.7° of rotational wobble with 3°-5° of tipping depending on the type of hex. Full seating of abutment over fixture can only be verified by

taking additional radiographs. Without intimate contact between the walls of the mating hexes, cyclic loading transmits forces directly to the fixation screw, which may cause it to repeatedly loosen.

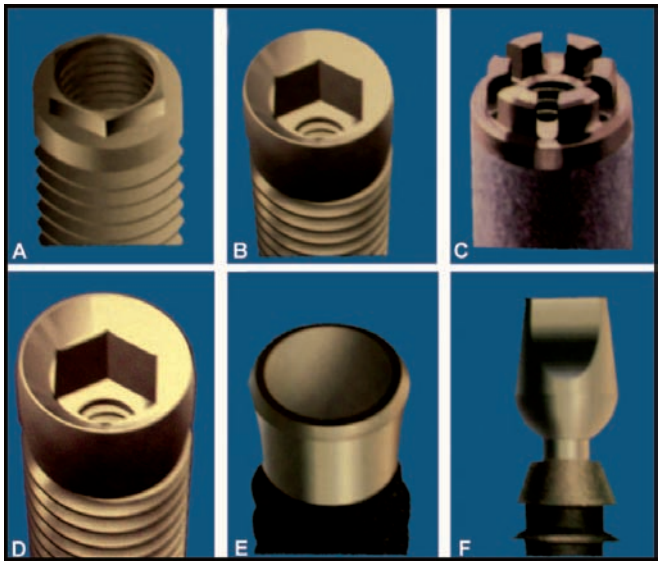
An *internal hex* in the implant is designed to prevent rotation of the abutments. Compared to an external hex, an internal hex allows a better protection against rotation of abutments and against gap formation at the implant abutment interface.

External spline by Calcitek acknowledges that its 0.4 mm spline connection allows 3° tipping thereby transferring forces to the abutment screw under lateral loading. However the butt joint shoulder of the spline connection can also trap soft tissue during abutment seating. Furthermore the 1.0 mm height of the spline connection can interfere with occlusal clearance and hinder establishment of anatomical contours on angled abutments.

Non-hexed conical connection is an ITI implant design which has a conical opening to an internally threaded shaft. Tightening an abutment with a matching conical surface provides lateral stability. It provides no interdigitation to resist rotation, which is of some significance in single tooth restorations. In order to assure contact with the mating conical surface, the abutment cannot be designed to seat on the top surface or 'shoulder' of the implant. This limitation prevents the use of abutments wider than the diameter of the conical opening and leaves the shoulder exposed to support the restoration. Without flush fitting abutments, there is no opportunity to prepare the margins to follow the natural contour of the tissue.

Non-hexed morse taper connection is provided by the Bicon Implant. A 1°-2° tapered abutment post frictionally fits into the non-threaded shaft of the implant, which has a matching taper. The body is designed with a series of fins for a press fit insertion procedure. This surgical protocol is dictated in part, by the implant's prosthetic connection, which lacks a wrench-engaging surface. The connection also dictates how abutments are attached and stabilized and the type of emergence profile they can provide. However there are several potential esthetic and hygienic limitations with this connection.

I. The tapered mating surfaces of the implant and abutment must contact each other in order to create the frictional fit. This creates an undercut at the implant to abutment transition, which prevents extension of the restoration margin below the abutment's height of contour. If the gingiva recedes or the implant is not adequately countersunk, the margin of the restoration can become exposed which will create an irresolvable esthetic problem.
II. Without an internal or external hex or other wrench-engaging surface, it is not possible to make a transfer impression and modify abutments for parallelism or contour on a working cast. Therefore, the dentist must modify the appropriate straight and angled abutment directly in the mouth, which is not an easy task with cross arch splinting of multiple implants.
III. Claims of Bicon's frictional fit stability must be questioned, since the manufacturer's recommended method of removing the abutment is simply to twist it with forceps.
IV. Striking the abutment with a sharp blow in the long axis of the implant completes seating the Biocon implant. This method of attachment cannot be



FIGURES 22.1A to F: Prosthetic interface. (A) Standard external hex (B) Internal hex (C) External spline (D) Non-hexed conical connection (E) Non-hexed morse taper

repeated as easily as tightening a screw with a torque wrench, and will not work if the abutment hits the bone crest before the taper interlocks.

V. In order to initially ensure a subgingival margin, the manufacturer recommends that the implant be placed 3 to 5 mm below the crest of bone to lower the height of the abutment contour for contact with the crest of ridge. This surgical procedure sacrifices important cortical bone support and requires bone contouring at the time of abutment seating to match the base of the abutment.

Additional Features

The additional features that are employed by the manufacturers include perforations of various shapes and dimensions, vents, ledges, grooves, flutes and indentations. The implant can be solid/hollow, with a parallel, tapered/conical, or stepped shape/outline and flat, round or pointed apical end.

Bone Factor

The stability of the implant at the time of placement is very important and is dependent upon bone quantity, quality as well as implants design. The most favorable quality of jawbone for implant treatment is that which has a well-formed cortex and densely trabeculated medullary spaces with good blood supply. Bone, which is predominantly cortical, may offer good initial stability at implant placement but is more easily damaged by overheating during the drilling process, especially with sites more than 10 mm in depth. At the other extreme, bone with a thin or absent cortical layer and sparse trabeculation offers very poor initial implant stability and fewer cells with a good osteogenic potential to promote osseointegration. Success is highly dependent upon a surgical technique, which avoids heating the bone. Bone should not be heated beyond 43°C, since alkaline phosphate begins to breakdown. Gentle surgical technique with the speed of drilling equipment not to exceed 2000 rpm and copious amount of sterile irrigation with internally irrigated drills should be used. The tapping procedure for threading and fixture installation into bone requires a drilling speed between 15 to 20 rpm. Factors that compromise bone quality are infection, irradiation and heavy smoking. The effects of the latter are results of a diminution of the vascular supply to the bone which compromises healing response, a feature that has been well described in the healing of fractures.

Loading Conditions

Following installation of an implant it is important that it is not loaded during the early healing phase. Movement of the implant within the bone at this stage results in fibrous tissue encapsulation rather than osseointegration. This has been compared to the healing of a fracture where stabilization prevents non-union. The Branemark system emphasizes on maintaining the fixtures unloaded for six months in the maxilla and three to four months in the mandible, mainly because of differences in bone quality.

No loading while healing is the basic guide to osseointegration.

The surgical procedures are divided into two stages. The first stage is the installation of the fixtures into bone, allowing a 3 to 6 month healing period. The mucosa supported interim denture should not be worn for 1 to 2 weeks, which also helps to prevent breakdown of the soft tissue wound. Bone healing begins within first week after insertion of the fixture and reaches a peak at the third or fourth weeks. The initial healing tissues gradually become bony tissue after six to eight weeks. If fixtures are displaced or loaded during this interim healing period, fibrous tissue formation will occur. The second stage is the connection of abutments to fixture. Due to these various sequences, the two stage surgical procedures are very important for successful osseointegration. Some systems employ a single stage approach in which the implant is installed so that it protrudes through the overlying mucosa, although avoidance of early loading is equally critical. Following the recommended healing period (3-6 months) abutments are connected to the implant to allow construction of prosthesis.

MECHANISM OF OSSEOINTEGRATION

The healing process with Branemark system is the same as normal bone healing. The implant bone integration

should ideally be like the primary healing where there is well-organized bone formation with minimal granulation tissue formation. To duplicate the primary bone healing, the surgery should be performed on healthy bone, free from infection and necrotic tissue.The healing process is sequenced as follows:

- Blood present between the bone and implant surfaces leads to *blood clot.*
- Phagocytic cells such as polymorphonuclear leukocytes, lymphoid cells and macrophages transform the blood clot. The phagocytic activity level peaks during the time between the first and third day after surgery. During this period formation of *procallus* occurs containing fibroblasts, fibrous tissue and phagocytes.
- The procallus becomes dense connective tissue and mesenchymal cells differentiate into osteoblasts and fibroblasts. This connective tissue is referred to as *callus,* including osteoblasts that appear on the fixture surface.
- The dense connective tissue then forms a f*ibro-cartilagionous callus,* usually forming between the fixture and bone.
- New bone penetrates and the new bone matrix is called the *bone callus.*
- This new *bone matures,* increasing in density and hardness.
- At this time, the prosthesis is attached to the fixtures and with stimulation or load by the prosthesis, *bone remodeling* occurs.

TERMINOLOGIES

Oral Implantology (Implant Dentistry):It is the science and discipline concerned with the diagnosis, design, insertion, restoration and/or management of alloplastic or autogenous oral structures to restore the loss of contour, comfort, function, esthetics, speech and/or health of the partially or completely edentulous patient (Carl E. Misch).

Implant Prosthodontics: It is the branch of implant dentistry concerning the restorative phase following implant placement and the overall treatment plan component before the placement of dental implants (Carl E. Misch).

It is the phase of prosthodontics concerning the replacement of missing teeth and/or associated structures by restorations that are attached to Dental Implants (GPT-7).

Implant

To graft or insert a material such as an alloplastic substance, an encapsulated drug or tissue into the body of a recipient (GPT-7).

Any object or material, such as an alloplastic substance or other tissue, which is partially or completely inserted or grafted into the body for therapeutic, diagnostic, prosthetic or experimental purposes (GPT-7).

Implant Prosthesis: Any prosthesis (fixed, removable or maxillofacial) that utilizes dental implants in part or whole for retention, support and stability.

Implant Surgery: The phase of implant dentistry concerning the selection, planning and placement of the implant body and abutment (GPT-7).

Implant System: Dental implant components that are designed to mate together. An implant system can represent a specific concept, inventor, or patent. It consists of the necessary parts and instruments to complete the implant body placement and abutment components.

Osseointegration: The apparent direct attachment or connection of osseous tissue to an inert, alloplastic material without intervening connective tissue (GPT-7).

Direct bone anchorage to an implant body, which can provide a foundation to support prosthesis (Branemark, 1983).

A direct structural and functional connection between ordered living bone and the surface of a load carrying implant (Albrektsson et al., 1981).

Endosseous Implant/Endosteal Implant: A device placed into the alveolar and/basal bone of the mandible or maxilla and transacting only on cortical plate (GPT-7).

A device inserted into the jawbone (endosseous) to support a dental prosthesis. It is the 'tooth root' analogue and is often referred to as *fixture* (Richard Palmer).

Single Stage Implant Surgery: Surgical placement of a dental implant, which is left, exposed to the oral cavity following insertion. This is the protocol used in non-submerged implant systems (Richard Palmer).

Two Stage Implant Surgery: Initial surgical placement of a dental implant, which is placed into the bone and then subsequently exposed with a second surgical procedure some months later.

COMPONENTS OF BRANEMARK IMPLANT SYSTEM

Implant Fixture/Implant Body (Fig. 22.2)

The portion of a dental implant that provides support for the abutment(s) through adaptation upon (eposteal), within (endosteal) or through (transosteal) the bone (GPT-7). The body is that portion of the implant designed to be surgically placed into the bone. It may extend slightly above the crest of the ridge.

Healing/Cover Screw

The component of an endosteal dental implant system used to seal, usually on an interim basis, the dental implant body during the healing phase after surgical placement. The purpose of the healing screw is to maintain patency of the internal threaded section for subsequent attachment of the abutment during the second stage surgery (GPT-7).

Healing Abutment/Interim Endosteal Dental Implant Abutment

Any dental implant abutment used for a limited time to assist in healing or modification of the adjacent tissues (GPT-7).

After a prescribed healing period that allows a supporting interface to develop, second stage surgery is performed to uncover or expose the implant and attach the transepithelial portion or abutment. This trans-epithelial portion is termed a second stage permucosal extension, because it extends the implant above the soft tissue and results in the development of a permucosal seal around the implant.

Implant Abutment

The portion of a dental implant that serves to support and/or retain any prosthesis (GPT-7).

Three main categories of implant abutments are described according to the method by which the prosthesis or superstructure is retained to the abutment: (i) an abutment for screw uses a screw to retain the prosthesis or superstructure; (ii) an abutment for cement uses dental cement to retain the prosthesis or superstructure; (iii) an abutment for attachment uses an attachment device to retain the removable prosthesis. Many manufacturers classify abutments as fixed whenever cement retains the prosthesis and removable when they are screw retained. Each of the three types of abutments is further classified into straight and angled abutments, describing the axial relationship between the implant body and abutment.

Hygiene Screw

It is placed over the abutment between prosthetic appointments to prevent debris and calculus from entering the internally threaded portion of the implant.

Transfer Coping/Impression Coping

Any device that registers the position of the dental implant body or dental implant abutment relative to adjacent structures (GPT-7).

Two basic techniques are used to make a master impression, and each use a different transfer coping based on the transfer technique performed in the mouth or on a mastercast. An *indirect transfer coping* utilizes an impression material requiring elastic properties. The indirect transfer coping is screwed into the abutment or implant body and remains in place when the set impression is removed from the mouth. The indirect transfer coping is parallel sided or slightly tapered to allow ease in removal of the impression and often has flat sides or smooth undercuts to facilitate reorientation into the impression. A *direct transfer coping* usually consists of a hollow transfer component, often square and a long screw to secure it to the abutment or implant body. After the impression material is set the direct transfer coping

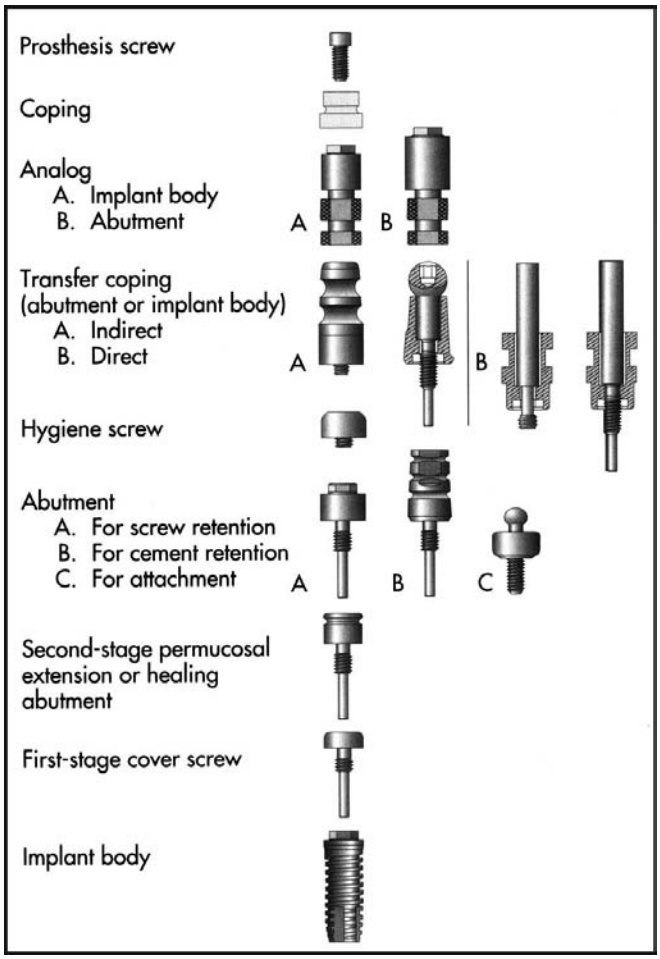


FIGURE 22.2: Components of Branemark implant system

screw is unthreaded to allow removal of the impression from the mouth. The direct transfer coping takes advantage of impression materials having rigid properties or eliminates the error of permanent deformation because it remains within the impression on its removal.

Implant Analog

An analog is something that is analogous or similar to something else. Implant analog is used in the fabrication of the master cast to replicate the retentive portion of the implant body or abutment. After the master impression is secured the corresponding analog (implant body, abutment for screw or other portion) is attached to the transfer coping and the assembly is poured in stone to fabricate the master cast.

Coping/Gold Cylinder

It is a thin covering usually designed to fit the implant abutment and serve as the connection between the abutment and the prosthesis or superstructure. A prefabricated coping usually is a plastic pattern cast into the metal superstructure or prosthesis.

Coping Screw

The screw retained prosthesis or superstructure is secured to the implant body or abutment with a coping screw.

PROSTHETIC OPTIONS IN IMPLANT DENTISTRY

An edentulous patient can have one of two types of prostheses by osseointegrated implants. The first type of prosthesis is the *fully bone anchored prosthesis* and the second type is an *overdenture.*

Fully Bone Anchored Prosthesis (Fig. 22.3)

The fully bone anchored prosthesis is connected to supporting fixtures through the transmucosal components, the abutments either in the maxilla/mandible. To provide proper support for a fully bone anchored prosthesis a minimum of four to six fixtures are necessary. Ideally a fifteen millimeter length/longer should be placed when there is adequate bone. If bone density and quality is poor, the number of fixtures should be increased.

Design

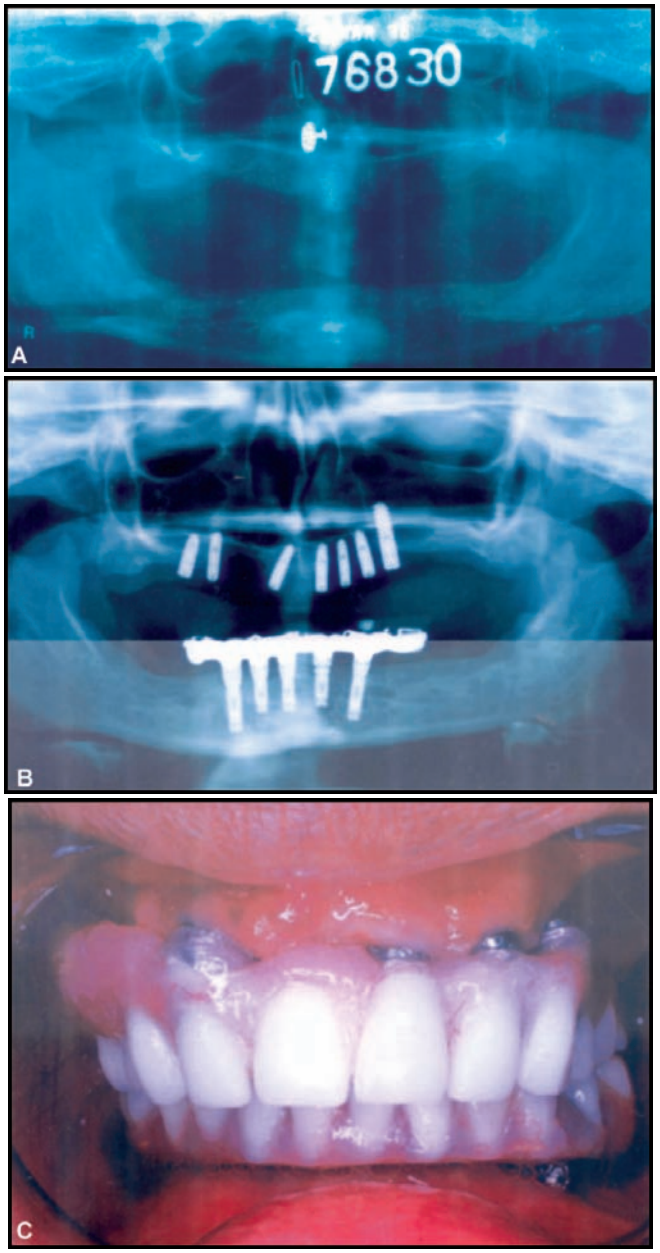
Fully bone anchored prosthesis does not obturate the space between the prosthesis and residual tissues.

Advantages

- Satisfies functional demands.
- Greater psychological acceptance.

Disadvantages

- Airflow pattern produced during speech is unimpeded, which may present problems for the patient if their occupation requires good speaking ability.



FIGURES 22.3A to C: Implant supported complete bone anchored prosthesis (A) Radiograph of complete edentulous foundation (B) Radiographic view of implants placed in complete edentulous foundation (C) Bone anchored prosthesis

- In case of severe resorption in the maxilla esthetic results may be difficult due to added amount of anatomical structures.
- It may be difficult to obtain lip support.

Overdenture (Fig. 22.4)

Implant supported overdenture is a treatment of choice in case of soft/hard tissue defects, Esthetics can be improved by increasing or decreasing the amount of denture base material. This change in design can enhance lip and facial support. Overdenture is attached to supporting fixtures using various connectors or attachments, which usually do not alter esthetic results. Minimum of two fixtures are needed for support.

Advantages

- Implants for overdenture may be used as secondary retention in patients with poor bone quality and quantity that may have been inadequate to support a fully bone anchored prosthesis.
- Problems related to functional speech disturbances and esthetic soft tissue support could be eliminated.
- It is the treatment of choice for handicapped patients or patients lacking manual dexterity for intricate hygiene procedures needed for the fully bone anchored prosthesis.
- Use of fewer implants can be considered a financial advantage if cost is of concern to the patient.
- It can be used as interim prosthesis if it has to be converted to a fully bone anchored prosthesis.
- Hygiene maintenance is less complicated.

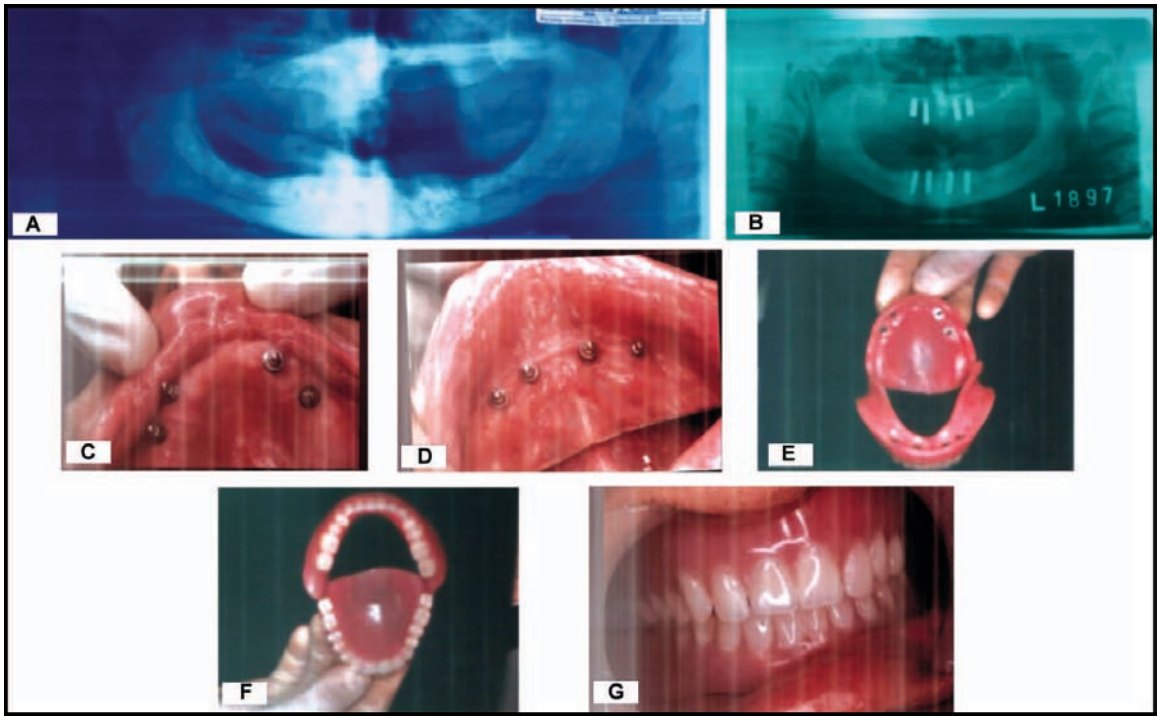
Disadvantages

- It may not satisfy patients with negative attitude towards removable prosthesis.
- Some overdentures may be bulky especially in a patient who has lost larger amounts of hard and soft supporting tissue since the denture base material is increased to compensate this loss.

BASIC SEQUENCE OF PROCEDURES IN IMPLANTS TREATMENT

Radiographic Stent (Fig. 22.6)

A diagnostic template incorporating stainless steel balls is used for treatment planning of the implant position. A



FIGURES 22.4A to G: Implant supported overdenture (A), (B) Radiographic view of complete edentulous foundation and placement of implants Implants in edentulous foundation (C), (D) Implants with ball abutments in maxillary and mandibular edentulous foundation (E), (F) Tissue surface and polished surfaces of the denture prosthesis (G) Final prosthesis in place

panoramic radiograph is made with template seated in the mouth to evaluate vertical bone height in relation to the mental foramen and inferior alveolar nerve in the mandible (Fig. 22.5). In the maxilla the vertical bone between the floor of maxillary sinus-alveolar crest and nasal floor-alveolar crest is evaluated. The actual diameter and position of the stainless steel balls in the template relative to the diameter and the position measured on the radiograph help determine distortion of size and position as seen on the radiographs.

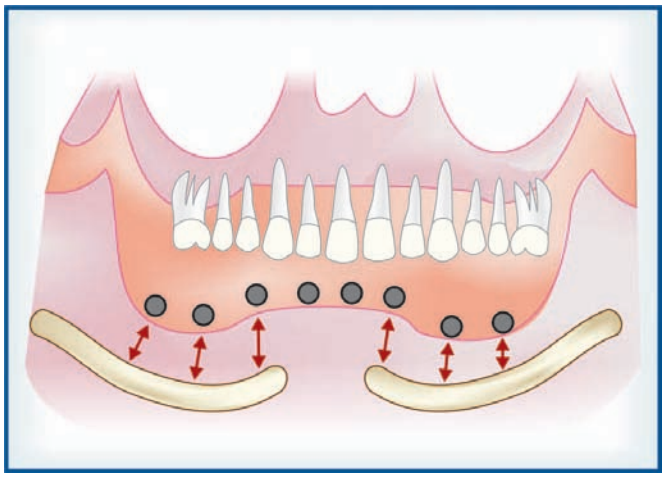


FIGURE 22.5: Radiographic view

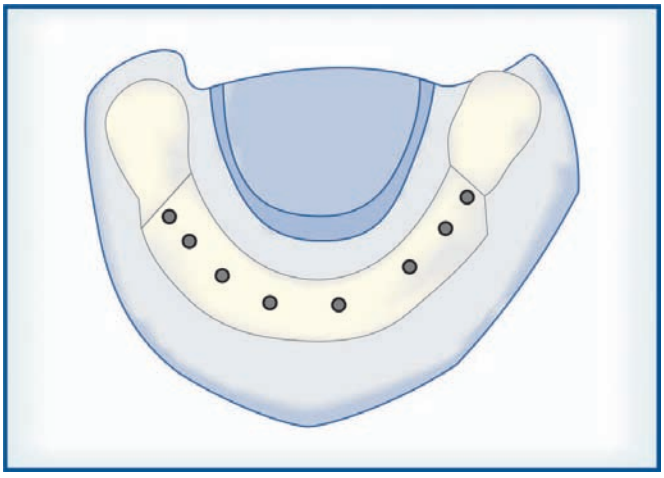


FIGURE 22.6: Radiographic stent

The formula

$$\frac{A_{(real)}}{A_{(OPG)}} = \frac{D_{(real)}}{D_{(OPG)}}$$

$$\frac{A_{(real)}}{18\ mm} = \frac{5\ mm}{6\ mm}$$

$$A_{(real)} = \frac{18\ mm \times 5\ mm}{6\ mm}$$

$$A_{(real)} = 15\ mm$$

There are two methods for fabrication of a resin splint. One method involves duplication of the patient's present prosthesis and using the duplicate as both a radiographic and surgical splint. The other method involves fabrication of a resin denture from study casts.

Surgical Template (Fig. 22.7)

As mentioned in radiographic splint, surgical template can be fabricated by duplicating the existing denture or a newly fabricated prosthesis.

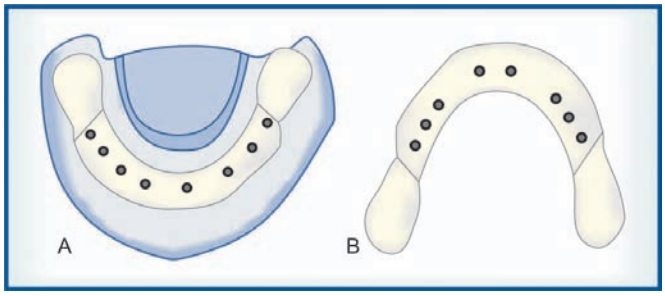


FIGURE 22.7: Surgical stent

First Stage Surgery

The following case demonstrates the placement of Branemark implant (Figs 22.8 and 22.9).

Second Stage Surgery

The uncovering of the implant is carried out after a healing phase of at least 4 months. The gingival former is screwed onto the implant and the flap sutured around it (Fig. 22.10).

Impressions

Impressions can be made after the soft tissues have healed – approximately two weeks. The transfer coping is

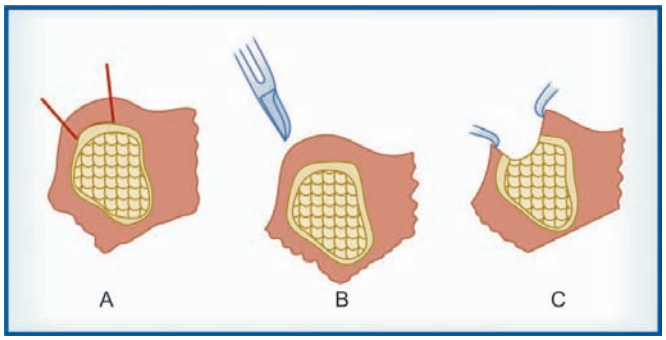


FIGURE 22.8: The bone is exposed by an incision and reflection of mucosal membrane and periosteum (full thickness flap)

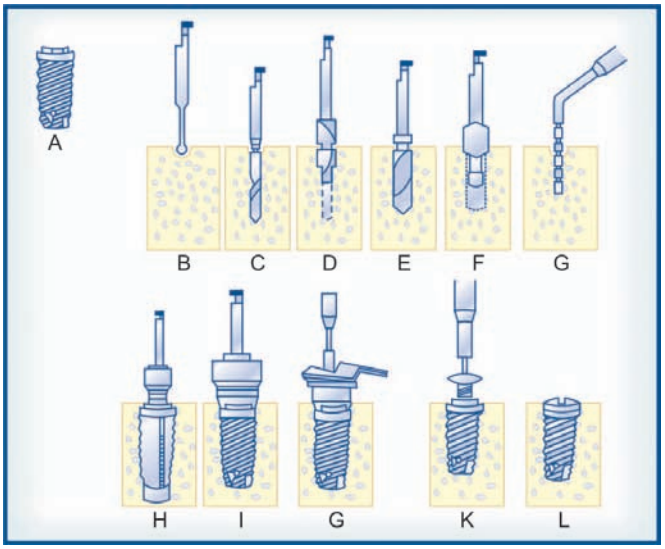
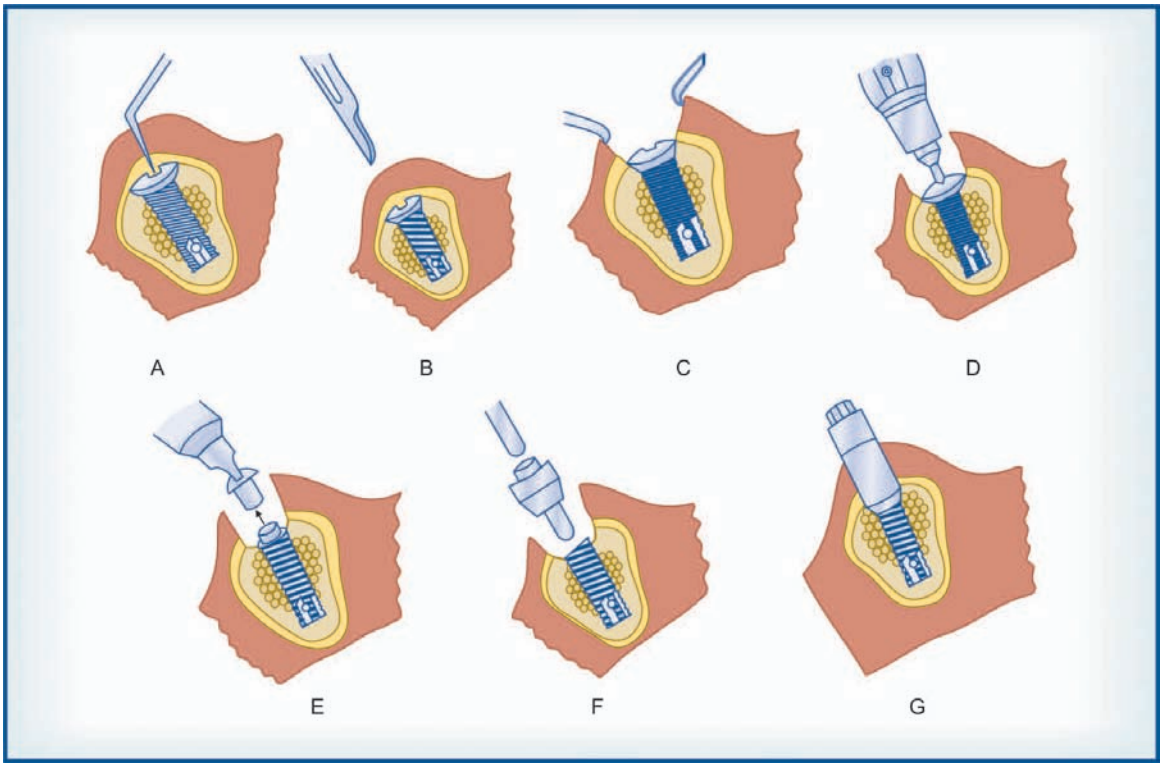


FIGURE 22.9: Procedure for implant placement

A. Nobel Biocare implant.
B. The manufacturer's recommended procedure begins with using the guide drill to half its diameter to penetrate the cortical plate at the proposed implant site.
C. Use the 2 mm twist drill to the final implant depth.
D. Use the counterbore to enlarge the coronal portion of the osteotomy in preparation of the 3 mm twist drill.
E. The 3 mm twist drill.
F. Countersink drill.
G. Depth gauge.
H. Screw tap the implant.
I. Insert the implant attached to the fixture mount.
J. The open-ended wrench stabilizes the fixture mount, while its fixation screw is removed from the implant.
K. Cover screw placement with the small hexagon screwdriver.
L. Seat the Nobel Biocare implant so that its cover screw is flush with the crest of bone.



FIGURES 22.10 A to G: Second stage surgery

A. Use of an explorer to locate the position of the cover screws
B. After locating the positions of the cover screw, a 5 mm incision is made across the screw
C. Dissector is used to reflect the soft tissue and locate the center hole of the cover screw
D. The needle of the punch blade placed in the center hole of the cover screw
E. The cover screw is removed with a screw driver
F. Small abutment clamp is used to hold the abutment and rotate it into position over the fixture
G. Healing cap placed over the abutment

inserted into the implant and the abutment screw tightened. The transfer coping transfers the exact position of the implant to the model through the impression. The two types of impression techniques are: *(a) transfer technique and (b) pickup technique.*

Transfer Technique

Once the gingiva is healed, the gingiva former is unscrewed and replaced with indirect transfer coping. The head of the screw should be covered with wax and the impression is made. Laboratory analogs are placed in the impression in relation to the impression coping and the cast is poured. The abutment is screwed on to the fixture (Fig. 22.11).

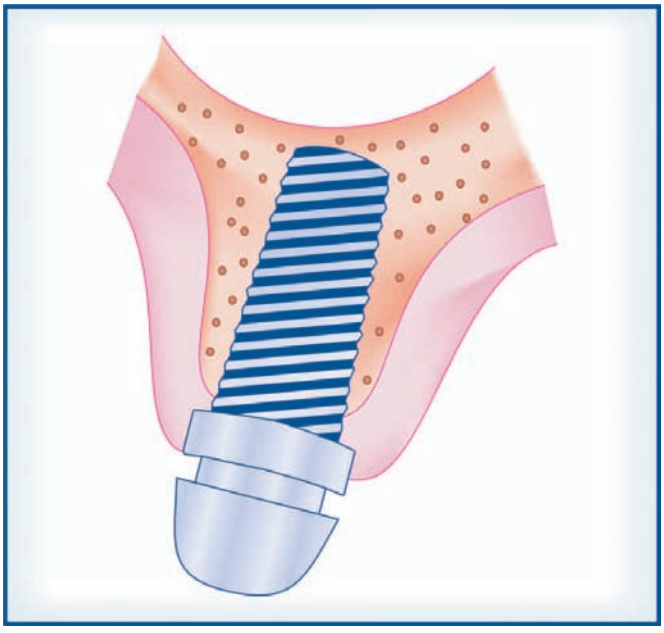


FIGURE 22.11: Impression coping attached to the fixture

Pickup Impression

An alternative method is to use an open tray. In this case the direct transfer coping is secured in place with a guide pin. Once the impression material has set, the guide pin is loosened. The transfer coping remains in the impression when it is removed from the mouth (Fig. 22.12).

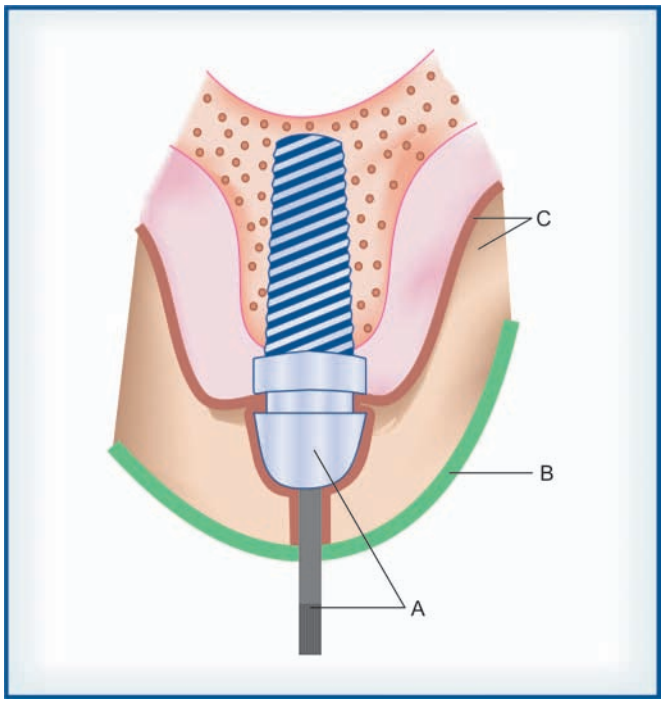


FIGURE 22.12: (A) Impression coping with guide pin (B) Impression tray (C), (D) Impression material

Base plate wax is adapted around the replicas and guide pins are screwed into the replica (Fig. 22.13).

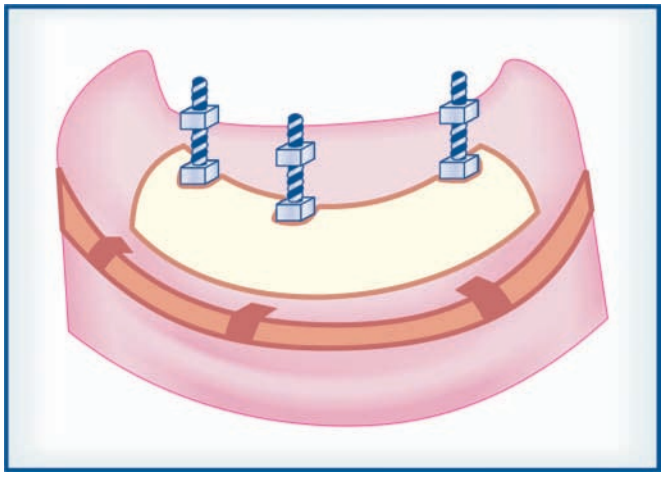


FIGURE 22.13: Adaptation of base plate wax

After application of tinfoil, substitute, autopolymerizing resin is adapted (Fig. 22.14) to the master cast such that the material engages undercuts in the gold cylinders. The interface between the brass replica and gold cylinder is opened for visualization on the facial surfaces.

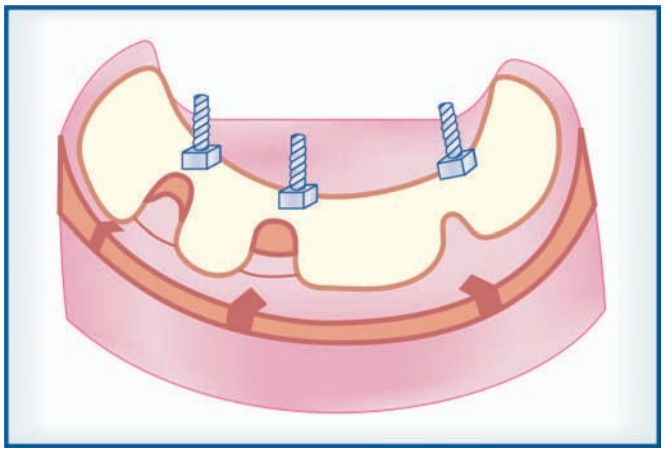


FIGURE 22.14: Record base fabrication

Base plate/modeling wax are used to fabricate the occlusion rim (Fig. 22.15) in the usual fashion. Wax occlusion rims are used to establish maxillomandibular relations followed by trial of the waxed up (Fig. 22.16) denture and final denture insertion (Fig. 22.17).

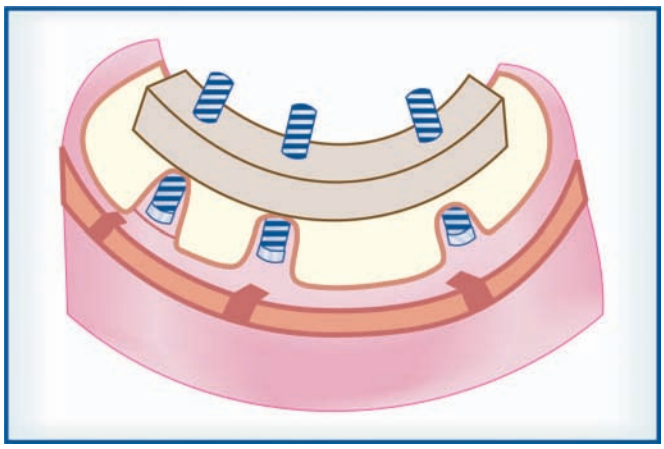


FIGURE 22.15: Occlusion rim for jaw relation record

SELF-HELP QUESTIONS

1. Define osseointegration.
2. Who developed the concept of osseointegration?
3. What is "Toronto denture?"

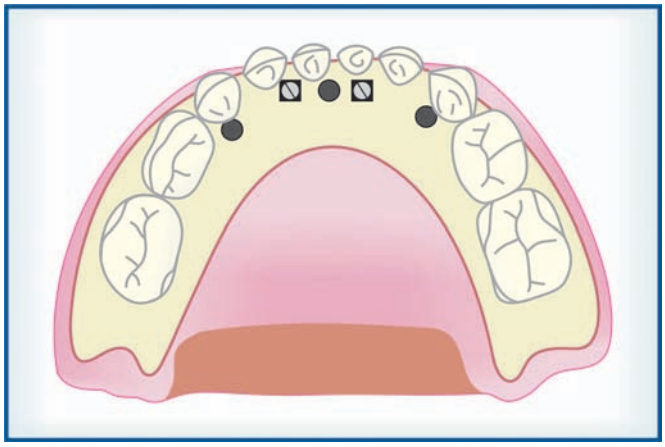


FIGURE 22.16: Waxed trial denture

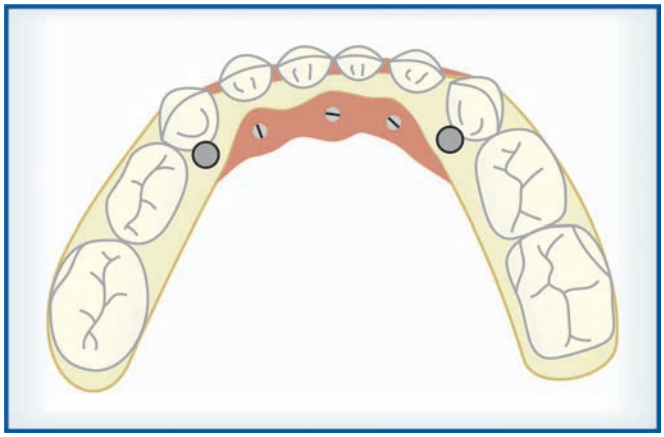


FIGURE 22.17: Final denture

4. Which is the choice of metal for the implant fixture?
5. What is the role of ceramics in implant treatment?
6. What are the procedures followed to obtain rough surface of the implants?
7. What is prosthetic interface?
8. What are the types of prosthetic interface?
9. What measures should be followed in order to preserve the health of the bone during treatment with implants?
10. Why should the loading of implant be avoided during the healing phase?
11. What is the importance of two stage surgical approach in implant treatment?
12. Describe the mechanism of osseointegration.
13. Define oral implantology.
14. Mention the components of Branemark implant system.
15. What is the purpose of radiographic stent?
16. Mention the types of impression techniques.

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CHAPTER

23

Maxillofacial Prosthodontics Related to Complete Edentulous Foundation

INTRODUCTION

Maxillofacial prosthodontics is a branch of prosthodontics concerned with the restoration and/or replacement of the stomatognathic and associated facial structures with prosthesis that may or may not be removed on a regular or elective basis.

Maxillofacial prosthesis may be:

1. **Extraoral:** Part of the facial or cranial structure (*eye*, ear or nose) is missing and a nonliving substitute or prosthesis is used to rehabilitate the part.
2. **Intraoral:** Refers to defects in and involving the oral cavity, for which prosthesis may be used to rehabilitate the defective area.

The maxillofacial prosthesis other than intraoral prostheses for edentulous foundation is beyond the scope of this book and hence the referral of other books on maxillofacial prostheses is advised.

One of the most common surgical defects in the oral cavity is the defect caused by maxillectomy. This defect leads to problems in speech, mastication and deglutition unless a surgical / prosthetic reconstruction is carried out.

Obturator is a prosthesis used to close a congenital or acquired tissue opening, primarily of the hard palate and or contiguous alveolar structures. Prosthetic restoration of the defect often includes use of a surgical obturator, interim obturator and definitive obturator (GPT-7).

Ambroise Parr is considered to be the first to use an obturator to close palatal perforations. The term obturator originates from the latin word obturare which means to stop up.

FUNCTIONS OF OBTURATOR

The obturator fulfills the following functions:

- Feeding purpose.
- Maintains the wound/defective area clean.
- Enhances the healing of traumatic or post surgical defects.
- Helps to reshape/reconstruct the palatal contour and/or soft palate.
- Improves speech.
- It can be used as a stent to hold dressings or packs post surgically in maxillary resections.

INDICATIONS FOR USE OF AN OBTURATOR

1. To serve as a temporary prosthesis during the period of surgical correction.
2. To restore patient's cosmetic appearance rapidly for social contacts.
3. To provide for an inability to meet the expenses of surgery.
4. When the patient's age contraindicates surgery.
5. When the size and the extent of the deformity contraindicates surgery.
6. When the local avascular condition of the tissue contraindicates surgery.
7. When the patient is susceptible to recurrence of the original lesion which produced the deformity.

Obturators for Acquired Defects

Post-surgical obturators include:

1. The immediate temporary obturator or surgical obturator.
2. The temporary, treatment or transitional obturator.
3. The permanent obturator.

Surgical Obturator (Fig. 23.1)

This prosthesis is limited to the restoration of palatal integrity and the reproduction of palatal contours. Obturation may be accomplished with the placement of an immediate surgical obturator 6 to 10 days post-surgically. Immediate surgical obturator helps in:

a. Restoring and maintaining the lost height of the middle 3rd of the face.
b. The prosthesis provides a matrix on which the surgical packing can be placed.
c. It reduces oral contamination and thus reduces the incidence of local infection.
d. The prosthesis permits deglutition, thus the nasogastric tube can be removed at an earlier date.
e. The prosthesis enables the patient to speak more effectively post operatively by reproducing normal palatal contours and by covering the defect.

f. The prosthesis reduces the psychological impact of surgery by making the post-operative course easier to bare.

The immediate temporary obturator is a base plate type appliance which is fabricated from the preoperative impression cast and inserted at the time of resection of maxilla in the operating room. If the extent of surgery is in question, it may be necessary to fabricate two or more prosthesis for more eventualities.

Principles of design for immediate surgical obturator

1. The obturator should terminate short of the skin graft.
2. The prosthesis should be simple and lightweight.
3. Normal palatal contours should be reproduced to facilitate post operative speech and deglutition.
4. Posterior occlusion should not be established on the defect side until the surgical wound is well organized.
5. In some patients the existing denture may be adapted for use as an immediate surgical obturator.

Treatment / Temporary Obturator

The temporary obturator must serve the patient from the time the surgical obturator and pack are removed (approx 10 days post surgical) until the healing is sufficiently stabilized to warrant a definitive prosthesis. Initially the surgical obturator is relined with soft liner. If this modified obturator cannot be worn due to gross changes in the healing tissues, then a new prosthesis is fabricated. The temporary obturator is fabricated from the post surgical impression cast which replicates the palate and ridge and absence of teeth. The closed bulb extending into the defect area is hollow. The new prosthesis should also be lined with soft liner and worn till a definitive obturator is fabricated after complete healing of the surgical defect.

Definitive Obturator (Fig. 23.1)

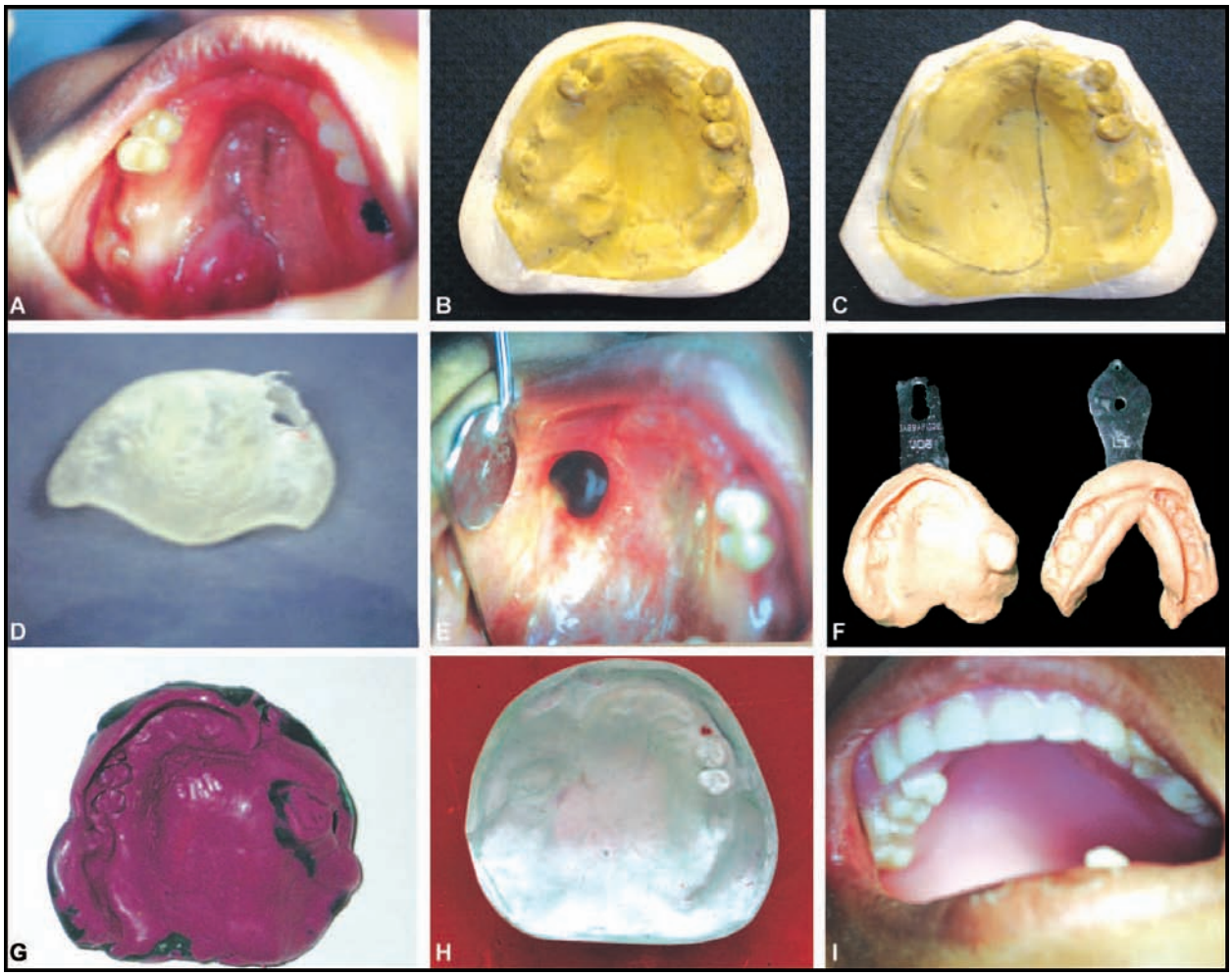
Three to four months after surgery consideration may be given to the fabrication of a definitive obturator. The timing will vary depending on the size of the defect, the progress of healing and the prognosis for malignancy control, the effectiveness of the present obturator and the presence or absence of teeth. The permanent obturator is fabricated from the postsurgical maxillary cast. This obturator with a hollow bulb replicates the palate, ridge and teeth.

General Consideration Concerning Bulb Design

1. A bulb is not necessary with a central palatal defect of small to average size where healthy ridges exist.
2. It is not necessary in surgical or immediate temporary prosthesis.
3. It should be hollow to aid speech resonance, to lighten the weight on the unsupported side, possibly to provide facial esthetics, and to act as a foundation for a combination extraoral prosthesis in communication with the intraoral extension.
4. It should not be so high as to cause the eye to move during mastication.
5. It should always be closed superiorly.
6. It should not be so large as to interfere with insertion if the mouth opening is restricted.

TREATMENT PROCEDURE

The intraoral defect should be carefully observed. The severe undercuts and small perforations which may cause accidental intrusion of the impression material into the nasal – maxillary sinus cavity should be noted. Such areas should be packed out with a lubricated cotton or gauze to which a piece of dental floss has been tied. The defect may also require some special addition or correction to the impression tray. This is easily done with wax or stick compound added to build up the tray, in order to capture the needed anatomy. The primary impression is made in irreversible hydrocolloid impression material. The custom tray is then fabricated which is designed to fit the cast obtained from this primary impression. A final impression now is made with a rubber base material. This is boxed, poured, trimmed and the periphery is outlined with a pencil. The temporary record base should not use all the retentive areas so that it can be withdrawn from the stone working cast easily. During jaw relation record the procedure. The denture base should be stabilized with denture adhesive. Jaw relation is completed in the conventional manner followed by wax try-in. The waxed up denture is flasked and dewaxed. Finally during the laboratory procedure, a layer of acrylic in dough



FIGURES 23.1A to I: Maxillary obturator (A) Intraoral growth indicated for surgery (B) Cast obtained from presurgical impression (C),(D) Immediate obturator (E) Post-surgical defect (F) Priliminary impression of post surgical defect (G) Final impression (H) Master cast (I) Final prosthesis

stage should be packed to the walls of the defect. The center space is filled with salt and an acrylic lid is placed over which acrylic is packed as for a conventional denture. The obturator is cured and retrieved. A small perforation is made in cured bulb of the oburator and salt is flushed out using water in a syringe and the perforation is sealed with autopolymerizing resin.

Congenital Deformity

The causes of cleft palate are not entirely clear. The causes may be due to infectious diseases of the mother, mechanical interference with local blood supply in the fetus, malnutrition in the mother or any of the several changes in intrauterine environment.

The famous French plastic surgeon Victor Vue presented the following system of classification of clefts (Fig. 23.3):

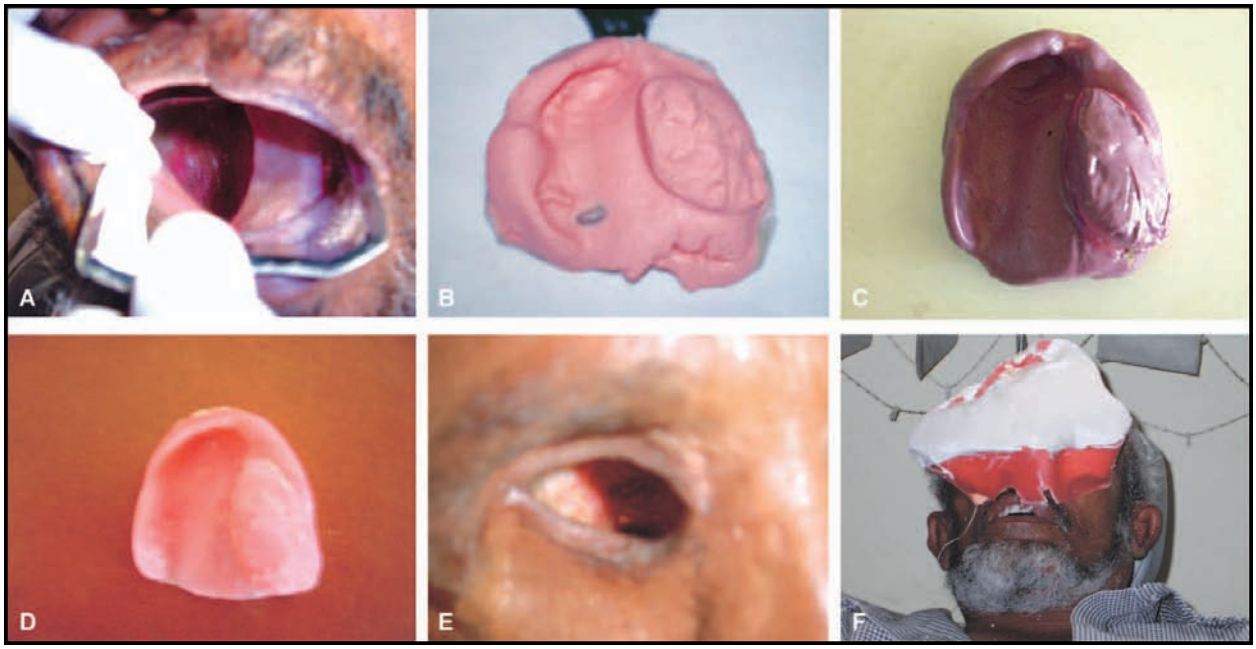
Class I: Clefts involving the soft palate only.

Class II: Clefts involving the soft and hard palate upto the incisive foramen.

Class III: Clefts of the soft and hard palate involving the alveolar ridge and continuous with the lip on one side.

Class IV: Completed cleft of the palate involving alveolar ridges as well as lip on both right and left sides.

Of these four classes, the clefts of class I type are surgically correctable and usually do not require any pros-



FIGURES 23.2 A to F

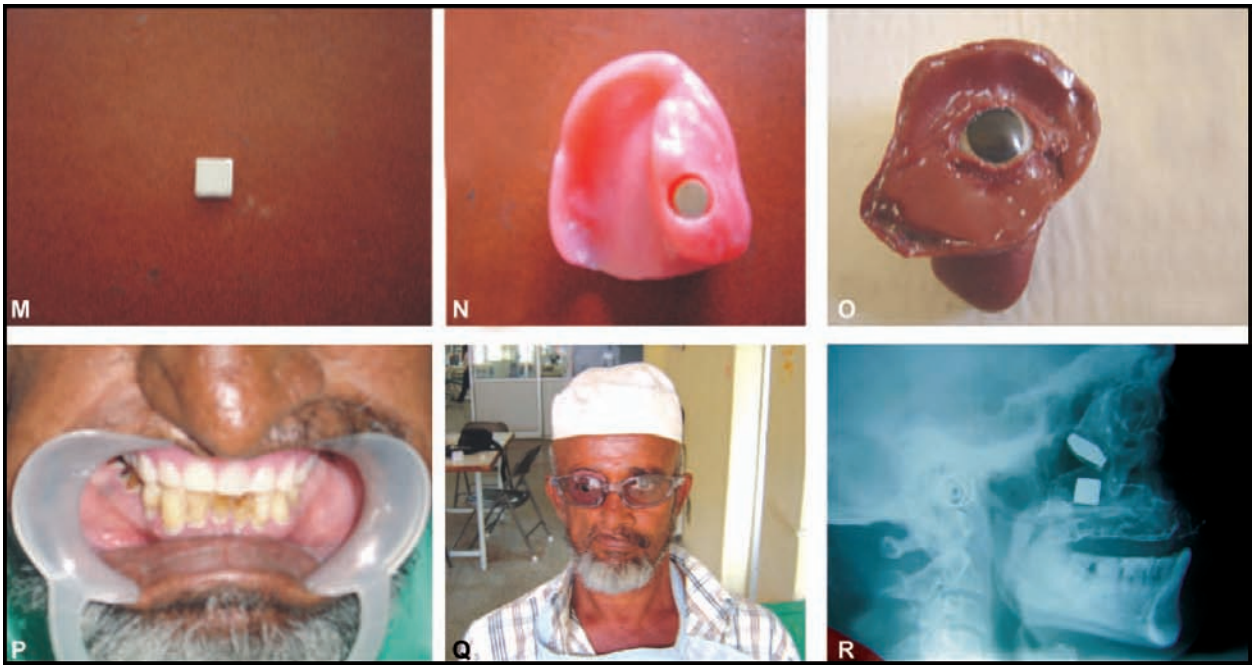
FIGURES 23.2G to L

thesis. In the class II type, the soft palate can be surgically corrected if the cleft of the hard palate is not correctable; the prosthetic assistance is provided for it. The class III and class IV generally require some form of prosthesis.

Prosthodontic Rehabilitation

Presurgical Prosthesis

Corrective therapy should be instituted for the cleft palate patients at the earliest possible. The child born with cleft



FIGURES 23.2M to R

FIGURE 23.2: Magnetic retention of obturator and eye prosthesis (A)Intraoral defect (B) Priliminary impression (C) Final impression (D) Obturator (E) Occular defect (F) Priliminary impression (G)(H),(I) Custom tray (I),(J) Final impression (K).Waxed up prosthesis (L),(M) Magnets (N),(O) Placement of magnets in final prosthesis (P),(Q) Final prosthesis (R) Radiographic view of magnets in prosthesis

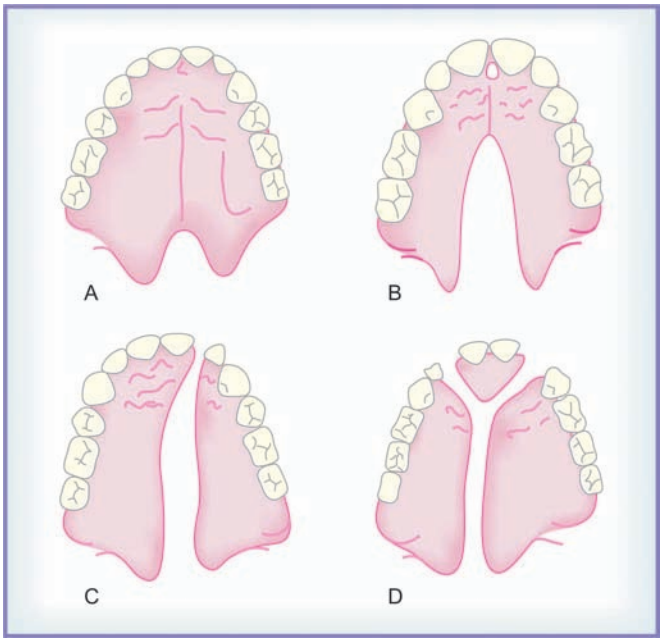


FIGURE 23.3: Vue classification

palate is very susceptible to respiratory and middle ear infections. Moreover adequate feeding is essential for normal growth and development. The prosthetic appliance which closes the defect ensures better feeding, decreases irritation to the nasopharynx and promotes better health and in turn growth and development of the child.

Intermediate Prosthesis

This group consists of appliances which are used to close the defect until a second stage surgical operation is indicated e.g. when a primary closure of the soft palate has been performed and the repair of the hard palate cleft is postponed. In this case an obturator will be needed for the interim period to close the defect of the hard palate.

Post-surgical Prosthesis

This group includes a maximum number of patients. The patients who refuse surgery for some or other reason

or where surgery has failed will have the necessity of this post surgical prosthesis.

Prosthetic Treatment

The effect of forces of retention in complete dentures, such as cohesion, adhesion, atmospheric pressure and peripheral seal is less in a complete edentulous cleft palate patient. Hence, the denture must be designed to take maximum advantage of all retentive aids.

Impression

The preliminary impression should be made in alginate using a metal tray with 3 to 4 mm of space between tray and tissue surface. Soft utility wax should be placed on the tray so that most of the impression material will be confined to the mucosal bearing area and not forced into the cleft. The tray should be under loaded in the cleft area. The cast is poured and custom tray is fabricated as for a conventional complete denture.

Bordermolding and Final Impression (Fig. 23.4)

The seal in class II cases will be obtained by the following procedure:

Buccal seal is obtained from the frenum along the right side of the denture. This is continued through the right hamular notch, running medially at the post dam area until it reaches 3-5 from the cleft edge. Here it turns forward and runs along 3 to 5 mm from the cleft edge, turns across the anterior limit of the cleft, runs back along the opposite edge, and turns at the post dam area to turn laterally toward the hamular notch. It then courses through the notch to the buccal periphery and along the latter to complete the seal anteriorly at the anterior frenum. The buccal sections are bordermolded as in a conventional denture (Fig. 23.4A).

Class III and IV are handled similarly except that the cleft, which continues through the alveolus, would break the total seal. This imposes the necessity of sealing two separate chambers instead of one. A separate peripheral seal must be created on one side of the cleft and another on the other side (Fig. 23.4B).

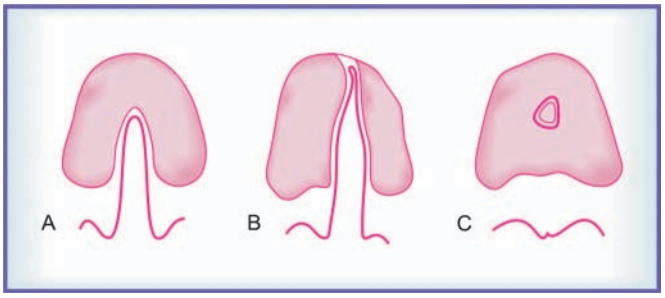


FIGURE 23.4: Procedure for obtaining border seal

The final impression is handled in a manner similar to that used for the normal denture except that, again, the tray is underloaded in the area of the opening. The final impression can be sealed by scraping the cast an appropriate width and depth in the areas where border molding is not possible.

Vertical dimension and centric relation are handled in the conventional manner, care being exercised to observe base-plate movement. Similarly, the arrangement of teeth follows the conventional pattern. At this point, it is often advisable to process and finish the denture and allow the patient to wear it until adjustments are made and the prosthesis is comfortable. Attempts to place the pharyngeal section on the prosthesis can be made at the same time that impressions of the arch are made, or during the checkup stage.

Pharyngeal Section

When the patient has successfully used the denture for several weeks, the pharyngeal section can be placed. It is very important that this section be as light as possible. The three general types of obturators are

a. The *hinge obturator* moves with the soft palate.
b. The *fixed obturator* is directed towards or slightly above the passavants pad.
c. The *meatus obturator* is directed at approximately 90^0 to the long axis of the palate.

Hinge type: It involves a mass of acrylic that is hinged to the base and supposedly moves up and down as the cleft soft palate moves. But the limited motion of the cleft soft palate makes it practically impossible for a velopharyngeal seal (Fig. 23.5).

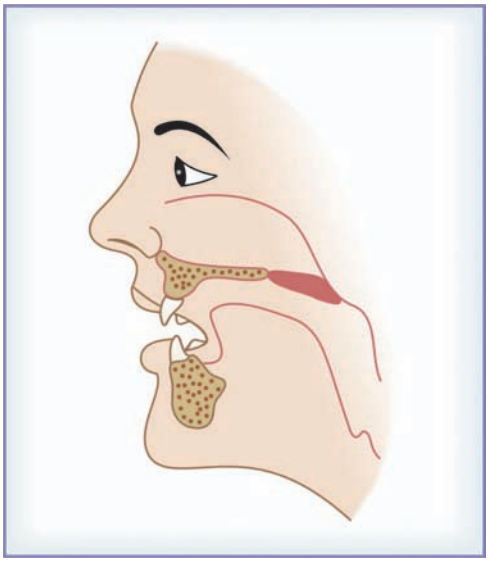


FIGURE 23.5: Hinge obturator

Fixed type: It is likely that this level is too low, and the prognosis is difficult to ascertain (Fig. 23.6).

Meatus type: It is directed almost 90° upward to reach the roof of the nasopharynx. It is formed by placing a bulk of compound on the posterior section of the denture in such a manner that the mass is directed upward to the roof of the nasopharynx. This bulk is initially smaller than the space it must occupy; it is gradually enlarged until the nasopharyngeal tissues are contacted. The impression should include the impression of the vomer bone, the lower turbinates and perhaps the Eustachian tube openings. During the impression procedure the patient is asked to swallow, bend the head forward, backward, and twist it from side to side. To improve the voice quality, a vent must be cut through the compound to allow air exchange through the appliance. This hole is started at 2 mm in diameter and gradually enlarged until the patient sounds normal in regard to nasality. When the impression is complete, the whole prosthesis can be flasked and the obturator section added in autopolymerizing resin (Fig. 23.7).

SELF-HELP QUESTIONS

1. Define maxillofacial prosthodontics.
2. Define obturator.

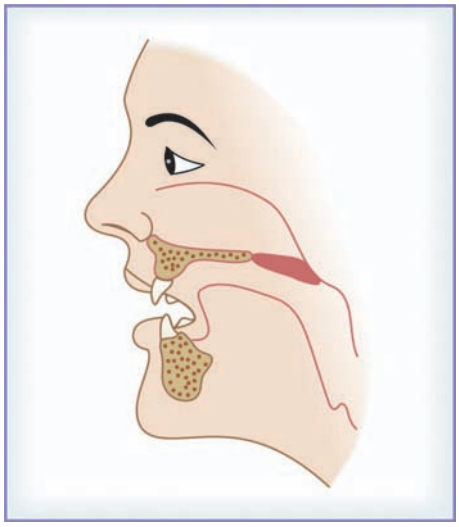


FIGURE 23.6: Fixed obturator

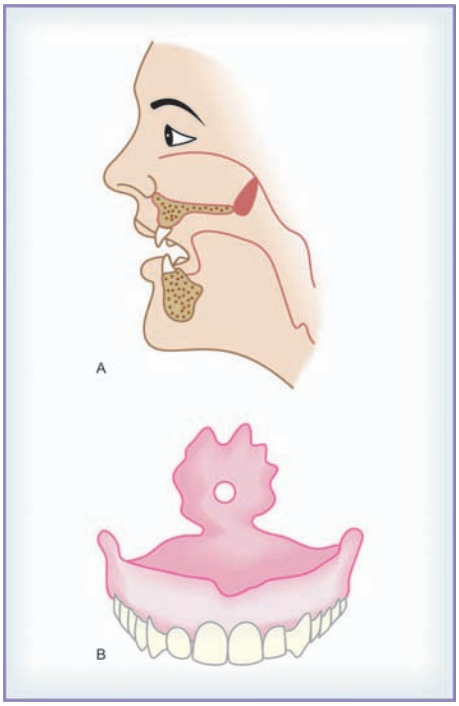


FIGURE 23.7: Meatus obturator

3. What are the functions of obturator?
4. Classify obturator.
5. Mention the principles of design of immediate surgical obturator.
6. What is the purpose of immediate surgical obturator?
7. What is a temporary obturator?

8. What is the principle of bulb design in obturator?
9. Classify cleft palate defects.
10. What is the purpose of pre-surgical prosthesis in cleft palate patients?
11. What is the procedure followed to obtain seal during border molding procedure in cleft palate patients?
12. Classify obturator with pharyngeal extension.

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