



## RESEARCH ARTICLE

### CONSERVATIVE TREATMENT OPTIONS FOR ADVANCED MANDIBULAR RIDGE RESORPTION

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#### ABSTRACT

Obtaining consistent mandibular denture stability has long been a challenge for the dental profession. In particular, "flat lower ridge" is associated with difficulties in providing successful dentures. Stability of lower denture in such cases is usually the distinguishing factor between success and failure. This article intends to acquaint the reader with the various conservative prosthodontic techniques which can be employed to improve mandibular denture stability in case of an atrophic ridge.

#### Key words:

Atrophic mandibular ridge,  
Denture stability.

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## INTRODUCTION

Stability is defined as resistance to horizontal displacement of prostheses. (The glossary of Prosthodontic terms, 2017) Providing a stable mandibular denture has been challenging for dentists. In particular it is more difficult to provide stable dentures in flat resorbed mandibular ridge. (Malachias *et al.*, 2005) A stable lower denture provides physiological comfort to the patient (Jacobson and Krol, 1983). This article primarily evaluates the factors necessary to develop stability in lower denture and further discuss the various conservative procedures to improve mandibular denture stability in an atrophic mandibular ridge.

#### Evaluation of factors necessary to develop mandibular denture stability

Wright C R describes the following factors which are necessary to create and maintain stability in lower complete dentures.

- (1) retention,
- (2) diagnosis,
- (3) functions of mouth,
- (4) denture base outline,
- (5) occlusal plane,

- (6) arch arrangement, and
- (7) instructions and patient education (Wright, 2004)

#### Retention

Retention is defined as the quality inherent in the dental prostheses acting to resist forces of dislodgement along the path of placement. (The glossary of Prosthodontic terms, 2017) Retention is an important pre-requisite for stability (Levin, 1984) Retention in turn depends upon the following factors

- (a) adhesion,
- (b) cohesion,
- (c) interfacial surface tension,
- (d) intimate tissue contact
- (e) peripheral seal,
- (f) gravity,
- (g) atmospheric pressure,
- (h) neuromuscular control. (Jacobson and Krol, 1983)

#### Diagnosis

A thorough examination of edentulous mouth will provide information to make a diagnosis that will relate directly to the retention and stability of lower dentures. Patients who have a normal tongue position possess a set of conditions that are conducive to retention of mandibular denture. Patients who

have a retracted tongue position lack the ability to develop or maintain retention without some degree of training. Normal tongue position (Fig 1) has the following characteristics

- (A) It completely fills the floor of the mouth.
  - (B) The lateral borders rest over the ridge.
  - (C) Tip of tongue rests on lingual side of lower anterior ridge.
- Retracted tongue position

- (A) The tongue is pulled back into the mouth exposing the floor of the mouth.
- (B) Lateral borders are inside or posterior to ridge.
- (C) Tip of the tongue is withdrawn into the body of tongue or lies in the posterior part of the floor of the mouth.



Fig. 1. Normal tongue position

### Functions of mouth

The three structures of mouth that are important to understand the functions of mouth are tongue, teeth, and medial roll of buccinator.

**Tongue:** The tongue is considered to be the fastest acting and the most accurate muscular organ of the body. It performs the functions of sucking, swallowing, receiving food in the mouth, mastication, vocalization and speech. The tongue can perform all these functions more efficiently when it is in a normal position.

**Teeth:** The primary function of teeth is to deal with food. Incisors incise the food, canines tear the food and molars and second premolars chew food. The first premolar neither tears nor chews food but performs other functions. The buccal surface of the first premolar forms a point of fixation for the medial roll of buccinator activity helps to keep the saliva and food inside the mouth during chewing and swallowing.

**Medial roll of buccinators:** The medial roll of buccinator is a band of muscle fibers within the larger buccinator muscle. At rest, the center of medial roll is slightly above the occlusal surface of the mandibular posterior teeth. The main function of the medial roll is to form the buccal wall of food trough and to retrieve food that is forced into the buccal pouch.

### Denture base outline

A properly formed denture base outline (Fig 2) develops a seal that can be maintained during most normal oral functions. The labial flange extends from one buccal frenum to other. The buccal flange extends from buccal frenum to retromolar pad. The posterior border extends to completely cover the retromolar pad. The lingual vestibule is divided into three

areas: the anterior lingual vestibule (sublingual crescent area), the middle vestibule, called the mylohyoid area; and the distolingual vestibule (lateral throat form or retromylohyoid curtain). (Levin, 1984)

### Occlusal plane

The superior-inferior position of occlusal plane is an important factor which affects stability. A mandibular plane that is too high can result in reduced stability. First, lateral tilting forces directed against the teeth are magnified in case of a raised occlusal plane. Second, an elevated plane prevents the tongue from reaching over the food table into the buccal vestibule. This compromises stability and makes the control of food bolus and denture difficult. (Jacobson and Krol, 1983) An occlusal plane that is too high creates unnecessary trouble, while an occlusal plane that is slightly low causes less problems. (Wright, 2004)

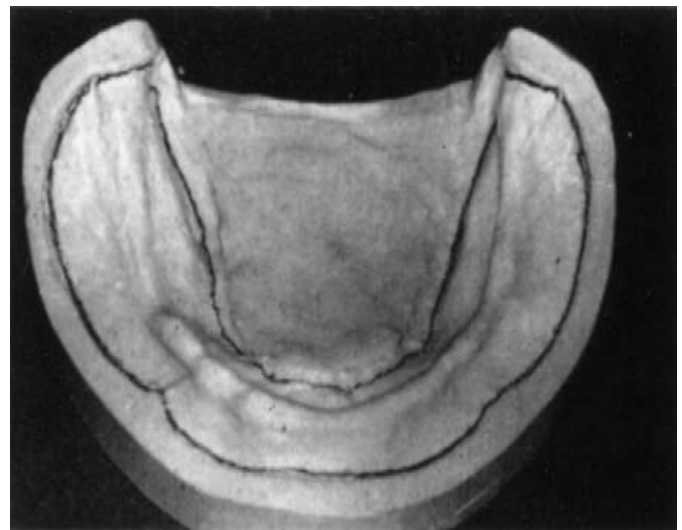


Fig. 2. Denture base outline

### Arch arrangement

The term arch arrangement indicates the buccolingual relationship of teeth to the crest of ridge or the stress bearing area. The anterior teeth are set on the anterior part of the crest of the ridge with an incisal tilt of 20° and posterior teeth are set over the center of stress bearing area of basal seat.

### Patient education

Information regarding proper use and care of denture should be given to the patient. Patients with retracted tongue position should be trained and given the following exercises (Fig 3).

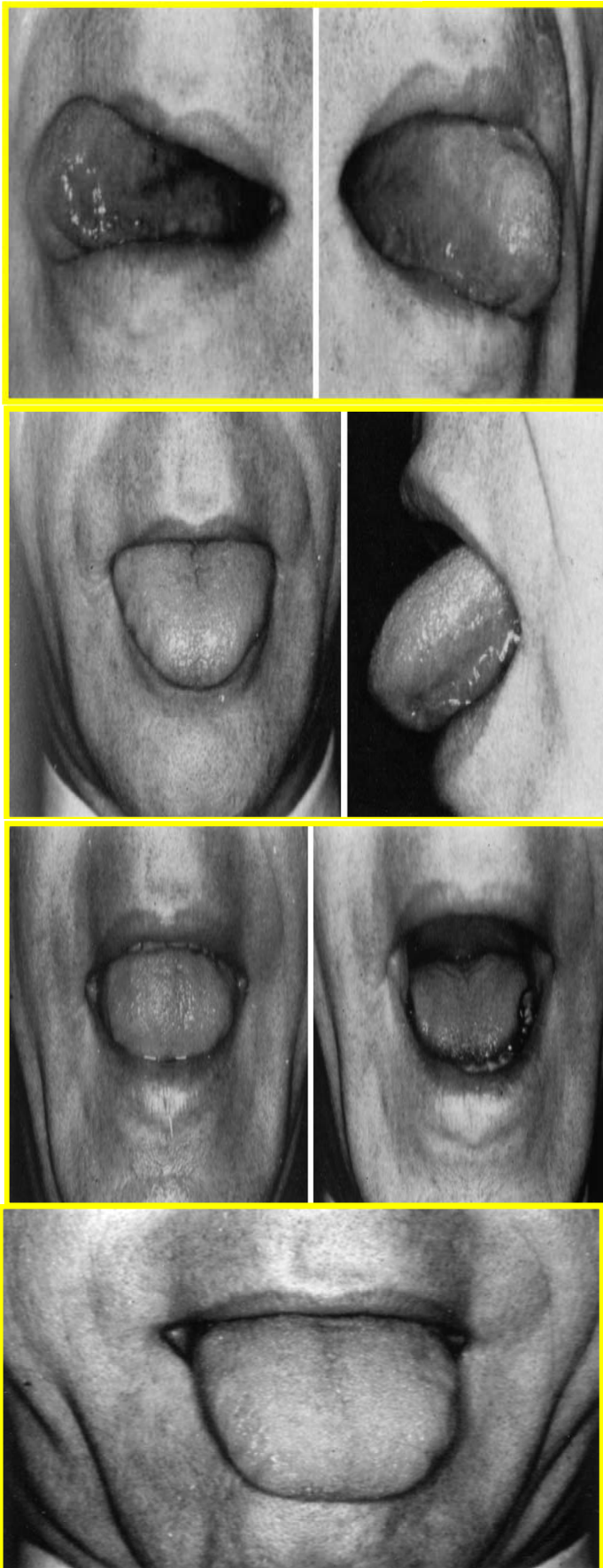
**Exercise 1:** Tongue is thrust in and out rapidly.

**Exercise 2:** Tongue is moved rapidly from side to side.

**Exercise 3:** Tongue is extended fully and quickly retracted.

**Exercise 4:** Tongue is raised to its highest position well forward in the mouth as the sound "ee" is articulated and dropped down as sound "yup" is articulated.

These exercises should be practiced twice daily for a period of 5-10 minutes. (Wright, 2004) The various factors (Christopher *et al.*, 2003; Douglas, 2001; Tyson and McCord, 2000; Gunner and Odont Odonthc, 1998) influencing ridge resorption are:



**Fig. 3. Patients Education**

- 1) Anatomic factors - Rate of vertical bone loss in a broad high ridge is slower than that of a small ridge, denser the bone, slower will be the rate of resorption
- 2) Metabolic factors – Parathyroid hormone imbalance, Post menopausal osteoporosis, Continuous synthesis of local

prostaglandins, Hypervitaminosis A and D, Hypovitaminosis C

3) Mechanical factors:

- (a) Functional factors- Frequency, direction and strength of forces acting on bone; Bruxism
- b) Prosthetic factors - Type and fit of prosthesis, duration of prosthodontic treatment, hours of prosthesis wearing per day, occlusal disharmony, lack of prosthodontic treatment (disuse atrophy).

**Treatment techniques**

**1. To improve the support**

Support (Jacobson and Krol, 1983) is defined as resistance to vertical component of mastication in maxillary and mandibular bones. It can be done using following:

- a. Maximal extension of the denture base
- b. Maximal area of contact between mucosa membrane and denture base
- c. Intimate contact of the denture base and its basal seat.
- d. The mandibular denture should terminate over the distal edge of the pear-shaped pad. If the ridge is poor, the support is difficult. It may be advantageous to bead the denture just distal to the pear-shaped pad and cover the retromolar pad.

**2. To improve the retention**

Retention (Azzam and Yarktas, 1992; Devaki *et al.*, 2012) is defined as the quality inherent in dental prosthesis with the ability to resist forces of dislodgment along path of withdrawal.

First, primary impression is made with impression compound and over it an wash impression is taken using alginate. Cast was poured in dental stone. Over the cast, special tray was constructed of autopolymerizing resin. The tray was trimmed 2 mm short of margin, checked in the mouth, and border molding was done. A properly formed denture base outline develops a seal that can be maintained during most normal oral functions.

Sublingual crescent area recording custom acrylic tray is trimmed 2 mm short of floor of the mouth and tracing compound was added to the border. The tracing compound is softened to a flowing consistency and the tray is placed into the mouth. The tongue should be in the normal rest position with the tip lightly touching the lingual surfaces of the mandibular anterior ridge.

**Procedure**

A custom tracing tray was trimmed 2 mm short of floor of the mouth and tracing compound was added to the border. The lateral throat form area was recorded by asking the patient to protrude the tongue. This action activates the superior constrictor muscles which support the retromylohyoid curtain. The dentist then applied downward force on the impression tray while asking the patient to close the mouth. This records the action of medial pterygoid muscle on the retromolar curtain. Secondary impression was made in zinc oxide eugenol and the cast was poured in dental stone.

**To enhance mandibular denture stability**

- (a) Over dentures,
- (b) Neutral zone in complete dentures,
- (c) Dynamic impression methods,
- (d) Flange technique,
- (e) Metal denture bases,

- (f) Neurocentric concept,
- (g) Linear occlusion concept
- (h) Single stage border moulding
- (i) Implants

### Over dentures

The mandibular anterior ridge can be preserved by maintaining one or more endodontically treated roots and placement of an over denture. Preservation of the ridge can be attributed to the following factors

- (1) masticatory force is transmitted to the root and periodontal ligament, thus simulating normal physiological function,
- (2) removal of coronal and pulpal tissues in the apical canal make no change in the proprioceptive response of the patient,
- (3) retained roots substantially increase lateral stability of denture thereby reducing trauma to the edentulous ridge.

The advantages of an over denture over conventional denture are

- (1) denture has more horizontal stability,
- (2) increased vertical stability during functional loading,
- (3) soft tissues over the residual ridge are spared of abuse due to support of abutment teeth,
- (4) patient acceptance is excellent, (Jennings, 1989)
- (5) better occlusal awareness, biting forces and neuromuscular control.

### Neutral zone in complete dentures

Potential space between lips and cheeks on one side and tongue on other; that area or position where the forces between the tongue and cheeks or lips are equal. The aim of neutral zone is to construct a denture which is in harmony with its surroundings to provide optimum stability, retention and comfort. (Gahan and Walmsley, 2005) Various materials have been suggested to record the neutral zone - modeling plastic impression compound, soft wax, polymer of dimethyl siloxane filled with calcium silicate, silicone, tissue conditioners and resilient lining materials (Makzoume, 2004). Fish described a denture as having three surfaces: the impression surface, the occlusal surface and the polished surface. (Fish, 1948) In case of a highly resorbed ridge, the area of impression surface decreases and the area of polished surface increases, and denture stability and retention are more dependent on correct positioning of teeth and contour of external surface of denture. (Beresin and Schiesser, 1976) Dentures fabricated using the neutral zone have the following advantages (a) Improved stability (b) Posterior teeth are correctly positioned providing more space for the tongue (c) Reduced food trap in the molar teeth region (d) Good esthetics.

### The neutral zone technique

The usual sequence for complete dentures is to make primary impressions, fabricate individual trays, make final impressions, and then fabricate stabilized bases. Occlusion rims are used to establish the occlusal vertical dimension and centric relation. With the neutral zone approach (Fig 4) to complete dentures, the procedure is reversed. Individual trays are fabricated first. These trays are very carefully adjusted in the mouth to be sure that they are not overextended and remain stable during

opening, swallowing, and speaking. Next, modeling compound is used to fabricate occlusion rims. These rims, which are molded by muscle function, locate the patient's neutral zone. The mandibular neutral zone rim is indexed with plaster placed on the buccal and lingual surfaces. Teeth are set up exactly following the index.

### Dynamic impression method

For dynamic impressions irreversible hydrocolloid is the impression material of choice as it can be mixed to desired consistency. A perforated acrylic resin individual tray is made on diagnostic cast which does not interfere with muscle movements. To obtain correct thickness of impression material against denture bearing tissue, stops are made using green stick compound or thermoplastic impression material (3 stops, 2 mm high, one each in region of molars and one in the region of central incisors). Mandibular rests are placed in the molar region on the occlusal surface of the tray. These rests are made using thermoplastic impression material at a height corresponding to mandibular rest position. Sufficient irreversible hydrocolloid is mixed (with 50% extra water) and placed directly into the mouth to cover the lower ridge and sublingual denture space. A small amount is placed in the tray and then the tray is placed in the patient's mouth. The tray is pressed with digital pressure until the stops are firmly seated on the residual ridge. Next, the patient is asked to close his mouth firmly until the rests have obtained firm contact with the maxillae. The patient is made to swallow three to four times at ten second intervals. He should forcefully protrude the tongue and vigorously contract the buccinator muscle between swallows. This procedure develops a proper registration of the denture space. After the impression material has set, the tray is removed from the mouth and the cast is poured immediately.

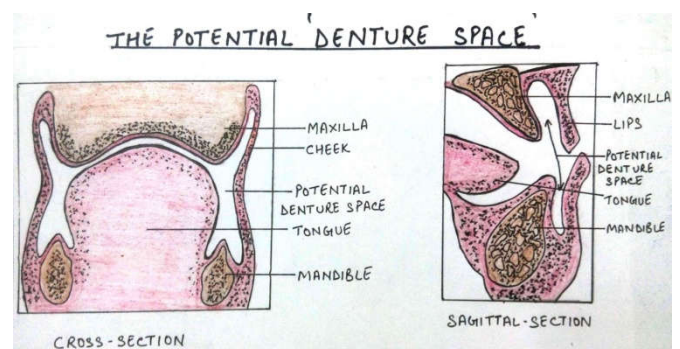


Fig. 4. Neutral Zone

### Flange technique

The flange technique involves making an impression of the soft structures of the mouth adjacent to the labial, buccal, lingual and palatal surfaces of the dentures and incorporating the extensions obtained in the final denture. These extensions obtained will be described as flanges. The flange technique can be used to

- (1) Determine physiological alignment of arch form of the anterior and posterior teeth on the occlusal rims.
- (2) To secure an accurate impression of structures surrounding the trial dentures and thus determining the form of the polished surfaces of the dentures.
- (3) To improve the retention, appearance and speech of otherwise acceptable finished dentures.

## Metal denture bases

In 1957, Faber advocated using metal bases for snugness of fit of the mandibular denture. Faber has given the following advantages of metal denture bases.

- (1) Prevention of acrylic warpage,
- (2) More strength,
- (3) Increased accuracy,
- (4) Less tissue change under the base,
- (5) Less porosity and therefore easier to clean and maintain clean,
- (6) Thermal conductivity,
- (7) Less deformation in function. (Faber, 1957)

However in a patient with severely resorbed alveolar ridge the metal base may frequently shift and irritate residual alveolar ridge tissues which are often atrophic and minimally resistant to stress. A metal-based denture with soft liner often meets the needs of these patients. The metal base provides the weight necessary to facilitate retention while maintaining strength in denture with modest extensions. The soft liner accommodates the ridge irregularities and changes such as excessive resorption, minimal keratinized ridge epithelium, and thin lamina propria. (Massad, 1987)

## Neurocentric occlusion

The neurocentric concept was developed by DeVan. He has suggested embodying the two key objectives of his occlusal scheme

- (1) Neutralization of inclines,
- (2) Centralization of forces.

The neutralization of inclines and centralization of occlusal forces aids in stability without interfering with speech, appearance and chewing capacity.

## Linear occlusion

William H. Goddard introduced the concept of linear occlusion. (Williamson *et al.*, 2004) Frush described occlusion in geometric terms as one dimensional (linear), two dimensional (flat) and three dimensional (cusped). (Frush, 1966) Gronas and Stout explained how anatomic and non anatomic occlusal schemes transmit lateral forces to the denture and reduce stability and suggested that the linear occlusal scheme has the potential for creating the smallest lateral force component. (Gronas and Stout, 1974) Linear occlusion consists of the following basic parameters:

1. Zero degree teeth (flat teeth) are opposed by bladed (line contact) teeth in which the blade is a straight line over the crest of the ridge.
2. Mandibular teeth are set to flat occlusal plane.
3. The arch which requires the greatest stability receives the bladed teeth.
4. There is no anterior interference to protrusive or lateral movements.
5. This non-interceptive occlusion provides a consistent vertical seating force in both centric and eccentric; hence transverse vectors are eliminated.

## One stage border molding

The primary objective of the complete denture impression is to accurately record the entire denture bearing area to produce a stable and retentive prostheses while maintaining patient comfort, esthetics, and preservation of remaining tissues. It is easy to use with less waste of material, there is no need for additional equipment and infection control procedures are also simplified.

## Role of implants in severely resorbed edentulous mandible

A dental implant is a prosthetic device made of alloplastic materials implanted into the oral tissues beneath the mucosal or/and periosteal layer, and on/or within the bone to provide retention and support for a fixed or removable dental prostheses (Stellingsma *et al.*, 2004). The treatment options available for restoration of extremely resorbed mandible with implants are:

1. Endosseous implants in combination with fixed or removable prostheses.
2. Augmentation of mandible by distraction techniques followed by placement of endosseous prostheses.

Choice between fixed and removable depends on anatomic factors, oral hygiene, speech related factors, patient preference and cost factor.

## Conclusion

If the prosthodontist is to successfully treat the patient possessing a poor mandibular alveolar ridge, it becomes necessary to understand the limitations of the patient, the available prosthodontic techniques, the limitations of the oral surgical techniques, and the capabilities of the laboratory technician. Treatment may include the routine or the more sophisticated prosthodontic techniques using advanced instrumentation or the aid of the oral surgeon to do extension procedures, augmentation procedures, or implant procedures. Although definitely more challenging, the severely resorbed mandibular ridge can be restored satisfactorily to a level of masticatory function.

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