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Stability in Complete Dentures: An Overview

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Abstract: *Retention, support and stability are discussed extensively in the literature. Various methods, choice of techniques, materials and concepts have been elaborated to attain the maximum of these factors. Stability prevents the unseating of dentures due to the horizontal forces acting on the denture. These forces are most of the time muscular but can also be foreign in nature. Studies have been carried out to modify various steps of complete denture therapy to improve stability in the final prosthesis. A literature search has been performed using PubMed, Google Scholar to identify studies published before 28th February, 2018 with key words complete denture stability, Evidence-based. 16 articles were hand sorted to be included in the current review. The criteria for selection was a direct discussion of one of the above key words as main focus of the literature. The present article is a compendium of researches which have been carried out in context of stability in complete denture, it also consists of evidence-based studies which have questioned some current practices.*
Keywords: *Evidence-based, Stability, Modiolus, Neutral Zone.*

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I. Introduction

Certain biologic and mechanical properties provide Retention, support and stability to dentures. Retention provides psychological comfort, stability provide physiologic comfort and support provides longevity to the patient, these factors needs to be summated for a successful prosthesis[1]. According to GPT-9 stability in complete denture is defined as "the resistance of a denture to movement on its tissue foundation, especially to lateral (horizontal) forces as opposed to vertical displacement[2]". One of the other definitions which is also accepted was given by Krol and Jacobson which states it as "the resistance to horizontal and rotational forces. Stability prevents lateral or anteroposterior shunting of the denture base[1]". Denture instability adversely affects support and retention and results in deleterious forces on the edentulous ridges during function. A denture that shifts easily in response to laterally applied forces can cause a disruption in the border seal or prevent the denture base from correctly relating to the supporting tissues. The objective of the present literature review is to identify among the array of methods the best method by which stability in complete denture patients be enhanced and thus help clinicians in incorporating the outcomes in the routine practice to improve the quality of treatment. Method of Selection of Articles for Review: A literature search has been performed using PubMed, Google Scholar to identify studies published in English language before 28th February, 2018 with key words complete denture stability, Evidence-based. 16 articles were hand-picked after abstract reading which discussed any 1 of these key words as its epicenter and explained its importance in clinical practise.4 out of the 16 articles were evidence based and validated few unconventional points. Exclusion criteria: Techniques without clinical reports, articles in language other than English were not included in the review.

II. History:

Fish in 1933 demonstrated that the lingual and the buccal flange should be moulded in conformation of the surrounding musculature and provided with a clear picture about the shape of mandibular denture which favors stability[3]. Lundquist D.O in 1959 stated that, the muscles on the working side of unilateral chewers contract more vigorously than those on the balancing side in normal opening and closing movements[4]. The electromyographic carried out by Lundquist D.O showed that the buccinator muscle has significant role in maintaining the stability of the denture and supports the theory of the action of the buccinator muscle as described by Fish. Shanahan T. E J in 1962 stated that Dynamic impressions reproduce naturally extended borders that provide for the function of the muscle attachments and for the movements of the soft tissues under the dentures during mastication, swallowing, speech, etc in contract to static impressions[5]. Brill in 1967 stated that the important factors essential for stability in complete denture are maximum coverage of the denture bearing area, good peripheral seal, equalization of pressure. Jooste CH, Thomas CJ stated that retro-mylohyoid extension has a stabilizing effect on complete mandibular dentures. Ohkubo C, Hosoi T in 1999 conducted a study which indicated that the use of a metal base to increase the weight of the mandibular denture may not affect its retention or stability[6]. Sho Hasegawa in 2003 Suggested that denture adhesive contributes to reducing denture movement and so improves chewing function[7]. There was significant evidence that dentures made from silicone impressions were rated as more stable and more efficient than dentures made from alginate impressions after adjustment [8].

III. Factors Contributing Stability

1. The Intaglio surface
2. The Cameo surface and surrounding musculature.
3. The Occlusal surfaces

1. The Intaglio Surface

- Denture Base Adaptation:

Contacting of the flanges with the ridge slopes is a critical factor contributing to stability as given by Friedman. Maximum contact between the tissue and denture borders must be limited by movable tissue. Optimal denture stability requires those tissues that provides perpendicular resistance, which can be done by incorporating the surfaces of the maxillary and mandibular ridges, which are at right angle to the occlusal plane. According to Boucher bony foundations which have firmly and closely attached mucosal tissues aid in stability.

- Importance of mandibular lingual flange:

Most desirable feature of mandibular lingual flange is that it is *perpendicular to the occlusal plane and it bears the horizontal forces well.* The *extension of the lingual flange* is dictated by the attachment of the mylohyoid muscle to the internal oblique ridge, posteriorly this muscle allows deep extension of flanges as compared to anterior region. The musculature of the floor of the mouth also influences the *degree of intimate contact* allowed. The mucosa should be resilient and thick enough to tolerate stress. Shanahan (1962) has Stated that the Lingual Flange of the Denture can be extended in three areas that are[9] the sub-lingual crescent space, the sublingual fossa area and the retro mylohyoid fossa

- **Anatomic considerations[1]** *(table 1)*

(Table 1)

FACTORS	GOOD Stability	POOR Stability
Height	More height	Less height
Conformation	Large, square and broad	Small, narrow and tapered
Arch Form	Square and Tapered	Ovoid
Shape of Palatal Vault	Steep palatal vault	Shallow palatal vault

2. Cameo surface and associated structures

Muscle can facilitate stability of the complete denture in two ways either by allowing the action of certain muscles without interference by the denture base or by utilizing normal action of certain muscle groups which help in the seating of the denture base and enhance stability.

The basic geometry of the dentures must be triangular *(fig 1)*.

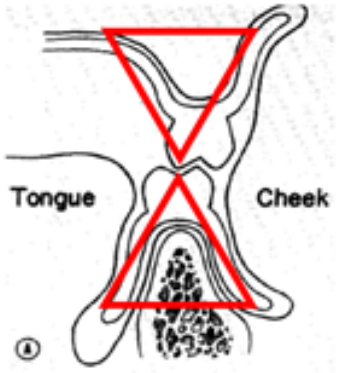


Fig 1 *Desirable geometry of Complete Denture*

This is to direct seating action on the dentures. There is contraction of muscles such as orbicularis oris (lips) and buccinator(cheeks) during functional movement (speech, deglutition, mastication). The buccal and the labial flange of the maxillary and the mandibular denture must be concave to permit positive seating by cheeks and lips. The proper contouring of the denture flanges permits the horizontally directed forces that occur during contraction of these muscles to be transmitted as vertical seating forces. Tongue is another entity which is to be critically analysed in order to achieve stability the level of the tongue which it occupies during maximum of its function must be considered during recording of lingual flanges. For the ease of understanding the tongue levels are classified into three types. The high level of the floor of the mouth accommodates for those functions of the tongue which require it to be more than moderately extended[10]. The low level of the floor of the mouth accommodates for the movements of the tip of the tongue as it moves to the floor of the mouth, such as when it retrieves food[10].The normal tongue position places the floor of the mouth and the lateral throat forms in their normal positions, this is the position the tongue acquires during maximum of its function. The floor of the mouth at its normal level appears to be approximately even with the internal oblique lines on the body of the mandible. Normal position of tongue can be achieved by some tongue excercises.

Tongue exercises to regain normal tongue position[10]:

- The tongue is thrust in and out rapidly.
- Tongue is made to move sideways
- Thrusting the tongue out to its most extended position

And pulling it back quickly

Modiolus: the area near the corner of the mouth where eight muscles converge; it functionally separates the labial vestibule from the buccal vestibule[2] (GPT 9)

The 8 muscles are:

1. Orbicularis Oris
2. Buccinator
3. Zygomaticus
4. Canninus
5. Triangularis
6. Levator anguli oris
7. Rizorius
8. Platysma

When the origin and insertion all the associated muscles are observed it is found that none of these muscles have more than one bony attachment. The buccinator takes origin from a curved line which is present above the molar teeth in the maxilla and runs down from a ligament along the pterygoid process to the lower molar teeth. Further they run anteriorly and decussate with the fibres of orbicularis oris. If only we consider the action of these 2 muscles they ought to pull the face on one side, but it is not true. As there are other muscle (the x shaped arrangement) which are arranged in such a way that it stabilizes this union at a fixed point. If we say 'OH' then the modiolus is pulled in front, while when we say 'ee' it is fixed backward[3]. The outline of the denture is influenced by the musculature associated with it *(fig 2)* The outline of mandibular denture base is closer to the ridge in the premolar area[3], the flanges are narrow fashioned to escape the action of the muscles in these regions. The outline of the denture base is away from the ridge near distobuccal and disto-lingual flange are wider in the buccal region owing to the presence of buccal pouch[3].

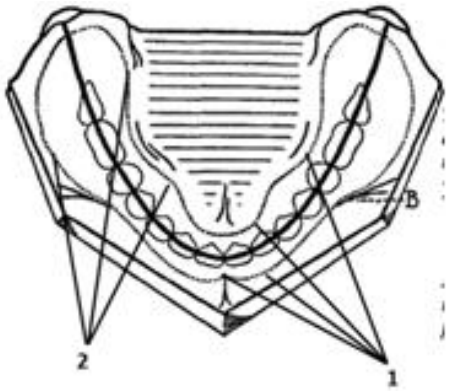


***Fig 2** Outline of Complete Denture in Mandibular Arch*

The Concept of Neutral Zone

The central thesis of the neutral-zone approach to complete dentures is to locate that area in the edentulous mouth where the teeth should be positioned in such a way that the forces exerted by muscles will tend to stabilize the denture rather than unseat it[11]. The theory used to develop the denture base contours is based on the belief that the muscles should functionally mould not only the borders of the denture but also the entire polished surface. The polished surface contours and the position of the teeth are to be determined by realizing a space

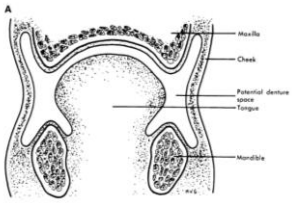


***Fig 3:** Neutral zone in molar region*

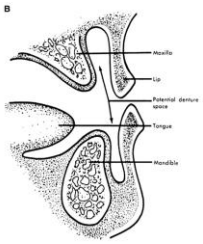


***Fig 4:** Neutral zone in anterior*

where the action of tongue and the muscle of the buccal mucosa is balanced. (outlined in the fig 3 & 4). Ridges which are broad and well rounded the horizontal forces are well borne, this is due to the presence of a vertical component to resist the horizontal force. Resorption of ridges leads to loss of this advantage. In case of

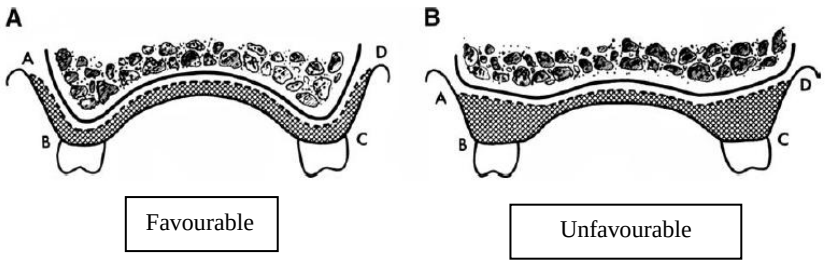
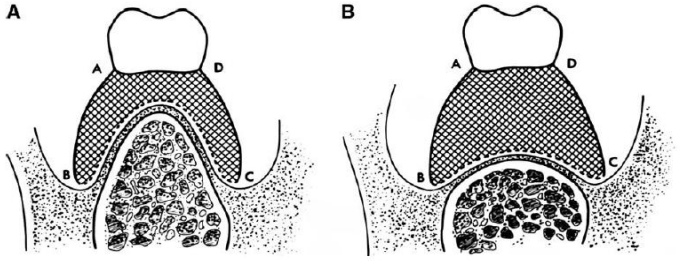


***Fig.5** Maxillary Ridge Antomy*

resorbed ridges, it is favourable to locate the neutral zone where the horizontal forces are balanced[11]. The following figures explains this phenomenon[11] (fig 5 and fig 6)



Favourable

Unfavourable

3. Occlusal Surfaces

Harmony developed between the opposing occlusal surface also contributes to stability. The denture must be free of interferences within the functional range of movement of the patient. During functional or parafunctional movements, the occlusal surface must not prematurely strike[1]. These unwanted forces result in lateral and torqueing forces that adversely affect the stability.

The relationship can be discussed under the following headings:

- Occlusion
- Tooth position & Occlusal plane
- Ridge Relation

Occlusion

To minimize dislodging forces the occlusion must be balanced throughout the functional range of movement of the patient. The bilateral balanced occlusion is important during activities such as swallowing saliva, closing to reseat the denture, and the bruxing of the teeth. Patients with balanced occlusion do not upset the normal static, stable and retentive position of the dentures. Lingualized occlusion provide both limited range excursive balance and a directing of forces the lingual side of the lower ridge during working side contacts. Horizontal forces can be minimized when the patient learns to place food bilaterally. *Frechette in 1961* demonstrated even force distribution regardless of tooth position in the patient who chewed bilaterally, he also concluded that bilateral chewing contributed more to the chewing than balanced occlusion.[12]

Tooth position and Occlusal Plane

A primary question has always arisen that whether the teeth must be placed on the ridge or far off the ridge. A general answer to this question is place the anterior teeth as closely in relation to the ridge as their natural position. Fish states that in the upper jaw there is no exception to the rule of replacing the natural teeth by setting the artificial ones in exactly the same relation to the body of maxilla. The neutral zone in the upper arch is not very narrow hence there is a latitude for positioning the upper anterior, plus the upper neutral zone is not as critical in maintaining the denture stability as the lower neutral zone[1]. The occlusal plane must not be placed too high and an attempt must be made to place the plane below the level of the tongue so that the tongue maintains the position of lower denture. Stensen's duct, retromolar pads, should be used to determine an acceptable occlusal plane.

Ridge Relationship

Prognathic and retrognathic patients show offset ridge relation. If the teeth are arranged in normal position on these offset ridges adversely affect stability. Weinberg recognizes the need to set teeth in crossbite when the ridges are in severe crossbite relation[1]. In class III cases the lower arch is anterior to upper arch. Sufficient mandibular occlusion must be developed so that the contact to the maxillary is more than half that of distance between the incisive papilla and the hamular notch. This prevents the tipping of the maxillary denture antero-posteriorly.

IV. Complete denture stability in abnormal cases

Xerostomia reduces an ability to form suitable seal, which further affects the retention and stability of dentures the treatment options include incorporation of salivary reservoir in complete dentures and remediation with artificial salivary substitutes[13]. Patients who have retracted tongue position, a bleb of was 2-3 mm in dimension is placed on the lingual surface of the mandibular lower teeth and the patient is trained to place to tongue in relation to this bleb to attain normal tongue position, this helps in regaining the normal tongue level.[14]

V. Evidence based Practise studies

1. Psillaskis in 2004 stated that use of a denture adhesive can improve resistance to bite force related dislodgement in patients who wear a maxillary complete denture[15].
2. A pilot study conducted by Kimoto et al in 2006 compared Lingualized occlusion and bilateral balanced occlusion and showed that lingualized occlusion is better accepted by patients and proved to have greater stability and masticatory performance[16].
3. T. P Hyde in 2014 conducted an RCT of 85 patients all edentulous patients above 18 years of age the final impression was recorded using alginate and silicone. In case of alginate the border moulding was done with green stick and in case of silicone the border moulding was done by medium body silicone and oral health related Quality of Life was assessed using a questionnaire. Follow up and survey revealed that silicone is a better impression material than alginate in fabrication of complete denture, with respect to patient satisfaction, stability, post insertion adjustments[8].
4. Greets in 2017 conducted a RCT of 35 patients age 47-85 years of age, a set of dentures was given. One fabricated by conventional technique and the other by neutral zone technique. There was very insignificant difference between dentures fabricated with neutral zone technique compared to conventional technique[17].

VI. Conclusion:

The relationship of denture base to surface tissue is an important factor in maintaining stability. The action of the orofacial muscles is to be considered in order to decide the shape of denture flanges. The extension of denture flanges is dictated by the movable tissue which further helps in attaining stability Relationship of occlusal surfaces should be utilized to gain maximum stability. Neutral zone is an important phenomenon, it is essential to recognize the importance of neutral zone in teeth arrangement and polished surface which gives stability, however it is still questionable that successful dentures are fabricated without recording the neutral zone. This article has reviewed a number of techniques and concepts which can be applied in therapy to attain better stability. It has focused on solution to some situations in which attaining stability is difficult. It has also highlighted a few studies which have questioned the conventional methods. However, the reviews sole intention is to help clinicians to identify and apply these concepts to deliver a successful prosthesis.

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