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Neutral Zone : Rationale, Concept, Merits And Demerits Of Special Techniques

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Abstract
The goal of dentistry is to keep teeth in a healthy state. If the teeth are lost despite all efforts to save them, re-establishment should be made such that teeth function efficiently and comfortably in harmony with muscles of the stomatognathic system and temporomandibular joints (TMJ). One of the most common problems encountered among long term denture wearers is the diminution in the denture foundation area. Rehabilitation of a patient with severely resorbed ridge is a challenging therapy a prosthodontist can undertake. In order to ensure a favorable prognosis, the impression technique, impression material and tooth moulds selected should be based on the present state of the basal tissue support. This article discusses the concept, muscles involved, technique, advantages and indications of neutral zone technique to achieve stability in highly resorbed mandibular edentulous ridge and also an insight into the rationale of using these techniques.

Key Words
Neutral Zone, Stability, Resorbed Ridges

Quick Response Code

Introduction:

The fabrication of complete removable dentures has evolved noticeably over the last 20 years with the advent of new materials and a better understanding of patient's expectations. There is a general agreement about one aspect of complete denture treatment i.e. an accurate impression of the edentulous alveolar ridges and adjacent functional structures must be obtained before proceeding to fabricate the complete dentures. Without this foundation, there is no hope of providing patients with idyllic function, comfort, and aesthetics. The lower denture commonly presents the most difficulties with pain and sloppiness being the most common complaint, because the mandible atrophies at a greater rate than the maxilla and has less residual ridge for retention and support.[1],[2],[3],[4] Looseness and discomfort are the most frequent complaints reported by patients and they are quite often difficult to manage by dentists. Neuromuscular control is said to be the key determinant in stability of lower complete denture as the area available for support is far less than maxillary support area.[5]

Throughout time, many theories emerged to illustrate where prosthetic teeth of denture should be positioned. These approaches have been challenged from time to time and found insufficient in patients with severely atrophic mandibular ridges and patients with enlarged tongue. To beat such problems, the neutral zone technique was advocated.[4],[6],[7] The neutral zone is the zone of minimal conflict, zone of equilibrium, potential denture space and the dead space area where forces generated in an outward direction from the tongue are being neutralized or balanced by the inward forces generated by lips and cheeks during functional activities. Setting teeth and contouring polished surface of lower CD within this zone adds more to stability.[5] The neutral zone technique is most effective for patients who have had numerous unstable, unretentive lower complete dentures.[1],[8],[9] This article discusses the concept, muscles involved, technique and indications of neutral zone to achieve stability in highly resorbed mandibular edentulous ridge and also an insight into the rationale of using this technique.

Various Concepts Regarding Arrangement Of Posterior Teeth (Table I).

[14], [15], [16], [17], [18], [35], [36], [37], [38]

Regardless of the fabrication technique used, functionally inappropriate denture tooth arrangement or physiologically unacceptable denture base volume or contour have been implicated in poor prosthesis stability and retention of the denture. Neutrocentric concept by Devan has been used practically to enhance this stability. This concept states that posterior mandibular denture teeth are arranged to occupy as central a location as possible, relative to the denture foundation, without disturbing adequate tongue function. This tooth arrangement is said to facilitate mandibular denture stability during occlusal loading. Various concepts have been suggested about the arrangement of posterior denture teeth.[10],[11],[12],[13],[14]

Neutral zone is that region where forces imposed by the tongue directed outward are neutralized by inwardly directed forces originating from the cheeks and lips during normal neuromuscular function. In general, boundary conditions that define the neutral zone are developed through muscular contraction and relaxation during the various functions of mastication, phonation, deglutition, and facial expression. These neuromuscular forces vary in magnitude and direction in different areas of the oral cavity, in different individuals, and at different periods of life. The trajectory of force applications to prosthetic surfaces will either serve to stabilize or dislodge the complete dentures. [15], [16], [17], [18], [21], [22], [24], [25]

Muscles Invcolved In Neutral Zone (Table II)

[16], [17], [18], [19], [20],

Weinberg et al	Recommended that buccal cusps and central fossae of mandibular posterior denture teeth should be arranged directly over the crest of the edentulous residual ridge. This is the most accepted theory
Pound et al	Recommended that the lingual surfaces of mandibular posterior denture teeth should occupy an area bounded by 2 lines originating from the mesial surface of the mandibular canine and extending posteriorly to the lingual and buccal aspects of the retromolar pad. This area has been called Pound's Triangle.
Halperin et al	The authors suggested that the lingual surfaces of mandibular posterior denture teeth should occupy an area bounded by 2 lines originating at the mesial surface of the mandibular canine, one line extending posteriorly to the lingual border of the retromolar pad and the other extending posteriorly passing through the central aspect of the retromolar pad.
Gherini et al	Recommended that posterior maxillary denture teeth should be arranged to satisfy specific mathematical formulas based on natural tooth intercuspal width.
Lammie et al	Argued that in aging patients, mandibular posterior denture teeth should be arranged over the buccal shelf to provide increased tongue space and to facilitate the development of vertical facial denture polished surfaces against which an effective facial seal can be achieved and maintained.
Wright et al	Believed that posterior mandibular denture teeth should be arranged directly over the centre of the denture stress-bearing area. This location may not correlate with the crest of the edentulous ridge, particularly in the presence of severe ridge atrophy.
Martone et al	Suggested that facial cusps of mandibular first molar denture teeth should be arranged directly over the crest of the edentulous ridge. Lingual cusps of the other mandibular posterior denture teeth should correspond to a line extending from the mesial aspect of the canine denture teeth to the facial side of the retromolar pads. This line should curve in the vertical plane to correspond to the curvature of the mandibular edentulous ridge.
Campbell et al	Stated that posterior denture teeth should be so placed that a line drawn through the long axis of the tooth will pass through the crests of the maxillary and mandibular ridges. When viewed in coronal cross-section, mandibular posterior denture teeth should be arranged slightly lingual to the crest of the edentulous ridge, while the maxillary posterior denture teeth should be arranged slightly buccal to the edentulous ridge. Of particular interest is use of the neutral zone, to guide posterior denture tooth arrangement and denture base contouring.

Table 1

DISLOCATING MUSCLES	FIXING MUSCLES
Vestibular:	**Vestibular:**
- Masseter	- Buccinators
- Mentalis	- Orbicularis
- Incisive labii inferioris	
Lingual:	**Lingual:**
- Medial Pterygoid	- Genioglossus
- Palatoglossus	- Lingual longitudinal
- Styloglossus	- Lingual transverse
- mylohyoid	- Lingual vertical

Table 2

Table III: Materials to record neutral zone Impression
➢ Impression plaster
➢ Impression waxes
➢ Impression compound
➢ Combination of green stick and impression compound
➢ Regular bodied silicone
➢ Tissue conditioner
➢ Polyether

Table 3

[21], [22], [23], [24], [25], [26]

The musculature of the denture space cam be divided into two groups **(Fig 1)**

- Dislocating Muscles: Muscles primarily involved in dislocating denture during activity.
- Fixing Muscles: Muscles that fix the denture by muscular pressure on the polished surface.

These can be further divided according to their location on the vestibular (labial & buccal) side or lingual side of the dentures.

Rationale [18], [21], [22], [23], [24], [25], [26]

Increased access to dental care has led to patients losing their teeth at a later stage of life. Compounded by increased life expectancy, this has led to the majority of complete denture wearers to be elderly and has increased the proportion of those who have poor neuromuscular control, poor adaptive capacity and severely atrophic ridges. The rationale of Neutral Zone is: To fabricate a lower complete denture that is optimally situated and in harmony with the structures and forces discussed above. By doing so, these forces are more likely to be stabilizing rather than unseating.

Indications and Materials (Table III) [29], [30], [31], [32]

In general, neutral zone technique is indicated when stability and patient's acceptance of lower complete denture are in question. This technique is found to be used in the following clinical situations:

- Severely atrophic mandibular ridge
- Patients with prominent and highly attached mentalis muscle, lateral spreading of tongue as a result of poor transition from dentate to edentulous state and severe resorption.
- Patients with diminished neuromuscular control such as those with a history of stroke, Parkinson's disease or patients with impaired motor innervation to oral and facial muscles.
- Patients with atypical shape or consistency of oral and perioral structures. Patients with scleroderma or patients who have undergone marginal or segmental mandi bulectomy are also candidates for this technique.
- This technique can be used to locate optimal position for implants in cases of implant-supported or retained overdentures, which enhances the overall outcome of treatment.

Technique [5],[7],[8],[9],[10],[11]

1. Primary impression is made in stock tray with alginate hydrocolloid material/impression compound.
2. Impression is poured in dental plaster and special tray is fabricated with spacer **(Fig 2)**.
3. Extensions of the special tray are checked intra-orally. A secondary impression is made with polyvinyl silicone impression material.
4. Master cast is obtained. Heat cure denture base is fabricated over it.
5. Wax block is added to the base plate and occlusal registration is made in

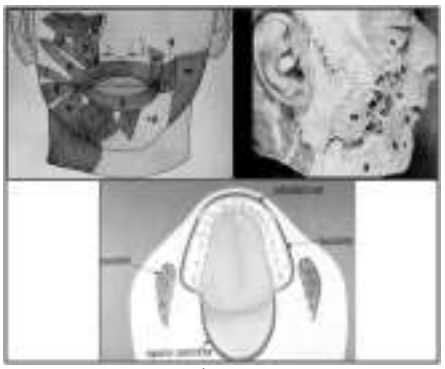
Figure 1


Figure 2


Figure 3

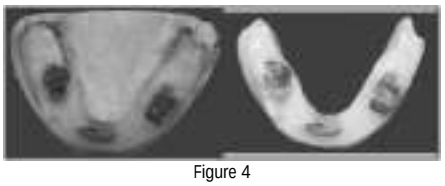
Figure 4


Figure 5

the conventional manner.

6. Maxillary cast is mounted on semi-adjustable articulator using face bow transfer. Centric registration and mounting of lower cast. This is from here that techniques to record neutral zone vary.

a) By use of tissue conditioning agent: Mandibular wax block is removed and replaced by wire loops attached to acrylic denture base **(Fig 3).** These are carefully positioned within the contours of the wax block and conformed to the same vertical dimension of occlusion. Tissue conditioning material is applied to the wire loops and placed inside mouth. **(Fig 4)**. Patient is instructed to carry out simple oral movements – swallowing, chewing, puffing of lips and sipping water. **(Fig 5)**. These movements will help to shape tissue conditioning material to the contours of neutral zone.

b) Neutral zone can also be recoded using "ADMIX" technique.[49] Wax block is removed from the mandibular base and is replaced with admix compound (7 parts of green stick compound and 3 parts of red compound). This material removes any folds on the edentulous tissue and its increased flow helps in recording neutral zone effectively **(Fig 6)**. Compound rim is conformed to the established vertical dimension. Place the completed record base and recording rim in the water bath (1400 F for approximately 2 minutes in preparation for the clinical procedure. Remove the base and rim from the water bath and quickly place it intra-orally. Instruct the patient to swallow. Next, provide a cup of warm water to the patient and instruct the patient to sip and swallow. Have the patient repeat this sip and swallow exercise several times. When the neutral zone record has cooled and hardened, remove and inspect the record for accuracy and completeness. If necessary, repeat the procedure to ensure proper recording of the entire neutral zone. Eliminate excess impression compound that has been displaced superior to the intended occlusal plane during the recording procedure and, if necessary, repeat the recording process, beginning with warm water bath.

7. To develop the facial and lingual neutral zone index, seat the neutral zone record on the mandibular definitive cast. Prepare laboratory putty (Poly V Putty; Accurate Set, Inc, Newark, NJ) to a workable consistency and adapt it into the tongue space and buccal surface of the neutral zone record **(Fig 7)**. Mould the putty so that it: (a) completely fills the tongue space; (b) adapts accurately to the lingual contours of the neutral zone record; (c) is level with the occlusal plane of the record; and (d) extends over the posterior land area of the cast. Teeth arrangement is done within the confines of the index without of any consideration to achieve balance **(Fig 6, 8)**.

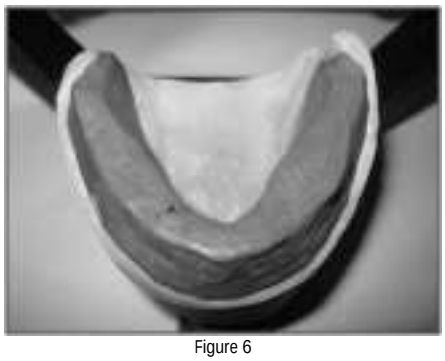
Figure 6


Figure 7

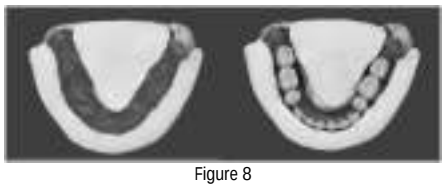
Figure 8

Discussion:

The ultimate aim of the prosthodontist is to restore form, function and esthetics. Many approaches to set teeth have been advocated and used in complete denture treatment. However, there is substantial debate on which of these provide optimal position in the facio-lingual dimension and guarantee a favourable outcome in terms of stability, facial support, chewing efficiency, aesthetics and patient comfort. Some authors have defined biometric measurements and location of relatively stable anatomical landmarks to set teeth; whereas, some relied on difference in resorption patterns to set denture teeth where their natural predecessors were thought to have been. Some authors adopted a mechanical

concept and advocated setting teeth directly in the centre of denture support area where the least amount of leverage is present which in turn enhances the stability of lower denture. [1],[4],[5],[6],[7],[8],[9],[10],[43],[44],[46],[47] All of these approaches were and are still being used and each of them proved to have advantages and disadvantages when compared to others. It has been found that neutral zone is closely related to the crest of residual ridge in patients who have been edentulous for less than two years and significantly differs in those who were edentulous for a period more than that.[5] The neutral zone approach registers the neutral zone to determine the proper placement of teeth after resorption has taken place.[2] Denture fabricated over a severely resorbed mandibular ridge by neutral zone impression technique ensures that the muscular forces aid in the retention and stabilization of the denture rather than dislodging the denture during function. The dentures will also have other advantages such as reduced food lodgment, good esthetics due to facial support, proper positioning of the posterior teeth which allows sufficient tongue space.[38],[39],[40]

This technique has been criticized based on claims that it is supported by practical evidence. However, other authors maintain that NZ technique is inaccurate based on significant clinical observations on the role of destabilizing forces the muscles apply to CDs during functional movements. Furthermore, the large number of case reports accumulated in a short period of time and clinical studies conducted by Stromberg & Hicke and Fahmy & Kharat add to the validity of this technique.[41],[42],[43],[44]

The principle of the neutral zone concept has remained the same since it has been first described by Beresin and Schiesser.[50] However; this technique has been subjected to various modifications. Type of retention incorporated in the baseplate (acrylic pillars or wire loops), recording materials used and further refinement to the initial record are among the variations between clinicians. Mostly the preference is to use combination of thin acrylic pillars in premolar region connected by a wire loop which maintains the VDO and provides maximum retention at the same time as explained earlier in this article. [45],[46],[47],[48]

The neutral zone philosophy is based on the concept that in each patient there is a zone of neutrality that helps to keep denture in place without displacement. In patients with extreme resorption of the alveolar ridges, it becomes necessary to record this position for long term success of the denture.

Conclusion:

NZ concept is considered as exceptionally important when considering treatment options for patients complaining from unstable lower CD predominantly if implant treatment is not feasible. It aims to place lower CD where forces generated by lips, cheeks and tongue have a stabilizing rather than dislodging effect. With improvement in dental material science and development of newer techniques in prosthodontics, the neutral zone impression technique may be incorporated into fabrication of any complete denture.

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