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Neutral Zone Concept: A Distinctive Approach to treat the severely resorbed Mandibular Ridge – A Case Report

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***Abstract**: Prosthodontic rehabilitation of an edentulous patient, with severely resorbed ridges or flabby displaceable tissues over the resorbed ridges, are some of the most challenging scenarios, a prosthodontist might face. In order to have a favourable prognosis for the denture therapy, impression technique selected should be based on the present state of the basal tissue support. Recently, the dental implant therapy has become a treatment of choice for improving the denture support, retention, and stability in severely atrophied ridges, supporting either a removable or a fixed denture, depending on the interarch space available. However, the neutral zone concept is also considered to be an important alternative approach to patients complaining of unstable dentures, particularly when implant therapy is not feasible. The neutral-zone approach to complete denture construction is neither new nor original but, rather, constitutes the bringing together of the concepts and ideas of many men[1-9] into a viable and practical procedure. This article, uses the concept of neutral zone for the impression making procedure of a completely edentulous patient so as to achieve a retentive and stable denture for the lower resorbed ridge while also incorporating a unique impression technique for the upper flabby ridge, limited to the premaxillary region.*

***Keywords:** Stability, Support, Neutral Zone, Resorbed Ridges, Impression Technique, Flabby Ridge.*

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I. Introduction

Complete dentures are primarily mechanical devices, but since they function in the oral cavity, they must be fashioned so that they are in harmony with neuromuscular function. All oral functions, such as speech, mastication, swallowing, smiling, and laughing, involve the synergistic actions of the tongue, lips, cheeks, and floor of the mouth which are very complex and highly individual. Failure to recognize the cardinal importance of tooth position and flange form and contour often results in dentures which are unstable and unsatisfactory, even though they were skilfully designed and expertly constructed. The coordination of complete dentures with neuromuscular function is the foundation of successful, stable dentures.[10]

Loss of teeth leads to multi factorial changes occurring in the mouth like alveolar ridge resorption, expansion of the tongue, and laxity of muscles of face. Continuous resorption of the residual alveolar ridge and the forces from the perioral musculature imposes challenges in determining the tooth position.[3] The extraction of teeth causes losses from the buccal sides of the maxillary alveolar ridges and from the lingual side of the mandibular alveolar ridges. Thus the residual alveolar ridge crest changes its location in a buccolingual direction after resorption.[4] In addition, the tongue has a tendency to enlarge in the edentulous mouth. Thus, the buccolingual space available, to position the teeth for normal function and equilibrium is greatly compromised.[1] Sometimes, when there has been excessive alveolar ridge resorption, the lost hard tissue is replaced by excessive soft tissue growth.[5]

When all of the natural teeth have been lost, there exists within the oral cavity a void which is the potential denture space. The neutral zone is that area in the potential denture space where the forces of the tongue pressing outward are neutralized by forces of the cheeks and lips pressing inward.[1, 2, 3, 4, 6, 10]

During childhood, the teeth erupt under the influence of a muscular environment.[7] This environment, which is created by forces exerted by the tongue, cheeks, and lips, has a definite influence upon the position of the erupted teeth, the resultant arch form, and the occlusion.[8] The dental arch is formed by the muscle forces

exerted on the teeth by the tongue, lips, and cheeks.[9, 10, 11, 12] There is also a genetic factor which cannot be overlooked. This inherent factor along with the muscular forces uniquely combine their influences to determine the final arch form and tooth position. Generally, muscular activity and habits which develop during childhood continue through life.[13, 14] After the teeth have been lost, muscle function and activity remain highly individual and greatly influence any complete dentures that are placed in the mouth.[15] It is therefore, extremely important that the teeth be placed in the mouth with the arch form located so that it will fall within the area compatible with muscular forces.[10]

Due to continued alveolar ridge resorption, the denture bearing surface area reduces continuously, thereby progressively taking away the potential for complete denture retention and stability.[16] Owing to the fact that the lower edentulous ridges have been reported to resorb much faster and much more than the upper edentulous ridges attaining optimum retention and stability in the lower denture, is well recognised as a difficult treatment aim to achieve.[17] Consequently, retention and stability for the complete denture become more dependent on the soft tissue support and the intimate contact between the contours of the external or polished surface of the dentures and the perioral musculature. Therefore, these surfaces should be contoured so that the horizontally directed forces applied by the peri-denture muscles, should act to seat the denture in this well balanced muscular space which is the neutral zone, particular to that patient.

The neutral zone, zone of minimal conflict[18] zone of Equilibrium[19], potential denture space[20] and the dead Space[4] are all terms used to describe the potential 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.

This present article describes the fabrication of a complete denture utilising the neutral zone concept for enhanced retention and stability of the denture in the lower arch and a window with relief two-tray impression technique for recording the upper flabby ridge, localized to the premaxillary region.

II. Case Report

A 69 year old male patient, reported to the Department of Prosthodontics, D.Y. Patil University, School of Dentistry, Navi Mumbai, with a chief complaint of inability to eat food efficiently due to missing teeth. On examination, it was found that the lower residual ridge was severely resorbed and the upper residual ridge was moderately resorbed and flabby in the premaxillary segment with a prominent incisive papilla and rugae. The mucosa over the lower ridge was well keratinised and displaceable only in the floor of the mouth, which was placed higher than the lower ridge due to the severe resorption. (Fig. 1).

Figure 1 : Preoperative View

The primary impression for the edentulous mandible was made with modelling plastic impression compound (Red impression compound; kerr corp.) and with irreversible hydrocolloid material (chromatic alginate impression material;coltene coltoprint)for the edentulous maxilla, in a flow consistency, so as not to displace the flabby tissue situated anteriorly (Fig. 2). The extent of the displaceable tissue in the premaxillary region was marked, with an indelible pen, after adequate probing and examination, so as to provide adequate relief during the fabrication of custom tray.

Figure 2 – Primary Impressions

After making the primary impressions and pouring the primary models, the custom tray for the upper arch, was fabricated with a unique two-tray technique. The inner tray was incorporated with a window cut out in the labial flange, along the outlined flabby ridge region. This tray was held by two vertical retentive rods, in the posterior hard palate region, by the means of which, the inner tray was oriented and stabilised onto the outer pickup tray. The outer pickup tray was fabricated, with the objective of supporting the painted-on impression plaster material which was used to record the flabby region in a mucostatic state. It was provided with holes in the region of the vertical rods, when oriented on top of the inner tray, with a slightly active fit between the holes and the retentive rods, so as to facilitate retention of the inner tray, while retrieval of both the trays from the mouth. The inner tray was given adequate spacer to incorporate polyvinylsiloxane monophase material as the wash impression material. This material was selected as the wash impression material, owing to its good flow properties and high accuracy in detail recording. The pickup tray was incorporated with triple spacer and relief holes in the flabby region, so as to achieve no displaceability of the mucosa during impression making. (Fig. 3) . The final impression was made by performing border moulding on the inner tray and the wash impression was made in two stages – an A-silicone monophase material (medium body a-silicone; dentsply aquasil ultra monophase) wash impression for the unaffected well keratinised portion of the upper arch and an impression plaster wash, by the paint-on technique of the impression plaster for the flabby tissue portion of the upper arch. The excess impression plaster flowed out of the relief holes provided in the flabby region, and both trays were stabilised intraorally. (Fig. 4).

Figure 3 – Upper Arch Custom Trays

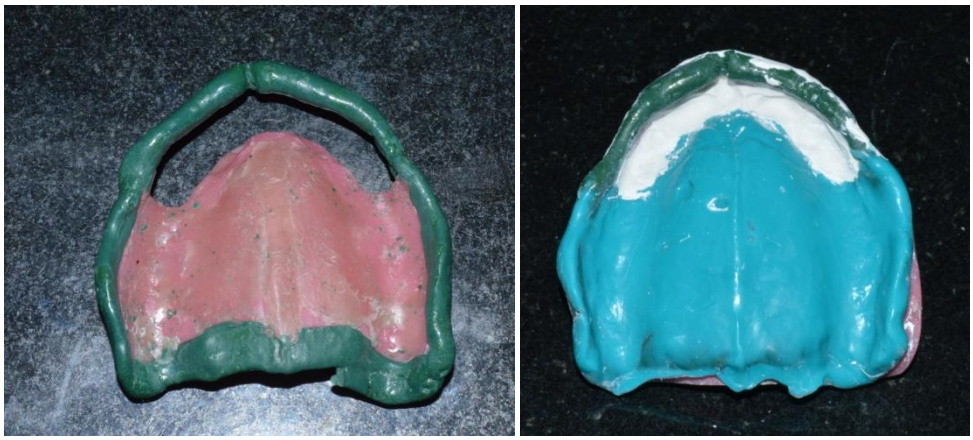

Figure 4 – Upper Arch Final Impressions

The custom tray for the lower arch was fabricated conventionally and the wash impression was made by the tertiary method. This method incorporated making the impression by rolling the green stick compound onto the tray like red cake impression compound, troughing the impression material with firm pressure from the pad of the index finger and recording the ridge details thus. After the lower ridge impression was made, the impression surface was scraped to create space for the wash impression material. The wash impression was then made with A-silicone Monophase material (Medium bodied, A-silicone, polyvinylsiloxane material;Dentsply Aquasil Ultra Monophase) (Fig.5).

Figure 5 – Lower arch final impression

The master models of the patient were poured in dental stone (type-III gypsum; Neelkanth co.). The occlusal rims were made on heat cure resin record bases. Patient's vertical jaw relation was first determined using Niswonger's method and centric relation was recorded and verified by the nick and notch method, while orientation jaw relation was recorded using the facebow, and then transferred onto a semi-adjustable articulator. (Fig. 6)

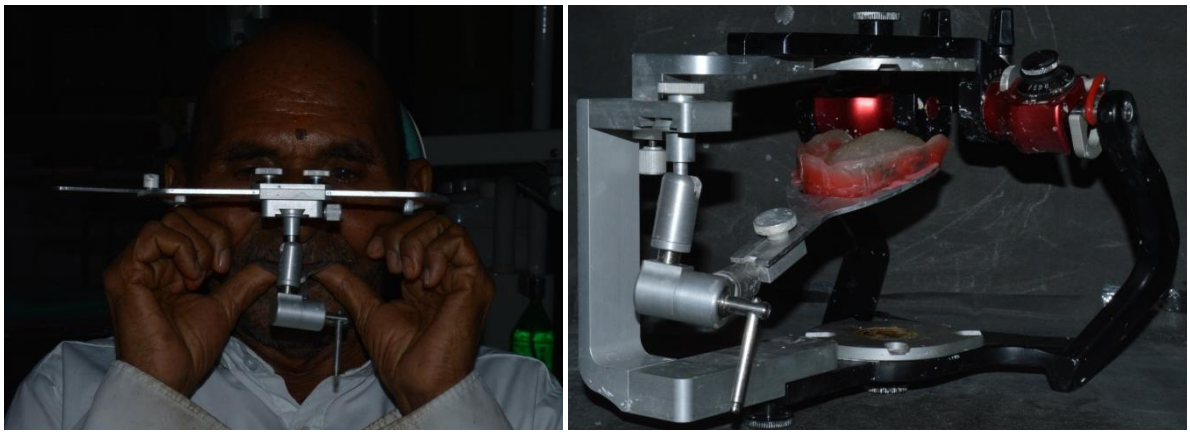

Figure 6 – Facebow recording and transfer of the patient

After the models were mounted onto the articulator, the lower wax occlusal rim was removed. The vertical dimension of occlusion was maintained by vertical acrylic stops in the canine and the first molar region. Three loops of 19 guage wire were embedded into the record base. The occlusal rim was then fabricated in impression compound, supported by the 19 guage wire loops, so as to ensure better mouldability of the lower rim according to the patient's functional neutral zone recordings. (Fig. 7)

Figure 7 – Replacement of lower wax occlusal rim with an impression compound rim

For the recording of the neutral zone, the patient was made to sit in an upright position with the head supported in the occipital region . The impression compound was heat tempered at 65^{o}c and the patient was asked to perform a series of actions like swallowing, speaking, sucking, pursing lips, pronouncing vowels sipping water, and slightly protruding the tongue several times which simulated physiological functioning. During function of the lips, cheeks, and the tongue, the forces exerted on the soft temperable compound, mould it according to the recording of the patient's neutral zone. The record base with the compound rim is removed and placed in cool water bath. It was then trimmed along the contours of the soft tissue and another final impression was recorded in soft liner, to ensure perfect recording of the soft tissue movements and contours, for the appropriate fabrication of the polished surfaces of the lower denture. (Fig. 8)

Figure 8 – Neutral zone recorded

The neutral zone, particular of the patient, thus recorded was preserved in its dimensions, by means of a putty index. The index was fabricated in two sections - a tongue split and a labial split, so as to facilitate its easy insertion and removal from the master model.(Fig. 9)

Figure 9 – Putty index fabricated for the neutral zone

The compound occlusal rim was then removed from the base plate, along with the acrylic stops and the wire loops and the index was adapted onto the mandibular cast. Modelling wax was melted and poured into the void left behind by the neutral zone record into the putty index.Teeth arrangement was done exactly following the index that is, within the bounds of the neutral zone, dictated by the confines of the putty index. The lower posteriors were arranged with zero degree or non-anatomic teeth. Once the waxed up trial dentures were ready, they were checked in the patients mouth for aesthetics, phonetics and occlusion. (Fig. 10)

Figure 10 – Try-in of the dentures

Once the try-in was deemed satisfactory the dentures were processed and finished. Care was taken during finishing and polishing of the dentures so that the contours recorded previously were unaltered. The dentures provided the patient with improved facial appearance, stability and retention during function — as they have been constructed in harmony with their surroundings.

III. Discussion

The success of any prosthesis depends on the proper positioning of the artificial teeth within the neutral zone.[1] The foremost people to have contributed to the concept of neutral zone are probably Wil-ford Fish[4] and Russell Tench. Weinberg [8] stated that buccal cusps and fossae of the posterior teeth should be directly over the crest of the ridge. Heartwell and Rahn[3] indicated that the posterior teeth should be positioned buccolingually on the residual alveolar ridge. Pound[21] stated that invariably arranging the teeth over the crest of the residual ridge, accentuated the facial deformity, provoking phonetic problems and making food manipulation difficult during deglutition. Robinson[22], Payne[23], Murray[24], and Watt[2] are of the opinion that artificial teeth should be positioned where the natural teeth grew. Beresin and Schiesser[10] have suggested that the denture teeth should be arranged in the neutral zone, where during function the forces of the tongue pressing outward are neutralized by the forces of cheek and lips pressing inward.

Other treatment options that may be advocated for the management of severely resorbed ridges fall under the surgical category . Surgical avenues include vestibular extension procedures that increase vestibular depth and augmentation procedures, which include (1) overlay grafts of rib or the crest of the ilium, (2) osteotomy grafts to include the visor osteotomy and the interpositional bone graft, (3) alloplastic grafts of which hydroxyapatite augmentation is the most common, and (4) various types of implants to restore the compromised ridge. The ultimate goal, regardless of the treatment modality chosen, is to restore the patient to a level of masticatory function.[25]

The acrylic vertical stops were placed in the canine and the first molar region, to ensure proper anteroposterior maintenance of the OVD. The soft liner was used to make the final neutral zone recording to ensure the recording of finest details for the polished surface contours of the denture. The horizontal and lateral forces generated by the cuspal inclines of the anatomic or the semianatomic teeth, would have been ill-tolerated by the resorbed lower ridges. Hence, monoplane/zero degree or non-anatomic teeth have been used in the fabrication of complete denture in this case. The anterior teeth selection was done according to the SPA factor of the patient and the shade selection was done according to the skin tone of the patient.The ultimate goal of any prosthodontic treatment is to restore the form, function, and aesthetics of the patient. Fish[4] pointed that out of the three surfaces of the denture the polished surface is bounded by the tongue and the cheeks. These are involved in normal physiologic movements such as speech, mastication, swallowing, smiling, and laughing. Denture fabricated over a severely resorbed mandibular ridge by neutral zone concept will ensure that the muscular forces aid in the retention and stabilization of the denture rather than dislodging the denture during function.[26] Hence, the fabrication of the denture must be in harmony with these functions. The dentures will also have other advantages such as reduced food lodgement, good aesthetics due to facial support, proper positioning of the posterior teeth which allows sufficient tongue space.[27] Clinicians must identify and record the neuromuscular dynamics of the oral tissues and this should be applied in the construction of the definitive prosthesis that will exist within the stabilizing boundary conditions of the neutral zone area.[28]

IV. Conclusion

Neutral Zone concept is considered as exceptionally important when considering treatment options for patients complaining from unstable lower denture particularly if implant treatment is not feasible. It aims to place lower denture where forces generated by lips, cheeks and tongue have a stabilizing rather than dislodging effect. The principle technique used to record neutral zone is extensively recorded; yet it needs to be backed up with high quality clinical trials to push it further up on the hierarchy of evidence.

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