



Innovative Approach Utilizing Combined Swallowing and Phonetic Method to Establish Neutral Zone in a Severely Resorbed Complete Edentulous Lower Arch: A Case Report.

Dr. Baisakhi Mallick¹(Corresponding author), Dr. Anasua Debnath², Dr. Priyanjali Paul³, Dr. Mandira Ghosh⁴, Dr. Gautam Naskar⁵, Dr. Amlan Biswas⁶

Assistant Professor, Dept. of Prosthetic Dentistry, Dr. R Ahmed Dental College and Hospital, Kolkata¹(Corresponding author)

Assistant Professor, Dept. of Prosthetic Dentistry, Dr. R Ahmed Dental College and Hospital, Kolkata²

Assistant Professor, Dept. of Prosthetic Dentistry, Dr. R Ahmed Dental College and Hospital, Kolkata³

Associate Professor, Dept. of Prosthetic Dentistry, North Bengal Dental College, Darjeeling⁴

Associate Professor, Dept. of Prosthetic Dentistry, Dr. R Ahmed Dental College and Hospital, Kolkata⁵

Ex-house surgeon, Dept. of Prosthetic Dentistry, Dr. R Ahmed Dental College and Hospital, Kolkata⁶

(Received: 27 October 2023

Revised: 22 November

Accepted: 26 December)

KEYWORDS

Severely resorbed mandibular ridges, Neutral zone, impression, edentulism

ABSTRACT:

Retention in lower complete denture prosthesis, most of the time is a rare achievement for the dental surgeons due to the configuration of the lower denture bearing surface and its associated tissues. Neutral zone technique is a firmly established method to achieve stability of the prosthesis in situations with difficulty in achieving retention. Even then, severely resorbed ridges often pose challenges with conventional neutral zone technique. This case report focuses on a unique technique in achieving stability of a complete denture prosthesis in Atwood's class IV and class V ridge resorption by using the advantageous effects of combined swallowing and phonetic technique. Imprint of the potential dead space area at the most non-disturbed zone, where soft tissues oral musculature and tongue produces minimal deflective and dislodging force on the prosthesis has been the goal of the technique used in this particular case report.

1. Introduction

The concept of retention of lower complete denture is almost impossible in case of long standing unrehabilitated lower edentulous arch. Such prosthesis can still have good survival by achieving stability. Stability in dentistry is defined as resistance of denture to movement on its tissue foundation, especially to lateral(horizontal) forces as opposed to vertical displacement (GPT-9).¹ Apart from bone heights, contour, there exists another important determining element known as the neutral zone which secures the denture in place by imparting stability. Neutral zone is a

potential three-dimensional space where, during masticatory function and speech, the forces of the lips and cheeks directed inward neutralize the forces of the tongue pressing outward.¹ The neutral zone is defined as a potential space between the lips and cheeks on one side, and the tongue on the other side, where the forces between the tongue and the cheek or lips are equal (GPT-9).¹ This zone is also referred to as dead space or zone of minimal conflict. Residual ridge resorption is an inevitable chronic disease that is characterized by its irreversible and progressive nature. This multifactorial pathophysiologic phenomenon along with the lesser



mandibular denture bearing area which is nearly half (14 cm square) of the surface area of the maxillary denture base (24 cm square), presence of outward thrust of tongue, loss of elasticity and neuromuscular coordination of the oral musculature makes the denture unstable.² With advancing age cheek and lip muscles lose their tonicity. The direction of bone loss is downwards and outwards in the mandible which also plays a challenge towards success of prosthesis. Enlargement of the tongue even aggravates the situation.³ This leads to shift of the denture bearing space more towards the buccal and labial sides, increasing the chances of destabilization of the denture. By employing the neutral zone concept, the dislodging muscle energy is programmed through learning and practice to contract to an extent which will provide retentive and stabilizing force only to the lower prosthesis.

Techniques

The stability of complete dentures is dictated by a three-dimensional dead space created by loss of teeth, resorption of bone and counter balance of tongue on one side with oral musculature on the other side. This space is unique to each patient. The clinical application of denture space recording methods was found to be effective in edentulous patients with severe ridge resorption.⁴ The relationship between the labiolingual and buccolingual pressure in patients with neuromuscular problems or with mandibular or lingual defects is a challenge. A stable prosthesis can be fabricated in this situation by locating the neutral zone using denture space recording methods. Denture space recording method depends on reproducibility of the recording material, position of the teeth and polished surface of the denture and functioning of the masticatory apparatus against the denture.⁴ Two commonly used techniques for recording the neutral zone are well known, i) phonetic method (pnz) and ii) swallowing method (snz). In a study by Joseph E Makzoume significant differences were noted with the swallowing technique in which the neutral zone was located more buccally in the left molar and right molar region than the phonetic technique.⁴ Significant differences were also noted lingually, in the right premolar region where they were found to be located more lingual in the swallowing technique than the phonetic neutral zone. There was no significant difference between the techniques for the anterior region.⁴ Utilizing this concept, we aimed at

recording a potential neutral zone space which will incorporate the recorded space that is a combination of both the recording techniques.

2. Objectives

The objective of this study was to recording a potential neutral zone space which will incorporate the recorded space that is a combination of both the phonetic and swallowing recording techniques.

3. Methods

A 52-year-old male patient reported to the Department of Prosthodontics and Crown and Bridge at Dr. R Ahmed Dental College and Hospital, Kolkata with inability to speak and eat. Detailed history of the patient revealed he has remained completely edentulous after total extraction for a period of 4 years. Intra-oral examination revealed severe residual alveolar bone resorption (Atwoods classification V in the anterior and VI in the posterior region), widening of the lingual space at the molar region and anterior flabby tissue in upper arch (Fig 1).^{5,6} The salivary flow is moderate. Line connecting the extra-oral facial profile including the soft tissue landmark like nasion to pogonion, revealed that the facial contour was a straight profile, with the pre-treatment indication that the maxillary and mandibular arch may be in class 1 molar relationship. With this diagnosis in mind, the treatment planning was decided with the fact that both tongue and musculature as the determining factor in stabilizing the denture. Preliminary impression of the maxillary arch was made with high fusing impression compound (Pyrax). Mandibular arch was recorded utilizing McCord and Tyson's technique (Fig 2).⁷ Diagnostic cast was derived. Spacer arrangement with Deepti dental modeling wax was made and a special tray was fabricated on top of it. In the next step border molding (DPI Pinnacle impression stick) was done and the final impression in lower arch was taken by zinc oxide eugenol paste (DPI impression paste) whereas final impression of upper arch done by window technique using zinc oxide eugenol paste and impression plaster (Fig 3). Occlusal rims were fabricated for the maxillary and mandibular arch. Tentative jaw relation was done. The rims along with the final cast were articulated. The mandibular occlusal rim was removed and retentive wires were placed on the record baseplate in the premolar and the molar area. Low fusing impression compound mixed with high fusing impression compound in 3:7



weight ratio, in accordance with McCord's technique was used in the next appointment to record the neutral zone.⁸ It was applied on the mandibular record base plate, with the retentive wires securing its position at the premolar region, where the defective forces on the prosthesis are maximum. Both the phonetic technique(pnz) and the swallowing technique(snz) has been used in an alternate manner to record the potential dead space.⁹The molding of the phonetic neutral zone (PNZ) was developed progressively. One lateral segment was molded first (right or left), then the other lateral segment; and, finally, the anterior segment. The phonetic technique utilizes sounds produced by the simultaneous effect of tongue on one side and the orbicularis oris and buccinator on the other side like sis, sos, sis (for the posterior lateral part of muscle and tongue movement) and tee, dee, mee (for anterior part of the tongue movement). The subject was asked to pronounce the phonetics "SIS,SOS,SIS" five times followed by the phoneme "TEE,DEE,MEE" five times, with the entire sequence being pronounced three times alternately. Both sounds had to be pronounced clearly, loudly, and vigorously to induce sufficient muscle contraction. Each time, the material was allowed to cool inside mouth before proceeding with the next step. Swallowing technique utilizes the pursing of lips and suckling movement against the swallowing phenomenon (contraction of posterior part of tongue against palate). The subjects were instructed to swallow and then purse the lips as in sucking, several times. To make swallowing easier, 1 mL of warm water was injected intraorally at each swallow.⁴ After the material cooled, the tray was removed from the mouth and excess compound forced to an excessive height was trimmed away with a knife. The swallowing and the phonetic techniques (Fig 4) were repeated alternatively each for three times, then allowing the material to cool in the patient's mouth. The entire assembly was sealed, taken out from the mouth and placed on the articulator. Notching was done on the buccal and labial aspect. Putty index was placed on the labial and lingual aspect of the recorded neutral zone space (Fig 5). The putty was cut into two pieces by slitting the posterior part at the oblique side close to each retromolar pad area. The low fusing compound material was removed (Fig 6). The void space was filled with molten wax (keeping the index in place). The index was removed when the wax solidified. Teeth (Acryrock,shade B2) were arranged in the available

space and position was cross checked each time by repositioning the index. Once the occlusion with the upper arch teeth was achieved, the denture was ready for anterior and posterior try-in (Fig 7). Esthetician evaluation and phonetic tests with the words TEE, DEE, MEE and SIS, SOS, SIS is evaluated to check stability. Words like 'mississippi', 'saraswati' were asked to be pronounced by the patient to check the closest speaking space. Post try-in, the wax up and carving was completed. The whole assembly was dearticulated and flaked. Dewaxing and heat curing were the next steps accomplished. The retrieved denture was finished and polished. On next appointment the denture insertion was done (Fig 8) after occlusal corrections and trimming of sharpness in the edges was performed. Follow up was done one week, one month and three months after denture insertion. Patient seemed satisfied (Fig 9) with the delivered prosthesis. He reported eating healthier and more in quantity compared to his earlier dietary habit.



Fig 1: Intra oral view of upper and lower edentulous ridge



Fig 2: upper and lower preliminary impression



Fig 3: upper and lower final impression



Fig 4: swallowing and the phonetic techniques performed to record neutral zone



Fig 5: putty index of lower arch to record neutral zone



Fig 6 : void created to receive molten wax in neutral zone



Fig 7: Try in done in patient's mouth



Fig 8: Front view of complete dentures in occlusion



Fig 9: Final prosthesis in the patient's mouth

4. Discussion

Rehabilitation of atrophic residual alveolar ridges is a testing phenomenon as physiologically, optimal denture contours and appropriate denture tooth arrangement should be accomplished to maximize prosthesis stability, comfort, and function.¹⁰ The dynamic nature of the denture space, that includes lesser denture bearing area, saliva accumulation, direction of the ridge resorption, muscular deflective forces by the tongue on one side and buccinator and orbicularis oris as the counter force, along with diminished neuro-muscular coordination dictates need for skillful approach towards the lower denture fabrication.¹¹ The number of patients needing a surgical deepening of lingual and vestibular sulci is reduced by utilizing knowledge of the denture space.^{4,12} Achieving stability of complete denture of the mandibular arch is the prime goal. A stable prosthesis can be easily fabricated by locating the neutral zone using denture space recording methods.¹³ The purpose of the denture space recording is to provide retention and decrease or prevent the chances of lateral forces to displace the denture.¹⁴ Resorption of mandibular ridge occurs from the lingual plate allowing for more space for tongue movement leading to tongue enlargement over the



years.⁸ The cheek and lip muscles lose their tonicity with the advancing age. This leads to shift of the neutral zone more towards the buccal and labial sides.¹⁴ Various materials have been suggested for shaping the neutral zone namely modeling plastic impression compound, soft wax, impression plaster, a polymer of dimethyl siloxane filled with calcium silicate, silicone, tissue conditioners and resilient lining materials.¹⁴ McCord and Tyson's technique uses impression compound and green tracing stick in the ratio of 3:7 parts by weight. This is placed in a bowl of water at 60°C and kneaded to a homogenous mass that provides a working time of about 90 sec.¹⁵ This maintains the flowability and increases the setting time till a desired time frame to allow the material to mold to the tune of movement of the oral musculature and the tongue. Apart from material movement of the musculature, phonetics play a controlling role in establishing the potential dead space area.¹⁶ Either of the two techniques i.e: snz and pnz has shown reproducibility, functional movement and position recording ability.¹² A person normally swallows up to 2400 times per day. During the entire swallowing sequence teeth come into contact for less than 1 second, with an overall estimate of less than 40 minutes of tooth-to-tooth contact per day during function, but most of the time the denture experiences deflective force due to the natural swallowing thus making swallowing technique a prime method for locating neutral zone.^{4,16} Speech is considered another vital part of daily oral activities. During speaking, the mouth is moderately opened and pressures of different magnitude and direction are generated. In this event forces are produced with greater horizontal components compared to the vertical, which directly affects the denture stability. Furthermore, speaking causes upward movements of the floor of the mouth similar to swallowing, though these movements are not as constant as those produced in swallowing.^{4,17} Teeth and denture flange area are the parts of the prosthesis that occupy the potential three-dimensional dead space. In recording the neutral zone both snz and pnz, combined together, delineates the height, position and shape of the teeth, denture flange and the polished area of the denture. The obtained record using the McCord's technique reveals surface details of concavity and convexity, both in the buccal side as well as the lingual side which are actually the conglomerative product of muscle contraction due to swallowing and

phonetics.⁷ Though both the techniques (snz and pnz) have been used separately in the past to establish the neutral zone, two of these above mentioned procedure utilizes musculature (orbicularis oris, buccinator and tongue muscles) , tendon like the modiolus present at the corner of the mouth as well as speech or phonetics against bony surfaces like hard palate, teeth, lips and associated soft tissues. Each individual has a conglomerative effect of features of both swallowing and phonetics. In this case report, we made an attempt of combining both techniques and utilization of the additive effect of each and vice-versa on the same patient. This allowed us to achieve an average area of potential dead space where the neutral zone created has a combined beneficiary stabilizing effect on the future complete denture prosthesis.

Conclusion

Many studies have utilized several impression materials, techniques, tray designs to record and delineate the neutral zone. Instead, we have approached a joint snz and pnz technique, keeping the material of choice for recording to be the most established and universally used McCord's technique. Our aim has remained to make full utilization of the muscles of swallowing and phonetics effective to locate a neutral place for the complete denture placement and functioning that will be able to withstand maximum displacing and dislodging forces from the surrounding musculature and the soft tissue.

References

1. The Glossary of Prosthodontic Terms: Ninth Edition. J Prosthet Dent. 2017 May;117(5S):e1-e105.
2. Savaliya A, Iyer J, Nadgere J. Neutral zone: a novel approach for resorbed ridge management-a case series. J Prosthodont Dent Mater 2020;1(1& 2): 82-89
3. Pan S, Dagenais M, Thomason JM, Awad M, Emami E, Kimoto S, Wollin SD, Feine JS. Does mandibular edentulous bone height affect prosthetic treatment success? J Dent. 2010 Nov;38(11):899-907.
4. Makzoumé JE. Morphologic comparison of two neutral zone impression techniques: a pilot study. J Prosthet Dent. 2004 Dec;92(6):563-8.



5. Atwood DA. Reduction of residual ridges: a major oral disease entity. *J Prosthet Dent.* 1971 Sep;26(3):266-79.
6. Fish EW. Using the muscles to stabilize the full lower denture. *J Am Dent Assoc* 1933; 20:2163-9
7. McCord JF, Tyson KW. A conservative prosthodontic option for the treatment of edentulous patients with atrophic (flat) mandibular ridges. *Br Dent J.* 1997; 182:469–472.
8. McCord JF, Grant AA. Impression making. *Br Dent J.* 2000; 188:484–492
9. Ladha K, Gupta R, Gill S, Verma M. Patient satisfaction with complete dentures fabricated using two neutral zone techniques: a within-subject cross-over pilot study. *J Indian Prosthodont Soc.* 2014 Jun;14(2):161-8
10. Agrawal KK, Singh SV, Vero N, Alvi HA, Chand P, Singh K, Goel P. Novel registration technique to register neutral zone. *J Oral Biol Craniofac Res.* 2012 Sep-Dec;2(3):198-202
11. Huuonen S, Haikola B, Oikarinen K, Söderholm AL, Remes-Lyly T, Sipilä K. Residual ridge resorption, lower denture stability and subjective complaints among edentulous individuals. *J Oral Rehabil.* 2012 May;39(5):384-90.
12. Masumi SI, Makihara E, Yamamori T, Ohkawa S. Effectiveness of denture space recording method in the prosthetic treatment of edentulous patients. *J Prosthodont Res.* 2022 Apr 27;66(2):221-225.
13. Masumi SI, Makihara E, Yamamori T, Ohkawa S. Effectiveness of denture space recording method in the prosthetic treatment of edentulous patients. *J Prosthodont Res.* 2022 Apr 27;66(2):221-225.
14. Qaiser S, Rizvi SZ, Siddiq M, Tariq K, Khan WU, Rafique A. Comparison of two neutral zone techniques to evaluate patient's satisfaction. *Pakistan Oral & Dental Journal.* 2021;41(4), 256-260
15. Yadav B, Jayna M, Yadav H, Suri S, Phogat S, Madan R. Comparison of different final impression techniques for management of resorbed mandibular ridge: a case report. *Case Rep Dent.* 2014; 2014:253731.
16. Bhat JT, Kumar N, Singh K, Tanvir H. Phonetics in prosthodontics: its clinical implications in designing of prosthesis. *Int J Appl Dent Sci* 2021;7(2):84-93
17. Matsuo K, Palmer JB. Anatomy and physiology of feeding and swallowing: normal and abnormal. *Phys Med Rehabil Clin N Am.* 2008 Nov;19(4):691-707,

Acknowledgement: None

Conflict of interest: Nil