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Comparison of patient's satisfaction with complete dentures with teeth arrangement in conventional and in neutral zone

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Abstract

Aims and Objectives: This study aimed to compare the satisfaction level of edentulous patients first provided with complete dentures fabricated by the conventional technique and then the same denture base used for the neutral zone.

Materials and Methods: The study was conducted on randomly selected 20 patients. The study protocol included a screening appointment of the patients to verify eligibility based on inclusion and exclusion criteria. A thorough clinical examination was done to evaluate maxillary and mandibular dentures and an OHIP questionnaire was taken before and after modification. 0.4 mm and 0.8 mm stainless steel wires will be glued onto the center of ridge crests and centers of arranged denture teeth respectively to measure the amount of shift in the center using the standardized radiographs were taken 52kV, 20 mA, and 4-4 ms to analyze the non-articulated casts with denture bases and the interwire distance was measured at the centers of right and left premolars and molars. The purpose of this study was to compare the satisfaction level of edentulous patients first provided with complete dentures fabricated by the conventional technique and then the same denture base used for the neutral zone. The null hypothesis was that the neutral zone relocation does not have much effect on patient satisfaction.

Results: A total of 20 edentulous patients were selected according to the specified criteria. Mean distances between the alveolar ridge crest and teeth in conventional dentures were 2.60mm, 3.10mm, 2.52mm, 3.30mm at right first premolar, left first premolar, right second molar, and left second molar. The amount of shift in the center of teeth after modification of denture in the neutral zone was 2.40 ± 1.18 ($P > 0.05$) at Right first Premolar and Right second Molar was 2.60 ± 1.14 ($P > 0.05$) indicating the non-significant difference between the two parameters obtained in conventional and in the neutral zone (Preoperative and postoperative). Comparison of median scores, for the variables of general satisfaction, mastication and speech were found as statistically significant ($P < 0.001$).

Conclusion: The present study was carried out to determine the amount of shift and patients satisfaction between the center of the teeth and the center of the alveolar ridge. Within the limitations of the study, the following conclusion was drawn: 1 The neutral zone was located slightly lingual to the crest of the ridge in the premolar and molar region on the left side. 2 There was no significant difference found between the right premolar and right molar indicated the position of the neutral zone over the crest of the ridge. 3. Regarding the overall satisfaction the patients found the after-modified denture better in speech and mastication. 4 For comfort and stability, no significant difference was observed before and after denture modification. As the teeth were already positioned in the mandibular central fossa of all teeth on the canine- mid retromolar pad line which is similar to natural teeth position and helps stabilize the mandibular denture (Pound's concept).

Keywords: Neutral zone, modified dentures in the neutral zone, conventional versus neutral zone

Introduction

The ultimate goal of dentistry is to keep all the teeth of an individual healthy and in comfort throughout his life. If however teeth are lost despite all efforts to save them, the prosthesis should be fabricated in such a manner to function efficiently and comfortably in harmony with the muscles of the stomatognathic system and the temporomandibular joints ^[1].

The primary objective of a complete denture prosthesis is to construct dentures that will satisfy the three basic requirements of the edentulous patient: maximum comfort, efficiency, and aesthetics ^[1].

Successful treatment outcome with a complete denture is largely dependent on proper tooth selection and arrangement. Factors that may complicate the arrangement of posterior teeth are anatomic configuration of the residual ridge, age of the patient, period of edentulism, physiologic and systemic status. Forces from the perioral musculature impose challenges in determining the tooth positions. These forces are directed against the denture. They either help in stabilizing it will dislodge it [2].

Continuous resorption of the residual alveolar ridge and the forces from the perioral musculature impose challenges in determining the tooth position. Weinberg stated that buccal cusps and fossae of the posterior teeth should be directly over the crest of the ridge. This position is said to result in more stability and less lateral force since the occlusal pressure on the tooth falls close to the fulcrum and creates little or no, torque.

Pound stated that invariably arranging the teeth over the crest of the residual ridge condemned patients by accentuating facial deformity, provoking phonetic problems, making food manipulation difficult during deglutition, and because of the instability of the mandibular denture. Robinson, Payne, Murray, G, and Watt are of the opinion.

Fish drew the profession's attention to the concept of "NEUTRAL ZONE" in complete denture construction. He argued that natural teeth occupy a "zone of equilibrium". In this zone, the outward forces exerted by the tongue counterbalance the inward forces of lips and cheeks [2].

Pound recommended that the lingual surfaces of mandibular posterior denture teeth should occupy an area bounded by two 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 modified Pound's concept in which he suggested that the lingual surfaces of mandibular posterior denture teeth should occupy an area bounded by two 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 [3].

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 [3]. The neutral zone is defined as "the potential space between the lips and cheeks on one side, and the tongue on the other; that area or position where the forces between the tongue and cheeks or lips are equal. It is also referred to as the potential denture space and the zone of minimal conflict [5]. Various movements including sucking, grinning, whistling, and pursing the lips push the material into a position where the buccolingual forces are neutralized [5].

The neutral Zone technique is principally used to record the mandibular denture space as mandibular dentures are less stable than the maxillary. Both the conventional and the neutral zone concepts are considered equally effective in denture fabrication. However, it remains a debatable issue as to which technique is superior in terms of patient satisfaction [25].

The patient's satisfaction level can be assessed by asking four major questions regarding comfort, dislodgement of dentures (stability), ability to chew (mastication), and speech. Each question was assessed by three categories i.e. good, fair, and poor. The patient's satisfaction level was graded as "highly satisfied" (score of 10 to 12), "fairly satisfied" (score of 7 to 9), and "poorly satisfied" (score of 4 to 6) [25]. The purpose of this study was to compare the satisfaction level of edentulous patients first provided with complete dentures fabricated by the conventional technique and then the same denture base used for the neutral zone. The null hypothesis was that the neutral zone relocation for teeth arrangement does not have much effect on the patient's satisfaction.

Materials and Methods

The subjects included in this study have explained the procedure and purpose of the study following which informed consent was obtained. This study was conducted on randomly selected 20 completely edentulous patients who had previously fabricated dentures patients reported to the Department of Prosthodontics and Implantology, Divya Jyoti College of Dental Sciences and Research, Modinagar with a complaint related to the prosthesis. This study had undergone ethical clearance at Divya Jyoti College of Dental Science and Research Modinagar.

The subjects who were selected based on the criteria for inclusion were –

1. Completely edentulous patients who had complete dentures.
2. Patients with good neuromuscular function.
3. Patients willing for modification.
4. Possessing an adequate understanding of written and spoken Hindi.
5. Able to understand and respond to the questionnaire used in the study.

The subjects who were excluded from the study were –

1. Acute/chronic symptoms of temporomandibular disorders.
2. Uncontrolled systemic diseases.
3. Intraosseous pathosis or defects
4. Patients with neuromuscular diseases.

The study protocol included a screening appointment of the patients to verify eligibility based on inclusion and exclusion criteria. A thorough clinical examination was done to evaluate maxillary and mandibular dentures. In the next visit, an OHIP questionnaire was taken to evaluate previous denture experience along with standardized occlusal radiographs of the denture bases. The standardization was done using the carding wax/sticky wax to make the occlusal surface of the mandibular denture parallel to the tabletop and then shift in the center of teeth was analyzed using standardized occlusal radiographs before denture modification. 0.4 mm and 0.8 mm stainless steel wires (smith) were glued onto the center of ridge crests and centers of arranged denture teeth respectively. Occlusal radiographs at 52kV, 20 mA, and 4-4 ms were taken to analyze the denture bases. (Fig 1,2,3)



Fig 1: 0.4 and 0.8 mm wire glued along the center of ridge and center of teeth



Fig 2: Standardization done using wax

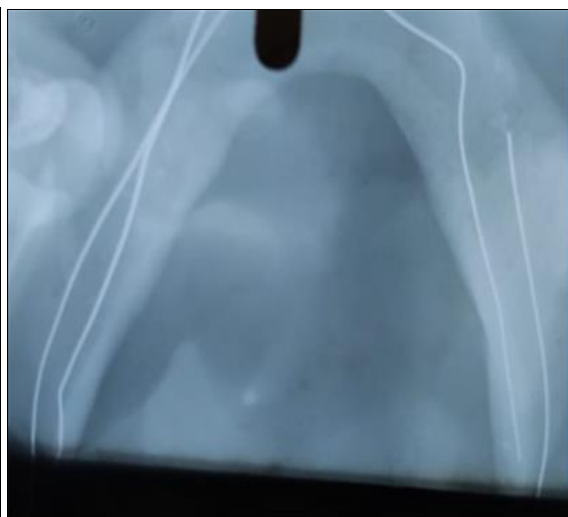


Fig 3: Preoperative occlusal radiograph

The measurement of the vertical dimension at occlusion was taken and bite registration was done accordingly and the cast with the dentures was mounted.

Later posterior teeth in the mandibular denture were trimmed off and the base was used as a permanent denture base as shown in figure 4

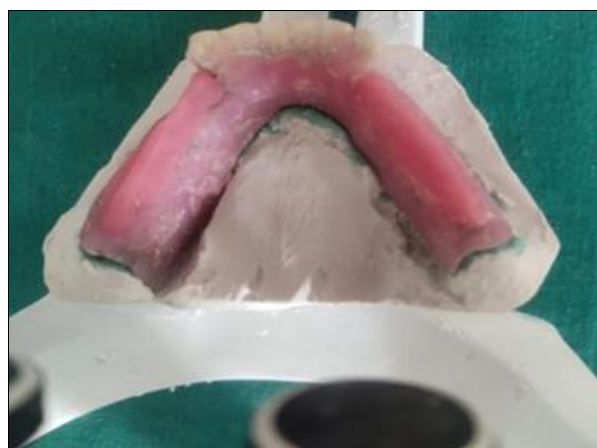


Fig 4: Posterior teeth trimmed



Fig 5: Rim prepared using green stick and impression compound

Impression compound and greenstick compound were taken and mixed in a 3:7 ratio respectively (Impression Compound and greenstick compound; DPI), kneaded thoroughly, and adapted to the record base, forming a recording rim. The recording rim was inverted and placed in a water bath for approximately 2 minutes so that it was prepared for the clinical procedure as shown in fig5.

The rim was then removed from the water bath and then placed intraorally. Then, the patient was provided with a cup of warm water and instructed to sip and swallow. This exercise was repeated several times, and the excess material was trimmed in between. This coordinated muscle activity plastically shape the rim to form the neutral zone and define the area in which the denture teeth were placed as shown in fig 6 and fig 7.



Fig 6: Patient doing movements to record NZ



Fig 7: Recorded neutral zone

When the neutral zone record had cooled and hardened, the record was removed and inspected for accuracy and completeness. If necessary, the procedure was repeated to ensure proper recording of the entire neutral zone.

Cast preparation was done with indexing for making putty indices of the neutral zone. To develop the lingual neutral zone index, neutral zone record was seated on the mandibular definitive cast (Fig 8)



Fig 8: Indexing of the Cast

Polyether impression material [Speedex: Coltene-whaledent company] was used for this purpose. Base and catalyst materials were dispensed and mixed together with fingers and were adapted to the tongue space of the neutral zone record so that it extends over the posterior land area of the cast. To develop the facial index, a rope of putty was adapted along the facial contours of the neutral zone record. Once

polymerized, both the lingual and facial indices were removed and it ensured that they can be replaced accurately and securely on the cast in the absence of the neutral zone record. An occlusal rim was fabricated with molten wax. Mandibular posterior teeth were arranged so that all posterior teeth contact the lingual index and the desired occlusal plane template. This was followed by the trial of mandibular teeth. (Fig9 ,10,11)



Fig 9: Putty Indices of Nz

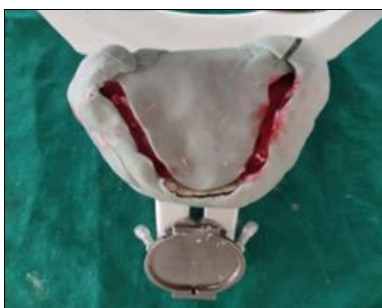


Fig 10: Rim fabrication in NZ



Fig 11: Teeth arrangement in NZ



Fig 12: Postoperative standardized radiograph



Fig 13: Denture inserted

Then, Investing, processing, finishing, and polishing was done. A shift in the center of teeth was analyzed using standardized occlusal radiographs after denture modification. The standardization was done by using the carding wax and parallelism with the tabletop was checked. 0.4 mm and 0.8 mm(26 gauge) stainless steel wires were glued onto the center of ridge crests and centers of arranged denture teeth respectively. Occlusal radiographs at 52kV, 20 mA, and 4-4 ms were taken to analyze the denture bases (Fig 12,13). The

distance of the radiographic film from the beam source was kept constant at 100 cms. The inter wire distances were measured on these radiographs at the center of right and left first premolar and second molar regions.

Data analysis

The data for the present study was entered in Microsoft Excel 2007 and analyzed using the SPSS statistical software 19.0 Version. The descriptive statistics included mean, standard deviation. The intragroup comparison for the different time intervals was done using a paired t-test to find the difference between the individual time intervals. The level of significance for the present study was fixed at 5%.

Results

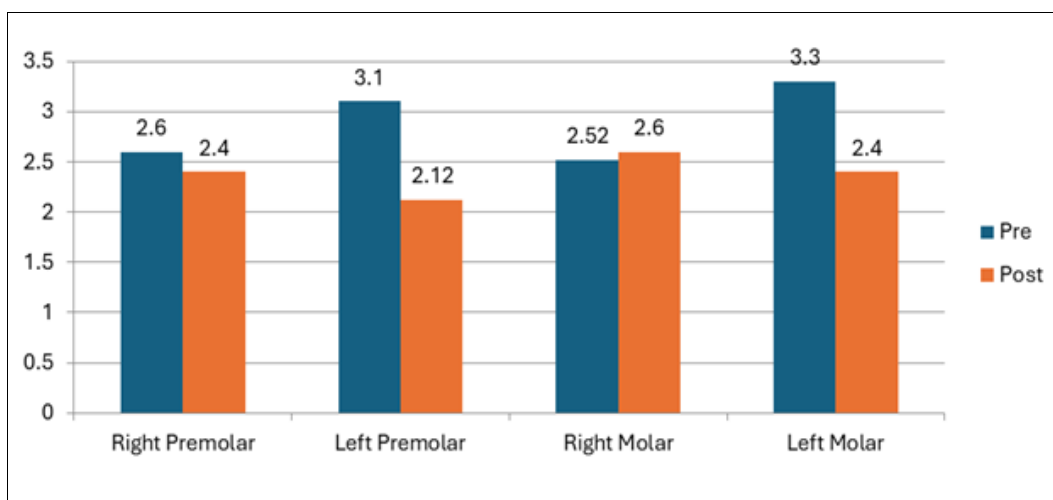
A total of 20 edentulous patients were selected according to the specified criteria. Mean distances between the alveolar ridge crest and teeth in conventional denture was 2.60mm,3.10mm,2.52mm, 3.30mm at right first premolar, left first premolar, right second molar, and left second molar as shown in table 2.

Table 2: Mean Of Distances Between The Teeths and Alveolar Ridge Crest In Conventional (Premodification)) And In Neutral Zone (Post modification)

	Pre	Post	P value	Significance
Right 1 st Premolar	2.60±1.75	2.40±1.18	0.619	Non-Significant
Left 1 st Premolar	3.10±1.07	2.12±1.68	0.043	Significant
Right 2 nd Molar	2.52± 1.16	2.60±1.14	0.847	Non-Significant
Left 2 nd Molar	3.30±1.21	2.40±1.42	0.020	Significant

Paired t-test at p less than 0.05The amount of shift in the center of teeth after modification of denture in the neutral zone was 2.40±1.18(P>0.05) at Right first Premolar and Right second Molar was 2.60 ± 1.14(P> 0.05) indicating the nonsignificant difference between the two parameters obtained in conventional and in the neutral zone (pre operatory and in postoperatory).

The distances measured at the left first premolar and left second premolar showed significant differences with the mean distance of 2.12±1.68 and 2.40 ± 1.42(P< 0.05) between the alveolar ridge crest and center of the teeth.



Graph 1: Distances between the teeth and alveolar ridge crest in conventional (Pre) And Neutral Zone (Post)

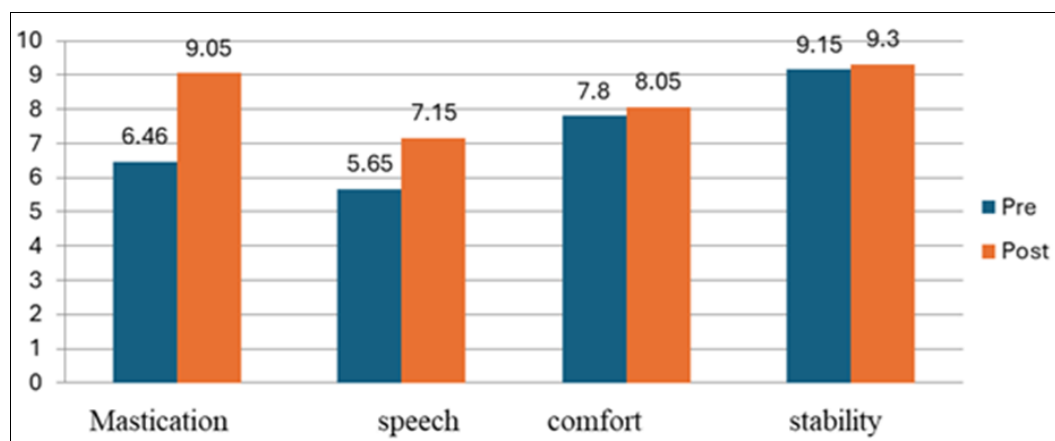
Graph 1 showed the amount of shift between the center of the teeth and center of the crest of the alveolar ridge at different location sites where no significant difference was found between the right premolar and right molar indicated the

location of the neutral zone over the crest and a significant difference was found between the left premolar and molar regions which indicated the neutral zone either buccally or lingually.

Table 3: Patient satisfaction scores before and two months after modification

	Pre	Post	P value	Significance
Mastication	6.46±1.45	9.05±1.51	0.001	Significant
Speech	5.65±0.95	7.15±1.22	0.001	Significant
Comfort	7.80±1.23	8.05±0.98	0.131	Non-Significant
Stability	9.15±0.98	9.30±0.57	0.603	Non-Significant

Comparison of median scores, for the variables of general satisfaction, mastication and speech were found as statistically significant (P-0.001).

**Graph 2:** Patient satisfaction with the dentures premodification and post-modification

The graphic representation showed a significant difference in mastication and speech while there was no significant difference in comfort and stability.

Discussion

Several studies have compared complete dentures fabricated using conventional and neutral zone (NZ) techniques. However, studies comparing patient satisfaction with complete dentures fabricated using swallowing and phonetic NZ techniques are lacking in literature [5].

For many years prosthodontists have been trying to find out the ideal location of the teeth during complete denture fabrication. The arrangement of teeth in complete dentures still has been based on mechanical principles. The biology and physiology of the stomatognathic muscles surrounding the prosthetic appliance are not being considered during various functions [42]. Literature is abundant which advocates the need for positioning the teeth in the neutral zone. Positioning artificial teeth in the neutral zone has two objectives. First, the teeth will not interfere with normal muscle function, and second, the forces exerted by the musculature against the dentures are more favorable for stability and retention [67].

After tooth loss, the process of mandibular alveolar residual ridge resorption begins [47], resulting in flattening of bone and thus reducing the ability to resist the lateral displacing forces exerted by the adjacent oral musculature on complete dentures [30]. In addition, as the distance from the occlusal surfaces of the teeth to the alveolar ridge increases greater leverage is applied by functionally generated forces leading to compromised denture stability [71]. Other than resorption lateral spread of the tongue, migration of the mentalis muscle and a loss of facial tonicity also impair the stability [53].

Tench *et al.* [32] were the first in this field and have proposed modeling plastic impression compound as the material to be used for recording the neutral zone. Although this advice is

Subjects directly compared the difference between the pre-modified dentures and dentures after modification concerning stability, comfort, ability to speak and chew.

At premodification, the values mastication, speech, comfort, and stability were 6.46±1.45, 5.65±0.95, 7.80±1.23, 9.15±0.98, and the values for the mastication, speech, comfort, and stability at two months after modification into the neutral zone were 9.05±1.51, 7.15±1.22, 8.05±0.98, 9.30±0.57. A statistically insignificant difference in the median scores was found between comfort and stability (P-0.131 and 0.603).

widely followed, other materials such as tissue conditioner wax, zinc oxide eugenol impression material [14], silicone material, chairside relining material [28], and acrylic resin are also described for this technique. Modeling plastic impression compound, being a thermoplastic material, is easy to manage and has the advantages of low cost and ease of availability. The position of NZ at right and left 1st premolar region, showed a variable trend from slightly lingual to slightly buccal locations. This could be considered almost vertical which is a normal physiological process where mandibular posterior ridges are resorbed vertically and hence directing NZ directly over the crest of the ridge, which is in agreement with the study conducted by Weinberg in 1958. So the position of the neutral zone does not vary considerably in the premolar region, and thus the teeth can be arranged directly over the ridge.

The result obtained from this study for the position of NZ with different duration of edentulism at right and left the first premolar and second molar region showed the neutral zone to be located lingually and in some cases, the neutral zone was located on the ridge, which follows the centripetal resorption of the mandible.

As the period of edentulousness increases, the mandibular ridge resorbs from the lingual side in the molar region. By this pattern of resorption, the arch will become wider in the posterior region. So the position of the neutral zone is lingual to the crest of the alveolar ridge.

The findings of this study suggest that the location of the neutral zone varies not only from individual to individual but also shows variability concerning the location. The location of NZ primarily depends on the musculature of patients, which changes the form of lateral spread of tongue on one side and weakening of oro-facial musculature on the side. This is further complicated with resorption, which increases with the duration of edentulism. Findings of Wright. C.R (1966) showed that if the sizes of the mandibular teeth are too large

(buccolingual) or if the posterior teeth are set even 1 mm lingually, the tongue is deprived of approximately 1000 mm³ of its functional space, This can force the tongue into an abnormally retracted position and instability of dentures. So the final teeth arrangement should be done considering all the factors in mind. The location of the neutral zone assists in these instances for the correct placement of posterior teeth.

In the present study, subjects rated their satisfaction with their old and Neutral Zone complete dentures by responding to a questionnaire that assessed various factors associated with the function of the prosthesis. Responses were recorded on a 5-point Likert scale. No significant difference was found in terms of patient satisfaction in comfort and stability. The results of the present study indicate that patients found NZ complete dentures more comfortable than their old dentures.

The patients' ability to chew and their satisfaction with the stability of maxillary dentures differ significantly between their old and Neutral Zone dentures. The patients were partially satisfied with the use of dentures in the neutral zone.

In the case of the mandibular denture, the patient's ability to chewing differ significantly with the mean values of 6.46 ± 1.45 and 9.05 ± 1.51 (P-value 0.001) before and after modification of dentures and their satisfaction with the stability was nonsignificant (P 0.603) as the lingual cusps of the teeth were located more buccally than the lingual border.

Ejlal M *et al.* [28] suggested the tooth position originally suggested by Pound positions the mandibular central fossa of all teeth on the canine- mid retromolar pad line. This position is similar to the natural teeth position and helps stabilize the mandibular denture. Thus, there was no significant difference in comfort and stability and the patients were partially satisfied with stability.

Ikebe *et al.* [2] and Gahan *et al.* [52] reported a similar need of grinding the teeth lingually. It is suggested that artificial teeth with narrow buccolingual widths should be readily available commercially or the teeth should be customized when constructing NZ dentures.

The accuracy of NZ location is enhanced when recording material will be chosen based on sound scientific rationale. Makzoume brought to light the importance of the technique of recording neutral zone based on a rationale that phonetic technique involves the location of neutral zone in different directions while swallowing forces are primarily vertical [5].

Within the limitations of this study, it is suggested that the neutral zone technique for fabricating prostheses should be considered on a more regular basis rather than as an approach for complex treatments.

Conclusion

The present study was carried out to determine the amount of shift and patients satisfaction between the center of the teeth and the center of the alveolar ridge. The neutral-zone philosophy is based upon the concept that for each patient, there exists within the denture space a specific area where the function of the musculature will not unseat the denture and where forces generated by the tongue are neutralized by the forces generated by the lips and cheeks.

Within the limitations of the study the following conclusion was drawn:

1. The neutral zone was located slightly lingual to the crest of the ridge in the premolar and molar region on the left side.
2. There was no significant difference found between the right premolar and right molar indicated the position of the neutral zone over the crest of the ridge.

3. Regarding the overall satisfaction, the patients found the after-modified denture better in speech and mastication.
4. For comfort and stability, no significant difference was observed before and after the modification of dentures. As the teeth were already positioned in the mandibular central fossa of all teeth on the canine- mid retromolar pad line which is similar to natural teeth position and helps stabilize the mandibular denture (Pound's concept).

Findings of this study suggest teeth arrangement done in accordance to an approximate neutral zone located by the Landmark which includes retromolar pad and first premolar area gives satisfactory result, though molding mark location of the neutral zone more precisely. In routine, if proper neutral zone molding cannot be done, then teeth arrangement using the landmarks gives an almost equally satisfactory result.

Conflict of Interest

Not available

Financial Support

Not available

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