



## ENHANCING COMPLETE DENTURE STABILITY THROUGH NEUTRAL ZONE AND FUNCTIONALLY GENERATED PATH TECHNIQUE - A CASE REPORT

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### ABSTRACT

Complete denture patients who have worn multiple dentures are gradually increasing. They usually come with severely resorbed ridges, decreased muscle tone and less neuromuscular function. These conditions may increase unless some physiologic means are employed to build stable dentures. This article describes technique to make functionally stable complete denture for a patient with highly resorbed residual ridges and Class II jaw relation. The neutral zone technique is especially favorable to record the external surface of denture and also in positioning artificial teeth. Functionally generated path generates occlusion physiologically. Combining neutral zone and functionally generated path technique enhances the stability of complete dentures.

### KEYWORDS

: resorbed ridges, functional chew in methods, functional bite technique, cuspal tracing technique, vertical dimension.

### INTRODUCTION

Very often we come across patients complaining-“Doctor my denture is loose.” As the size and span of elderly population is increasing so is their denture usage. Elderly patients, especially those who are long-time complete denture wearers have advanced ridge and perioral muscle atrophy.<sup>1</sup> Adaption to complete denture was less of a problem in the past probably because new denture wearers were younger.<sup>2</sup> However, currently people experience tooth loss later in life, and usually have severe atrophic ridge which makes it difficult for them to develop the neuromuscular skills needed for the successful wearing of dentures.<sup>3</sup> The conventional denture made many years back becomes worn out, ill-fitting and gradually increases ridge resorption. When ill-fitting dentures are used by the patient, an ideal case will become difficult and a difficult case even more chaotic. Success in treatment with complete denture is possible in such situations only if certain anatomic and physiologic facts are considered.<sup>4</sup> From this stand point, we must fabricate new denture that minimize the possibility of soft tissue abuse and bone resorption and is physiologically compatible.<sup>5</sup> To manage such difficult situations, Fish in 1933<sup>6</sup> drew the attention of the profession towards the cameo or polished surfaces of dentures. He highlighted the importance of the muscular function of the tongue, cheeks, and lips as being critical factors for denture stability. In order to construct dentures that function properly not only during mastication but also in speaking and swallowing we must integrate all three surfaces of complete denture prosthesis.<sup>7</sup>

According to the Glossary of Prosthodontic Terms (2005)<sup>8</sup> Neutral zone (NZ) is 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. The term neutral zone<sup>9</sup> was coined by Beresin and Schiesser in 1976. The neutral zone philosophy is based on the concept

that for each individual patient there exists within the denture space a specific area where the function of the musculature will not unsettle the denture. Thus, artificial teeth arranged in the neutral zone increases denture stability.<sup>10</sup>

Functionally generated path (FGP) has been defined<sup>8</sup> as the registration of the paths of movement of the occlusal surfaces of teeth or occlusion rims of one dental arch in plastic or other media attached to the teeth or occlusal rims of the opposing arch. Meyer stated that nature has built the occlusal surfaces and incisal edges of teeth to have certain curved pathways which balance and function harmoniously with movements of the condyles in the glenoid fossae. He defined Functional occlusal path as the automatic determination of the geometric harmonious relationship between the occlusal path and the condylar paths at a chosen vertical dimension.<sup>11,12</sup>

The concerned patient had conventional old denture which was not stable in function. A new denture was fabricated with both NZ and FGP technique. After 12 months, satisfactory denture stability was observed during partial and full mouth opening.

### CASE DESCRIPTION

A 52 year-old female patient came to the department and requested new complete denture. She complained that her denture which was made 2 years ago was loose and irritating, causing discomfort during eating. Intraoral examination revealed complete edentulism, classified as Class IV according to the American College of Prosthodontists Prosthodontic Diagnostic Index.<sup>13</sup> The existing conventional denture (Fig.1) showed Class II jaw relation with maxillary teeth set more buccally.



**Fig 1: Existing conventional denture, with class II jaw relation.**

All treatment options were explained to the patient and she did not prefer surgical intervention and requested only prosthetic treatment. As the patient presented with atrophic residual alveolar ridges achieving denture stability was the primary objective in treatment planning. So neutral zone (NZ) and functionally generated path (FGP) technique were incorporated in denture construction. The steps followed were;

1. Impression making, articulation and recording neutral zone.
2. Recording primary functionally generated path (PFGP).
3. Processing of Maxillary definitive prosthesis.
4. Fabrication of cuspal and sulcus analysis.
5. Recording final FGP.
6. Processing of Mandibular definitive prosthesis.

### 1. Impression making, articulation and recording neutral zone.

Preliminary impressions were made with irreversible hydrocolloid (Tropicalgin, Zhermack SpA via Bovazecchino, Badia Polesine, Italy) and poured with type II gypsum product. Special trays for selective pressure technique were fabricated with autopolymerising resin (DPI-RR Cold Cure, The Bombay Burma Trading Corporation, Mumbai, India). Definitive impression was made with zinc oxide eugenol impression paste (DPI impression paste, The Bombay Burma Trading Corporation, Mumbai, India) for maxillary

edentulous arch, Admix and Poly vinyl siloxane light body (Express XT Ultra-Light, 3M ESPE) for mandibular edentulous arch.<sup>14</sup> Definitive split casts were poured in Type III dental stone. The crestal area of permanent denture base (DPI Heat cure, The Bombay Burma Trading Corporation, Mumbai, India) was made rough to mechanically retain admix occlusion rims during NZ and FGP technique.<sup>15</sup> Face bow transfer was done.

Admix occlusion rims were softened in warm water and placed in patient's mouth. The patient was instructed to swallow and suck several times. A cup of warm water was provided to the patient and she was instructed to sip and swallow. This exercise was repeated several times. The functional movements of lips, cheeks and the tongue plastically shaped the admix rim to the form of neutral zone. Neutral zone and occluding centric relation record (OCR) was recorded with admix occlusion rims and transferred to a semi adjustable articulator (Artex Type TR 217560).<sup>16-20</sup> Neutral zone was indexed with lab putty (Coltene/Whaledent AG Switzerland). From here on the articulator was used only as Class I articulator.<sup>8</sup>

**2. Recording primary functionally generated path (PFGP).**

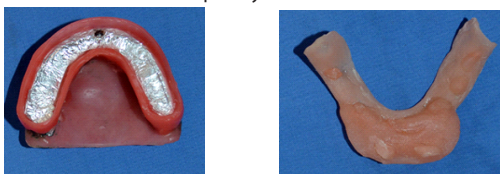
As class II jaw relation has large envelope of motion, the rims had to be stabilized during PFGP tracing. A 1.5mm diameter metal ball was positioned on the midline in level with the occlusal plane of admix maxillary occlusion rim. A stock metal tray handle was modified and attached on the labial surface in level with the occlusal plane of admix mandibular occlusion rim. So the maxillary stylus (metal ball) had point contact on the mandibular stock tray handle during generation of PFGP. This helped to maintain occlusion vertical dimension during functional movements. Two millimeters of maxillary and mandibular admix occlusal rims was reduced except around the ball bearing of maxillary admix occlusal rim and then rebuilt with carding wax (Shiva products, Thane, Maharashtra India). This was covered with tin foil (Hindalco, Dadra, India). The entire assembly was placed in the mouth (Fig 2) and PFGP was traced by functional movements. The functional movements were done within 5mm range of mandibular movements.



**Fig 2: Recording of primary functionally generated path with custom made tracing unit**

The patient was trained to bite mildly on the rims with mandible in centric relation and move to other eccentric positions. This completed one cycle of functional movement. This cycle of movements was repeated until a smooth and uniform tracing was obtained. As the PFGP was traced at the established occlusal vertical dimension (VDO), the assembly was transferred to articulator.<sup>11,12</sup>

A new mandibular temporary acrylic denture base with labial extension was fabricated to index the PFGP. Maxillary PFGP tracing was boxed (Fig 3); dental plaster was poured into it. Once the plaster showed initial set, the articulator was closed over the new mandibular temporary denture base at the established VDO. After final set the boxing wax was removed and the articulator was opened. The plaster record of maxillary PFGP tracing was retained on the new mandibular temporary denture base.



**Fig 3: Boxing of maxillary PFGP tracing & mandibular temporary acrylic denture base with labial extension for indexing PFGP**

**3. Processing of Maxillary definitive prosthesis.**

Teeth arrangement of the maxillary edentulous arch (Acryrock, Ruthinium group Dental Manufacturing S.p.A., Badia Polesine (RO) - Italy) was done in relation to NZ and maxillary PFGP record. The maxillary definitive prosthesis was processed after clinical try-in. Lab remounting was done with mandibular PFGP record and processing errors corrected (Fig.4).



**Fig 4: Lab remount & correction of processing errors for maxillary denture with mandibular PFGP record**

**4. Fabrication of cusp and sulcus analysis.**

Plaster PFGP was removed from mandibular temporary denture base and admix occlusion rim was constructed. The width of admix rim was increased to 10 mm so that carding wax was supported during functional movements. A coat of petroleum jelly was applied on the occlusal surfaces of maxillary definitive prosthesis and closed against the softened mandibular admix occlusion rim to the same OCR in the articulator (Fig.5). This leaves behind a narrow fin of admix compound over the crest of the mandibular admix occlusal rim. Then 5 mm of admix occlusion rim on the either side of fin representing buccal and lingual cuspal slopes was reduced and replaced with carding wax to perform cusp and sulcus analysis.<sup>11,12</sup>



**Fig 5: Occlusal Centric Relation on admix occlusal rim**

**5. Recording final FGP.**

Definitive maxillary prosthesis and cusp and sulcus analysis was placed intraorally. The patient was guided to first close into centric relation. The carding wax indentations of the maxillary anterior teeth acted as a guide for centric stops. Then the patient was instructed to open the mouth and slowly move the jaw to either right or left (about 5 mm) and slide the jaw back into the centric relation. Similarly, the protrusive movement was also traced. This cycle of movements was repeated until a smooth and uniform final FGP tracing was obtained (Fig.6). Boxing of final FGP tracing was done and poured in Type IV gypsum product (Ultrarock, Kalabhai, Mumbai, India) to a new maxillary temporary acrylic denture base (Fig.7).



**Fig 6: Final FGP tracing**

**Fig 7: Boxing of final FGP tracing done with type IV gypsum product**



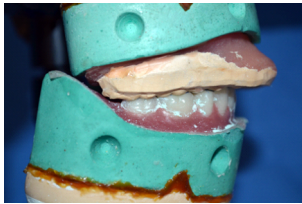
### 6. Processing of Mandibular definitive prosthesis.

Mandibular teeth were set in neutral zone; first premolars were excluded because of class II jaw relation. Centric occlusion was established. Occlusion was equilibrated with final FGP record to get uniform contact. Lower wax try in was done and bilateral balanced occlusion was confirmed. External wash impression was made with Zinc oxide impression material and it recorded buccal tongue contact (BTC) (Fig.8).



**Fig 8: External wash impression and Buccal tongue contact**

Processing, lab remounting of mandibular definitive prosthesis was done. Processing errors of 1mm was corrected with final FGP record (Fig.9) to obtain uniform contact. BTC did not interfere with final FGP. Mandibular definitive prosthesis was properly finished, polished and inserted in the patient's mouth. Smooth protrusive and lateral excursions without deflective occlusal contacts were achieved with bilateral balanced occlusal scheme.<sup>20</sup>



**Fig 9: Lab remount of mandibular definitive prosthesis with final FGP record**

Importance of denture maintenance was explained to the patient. The patient was recalled after 24 hours for the first post insertion visit. Review was done after 1 month, 3 months, 6 months and 1 year (Fig.10). Patient was satisfied with the new prosthesis which showed good denture stability to partial and complete mouth opening.



**Fig 10: Final Prosthesis**

### DISCUSSION

Optimum oral health should be the prime objective of all rehabilitation procedures, because the ultimate goal is always to restore the mouth to health and preserve this status throughout the life of a patient.<sup>11</sup> Techniques described here are intended to emphasize and illustrate the clinical value of recording the physiologic dynamics of oral and perioral muscle function. This information was used to fabricate complete denture contours and balanced occlusion within envelope of function.

The Neutral zone concept helps to coordinate complete denture with neuromuscular function.<sup>9</sup> This act as one of the foundation for successful stable dentures. Arranging artificial teeth within the neutral zone achieves two important objectives: (1) Artificial teeth do not interfere with normal muscle function. (2) Normal oral and perioral muscle activity imparts force against the complete denture that serves to stabilize and retain the prostheses rather than cause denture displacement.<sup>10,16</sup>

Most patients adjust to the orthodox occlusions which we build for them. If we set and balance teeth on an articulator adjusted by

means of positional interocclusal records, we usually can anticipate that the adaptive capacity of the patient's neuromuscular system will be equal to the task. However, the learning period is prolonged and painful for many patients. These are the people who can be most helped by a technique that automatically takes into account those jaw movements which are unlike articulator movements.<sup>20</sup>

The FGP technique described harmonizes the occlusal contacts of the opposing teeth, regardless of the direction of the path. The cusps moving against the opposing occlusion rim have, in effect recorded the cleared paths through the wax. The stone counter-cast, which is the negative of this kinetic wax record helps to prevent the cusp tips from being dropped into a position in which traumatic contact could result during mastication. The artificial tooth positioned and formed to this record will remain in harmonious contact with its antagonist at all times. Meyer has stated that principles and procedures involved in the FGP technique are in harmony with anatomic, physiologic, and neurological factors involved in occlusion and FGP principles and techniques can be applied equally well to all types of fixed and removable restorations.<sup>11</sup>

### CLINICAL SIGNIFICANCE

This article reports a case of ill fitting, old denture wearer with severely resorbed edentulous ridges. Patient complained of discomfort while wearing old denture. By incorporating neutral zone and FGP technique in the new denture we have enhanced denture stability and obtained satisfied functional result.

### REFERENCES

- Lammie GA: Aging changes and the complete lower denture. *J Prosthet Dent* 1956;6:450-64
- Miller WP, Monteith B, Heath MR: The effect of variation of the lingual shape of mandibular complete dentures on lingual resistance to lifting forces. *Gerodontology* 1998;15:113-9
- Ikebe K, Okuno I, Nokubi T: Effect of adding impression material to mandibular denture space in Piezography. *J Oral Rehabil* 2006;33:409-15
- Russell AF: The reciprocal lower complete denture. *J Prosthet Dent* 1959;9:180-90
- Hayakawa I: Principles and Practices of Complete Dentures: creating the mental image of a denture. Tokyo: Quintessence Publishing Co; 2001, pp. 9-10
- Fish EW: Principles of full denture prosthesis. London: John Bale, Sons and Danielsson, Ltd; 1933. pp. 1-8
- Zarb GA, Hobkirk J, Eckert S, Jacob R: Prosthodontic Treatment for Edentulous Patients: complete dentures and implant-supported prostheses. (ed 13), Missouri: Elsevier Health Sciences; 2013, pp. 180-194
- Glossary of Prosthodontic Terms. *J Prosthet Dent* 2005;94:10-92
- Beresin VE, Schiesser FJ: The neutral zone in complete dentures. *J Prosthet Dent* 1976;36:356-67
- Beresin VE, Schiesser FJ: The neutral zone in complete and partial dentures. Saint Louis: Mosby; 1978
- Meyer FS: The generated path technique in reconstruction dentistry part I: complete dentures. *J Prosthet Dent* 1959;9:354-366
- Meyer FS: The generated path technique in reconstruction dentistry part II: complete dentures. *J Prosthet Dent* 1959;9:432-440
- McGarry TJ, Nimmo A, Skiba JF, et al: Classification system for complete edentulism. *J Prosthodont* 1999;8:27-39
- McCord JF, Grant AA: Impression making. *Br Dent J* 2000; 188:484-492
- Manoj SS, Chitre V, Aras M: Management of Compromised Ridges: a Case Report. *J Indian Prosthodont Soc* 2011; 11:125-129
- Gahan MJ, Walmsley AD: The neutral zone impression revisited. *Br Dent J* 2005;198:269-72
- Wee AG, Cwynar RB, Cheng AC: Utilization of the neutral zone technique for a maxillofacial patient. *J Prosthodont* 2000;9:2-7
- Karkazis HC: Prosthodontic management of a patient with neurological disorders after resection of an acoustic neuroma: a clinical report. *J Prosthet Dent* 2002;87:419-22
- Kokubo Y, Fukushima S, Sato J, et al: Arrangement of artificial teeth in the neutral zone after surgical reconstruction of the mandible: a clinical report. *J Prosthet Dent* 2002;88:125-7
- Upadhyay SR, Singh SV, Bhalla G, et al: Modified functionally generated path technique for single complete denture against non-modified natural dentition. *J Oral Biol Craniofac Res* 2012;2:67-71