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Case Report

Clinical Outcomes of Neutral Zone Techniques Employment in Maxillofacial Prostheses

Masmoudi Karim[1]*, Chabbi K[1], Adouani A[1], Ayadi M[2] and Jamila J[3]

[1]*Removable Prosthetic Department, University of Dentistry, Tunisia*

[2]*Ear and Nose and Throat Department, University of Medicine, Sfax, Tunisia*

[3]*Removable Prosthetic Department, University of Dentistry, Tunisia Head Section, Tunisia*

***Corresponding Author:** Masmoudi Karim, Associate Professor, Removable Prosthetic Department, University of Dentistry, Tunisia.

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Abstract

Prosthetic rehabilitation for patients undergoing substantial maxillary surgery is challenging. Certainly, implantology is the best option for improving prosthesis's support, retention, and stability. Nevertheless, the neutral zone technique can also be considered an equally effective approach patients complaining about unstable maxillofacial reconstructions, particularly when implant therapy is not feasible.

The aim of this article is to describe the different steps in the construction of maxillofacial prosthesis using neutral zone technique through two clinical cases.

Keywords: Neutral Zone; Surgery; Stability; Esthetic; Phonation; Deglutition

Abbreviation

M.F.P.: Maxillofacial Prosthesis

Introduction

Surgery of maxillary tumors including all the teeth and radiation therapy procedures lead to severe morphological and histological damages of the oral cavity such as: interruption of the bearing surfaces, asymmetric interlabial gap, increase of bone resorption, mouth opening limitation, reduction in saliva flow etc [1].

Despite these local conditions, the medical team should keep in mind that a successful oral rehabilitation requires the restoration of speech, deglutition and mastication by providing a stable prosthetic base [2]. Undeniably, loosening of both maxillary or lower M.F.P. may be caused by shortened retracted upper lip and/or defected tongue mobility. Neutral zone technique may solve this problem by setting the polished surfaces in the space where the displacing forces of lips, tongue and cheeks are balanced leading to individualized design of the prosthesis for each patient [3].

Based on two clinical cases of mandibular and maxillary surgeries, this article describes the different steps of M.F.P. using neutral zone technique.

Case Report

Case report 1

A 74-year-old male patient was referred to the maxillo-facial prosthodontic department at the University of Monastir, Tunisia for oral rehabilitation (Figure 1). The medical history revealed surgical resection of an epidermoid carcinoma, performed in the maxilla one year ago.

Intraoral examination showed full edentulous ridges with lateral anterior maxillary defect leading to a large communication between oral, nasal and sinus cavities (Figure 2). This situation resulted in nasal regurgitation of food and liquid, inability to masticate properly and impaired speech. Furthermore, the patient was dissatisfied with his distorted facial appearance due to an asymmetric upper lip retraction; this heavy psychological burden worsened his social abilities.

Figure 1: Retracted upper lip (Frontal view).

Figure 2: Maxillary defect; sinuso-naso oral communication.

Figure 3: Maxillary master cast.

Figure 4: The height of the anterior wax rim.

Figure 5: Occlusal plane orientation.

The therapeutic decision was the fabrication of a palatal obturator using semi-piezography technique.

The treatment procedure was explained to the patient, and then the primary impression was taken using irreversible hydrocolloid and poured in plaster of Paris. A hollow bulb obturator with flexible walls was made using permanent silicone soft liner for easy insertion and removal. After the construction and the adjustment of the custom-tray made by self-cure-resin, the secondary impression was performed by green stick compound, polysulfide and poured with stone plaster (Figure 3).

The record base was prepared using acrylic resin, trimmed and polished. After that, wax rim was made in order to realize the occlusion record: the anterior wax rim height was 2 mm below the lip at rest and the Fox plane was used to verify the parallelism to the pupil's line (Figure 4 and 5). Then, the anterior sector of wax rim was adapted according to the esthetic and phonetic principles, touching the wet line of the lower lip while articulating 'F' or 'V'. The posterior sector was parallel to the Camper's plane (Figure 5).

The thickness of the anterior flange of the maxillary record base was reduced between the first premolars until transparency is reached. 5 mm of wax was removed from the buccal side of the anterior rim in order to create space for the piezographic materiel (Figure 6 and 7).

The peizographic material was loaded on the rims and modelling process was initiated by encouraging maximum mouth open-

Figure 6: The amount of buccal flange reduction of wax and resin.

Figure 7: The amount of buccal flange reduction of wax and resin.

ing, after which patient was asked to pronounce the phonetics "P, B and M". The objective was to obtain the shape of the anterior buccal flange according to the contractile pressure of the orbicular muscle of the upper lip (Figure 8). This procedure was repeated vigorously until the materiel was properly trimmed and the excess was eliminated (Figure 9).

Figure 8: Silicon carving using phonation.

Figure 9: Impression of the buccal flange.

Lastly, Anterior occlusion plane was set in line with the most concave portion of the upper lip impression and maxillary anterior teeth were set according to the plaster index (Figure 10).

Try-in was done, the stability, esthetics and satisfactory results were evaluated.

Figure 10: Final result: stable and esthetic complete denture.

Case report 2

The second case reports the management of a mandibular resorbed ridge with neutral zone technique.

A female patient aged about 76 years old was referred to the same department for complete denture restoration (Figure 11 and 12). The patient was given radiotherapy after tongue cancer (75 Gy

Figure 11: Facial and profile views of the patient.

Figure 12: Facial and profile views of the patient.

in 30 fractions). Intraoral examination revealed that the mandibular ridge was severely resorbed. In addition to this, the right-side tongue mobility decreased after partial glossectomy while the left side remains hypertonic (Figure 13).

Figure 13: Tongue aspect after surgical resection

The therapeutic decision was the construction of complete denture using neutral zone technique.

Primary and secondary impressions was performed according to the conventional methods, the record bases were made and carefully adjusted for stability and comfort (Figure 14). The piezographic material was an acrylic resin, which was hand-mixed, seated over the mandibular record base, and inserted intra-orally: The patient was asked to pronounce the phonetics (So, Six, Se, De, Te) until the material sets (Figure 15). This wall of resin so obtained is called piezogram or piezographic dam (Figure 16). The lateral border of the tongue created an impression on the dam which gave information about the situation of the posterior occlusal plan.

Figure 14: Mandibular working-cast and record base.

Figure 15: Molding piezographic materiel using phonation.

Figure 16: Location of neutral zone and occlusal plane.

Next, the excess of the resin over that curve was removed; 1 mm of the dam thickness was trimmed buccolingually (Figure 17). Multiple perforations were made in the piezogram using a 2 mm round bur to help in the retention of the silicone (Figure 18).

Figure 17: Reduction of the excess of resin before the swallowing piezography.

Figure 18: Stable drilled piezogram.

Hard liner silicon base was loaded over the dam, and inserted in the mouth. In the next step, the subject was asked to repeat the same sequence of phonetics. The mandible was guided close to centric relation position and occlusal vertical dimension for squeezing the impression materiel. The both record bases were removed from the mouth, placed on their master casts and keyways were prepared.

Figure 19: Occlusion record in O.V.D./C.R.

Figure 20: Neutral zone molding by deglutition.

Then, the piezographic support was removed from the mouth and examined: thickness, contours and shape of the polished surfaces were captured, in greater details, by the action of the lips, the cheeks and the tongue. External and internal pressure was exerted by these muscles on the resin and was modeled into state of neutral balance.

Artificial teeth arrangement was made according the neutral zone indices with plaster of paris.

Figure 21: Polished surfaces carved using phonation and swallowing function.

Discussion

Extensive oral surgery associated with alveolar ridges resorption makes the prosthetic rehabilitation challenging. These unfavorable conditions inherent to the altered anatomical situation have deleterious effects on the chain fabrication of the M.F.P. [4]. In fact, problems encountered while taking impressions, determining polished surfaces and arranging prosthetic teeth compromise the comfort and fit of the finished M.F.P. [5].

Indeed, Pieter J Schoen., *et al*. affirmed that almost half of edentulous head and neck cancer patients wore their mandibular prosthesis only few hours a day for aesthetic reasons and 23% of them were complaining about the MF.P.'s stability, conception and/or compromised buccal vestibule depth [6].

As a result, many authors advocated the importance of polished surfaces for retention and stability. Alvin G., *et al.* insisted that the posterior part of the arch form of the M.F.P. should be determined by the "piezography" technique in order to locate resin in an equilibrated space between the tongue and the cheeks, so that, artificial teeth and gum do not interfere with muscles movements during oral functions [7].

Recently, in 2019, Bhushan., *et al*. added that in case of plumper cheeks, piezography is scientific, cost-effective technique to improve facial esthetics and ensure complete integration of the prosthesis into the stomatognathic system [8]. A relevant question can be asked by prosthodontists: which oral function to choose in order to carve the neutral zone?

According to the literature, two major protocols have been described [9]. Heath, in 1946, confirmed that swallowing is adequate to mold the neutral zone and found that mastication couldn't carve the piezogram correctly, because of the disturbance of masticatory muscles movement due to edentulism [10].

In 1974, Klein insisted that phonation is the better function to determine the prosthetic space as all the muscles works only in isotonic contraction, contrary to deglutition which is difficult to use since it requires occlusion and should be restricted to deaf-patient only: phonation could activate better the bucinato-labial belt [11].

Concerning this work, the first case was treated using piezography based on phonation because it is the less altered function after surgery and teeth extraction. For the second case, the technique chosen was based on phonation mixed with deglutition because pronunciation was a tough act due to hemi-glossectomy.

Unfortunately, neutral zone technique is rarely used because of extra-clinical steps involved and complexity needing high professional skills. Long clinical experience is necessary to avoid errors. Furthermore, M.P.F. wearers remedy inadequacies in prosthesis retention and stability using adhesives. These commercial products cause potential harms such as mucosal irritation, food debris accumulation beneath the prosthetic base and adverse systemic effects [12].

Conclusion

Piezography is still a relevant technique for treating post-oncological unfavorable anatomy. Indeed, the neutral zone technique is used to carve out the appropriate space for teeth arrangement when constructing a denture in muscle balance, which may enhance the prosthesis stability, improve comfort and ensure masticatory function.

All the other options of stabilizing denture like implant treatment is not always possible for patients who are medically compromised, anatomically deficient and economically depressed, despite the recent advances in the medical care

Conflict of Interest

Declare if any financial interest or any conflict of interest exists.

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