Using neutral zone and mandibular guidance concepts to restore aesthetics and function in a hemi-mandibulectomy patient

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ABSTRACT:
Restoration of function in partial or hemi-mandibulectomy patients can be complicated and often impossible, without preliminary planning and cooperation between the surgeon and the prosthodontist. The designed prosthesis has to function in deranged neuromuscular function on a deficient tissue bed. The prosthesis must be inserted as soon as possible following surgery to prevent fixation of the residual mandible by cicatricial tissue. This report details how to achieve near normal maxillomandibular relations in a patient with mandibular discontinuity. Acceptable results were obtained with the guidance prosthesis utilising neutral zone concept.

Key words: Neutral Zone, Mandibular Guidance, Palatal Ramp, Hemi-mandibulectomy

INTRODUCTION
The prosthodontic rehabilitation of patients with acquired mandibular defects is challenging. With continued improvement in surgical resection and reconstruction techniques, the prognosis for these patients has greatly improved. However, morbidity and incomplete rehabilitation persists. Prosthodontic management of patients with mandibulectomy defects can enhance appearance, function, and speech.¹ The unilateral loss of mandibular continuity due to surgery or trauma results in mandibular deviation toward the defect side. The reason for the deviation is multifactoral and includes the location and extent of the resection, the amount of soft tissue involvement, the degree to which innervation has been involved, how tightly the surgeon closed the wound, and the presence of remaining natural teeth.²³ Numerous techniques have been described to reduce mandibular deviation by retraining the patient’s neuromuscular system. These include exercise programs, removable partial denture prostheses for dentulous patients, and complete denture prostheses for edentulous patients with modification in the occlusal scheme to compensate for the deviation.⁴⁵
The earlier that mandibular guidance therapy is initiated in the course of treatment, the more successful the patient’s definitive occlusal relationship. Delays in the initiation of mandibular guidance therapy, due to problems such as extensive tissue loss, tight wound closure, radiation therapy, radical neck dissection, flap necrosis, and other postsurgical morbidities, may result in an inability to achieve normal maxillomandibular relationships. Uncoordinated masticatory movements may result in dental or soft tissue trauma, including severe lip or tongue lacerations. Monitoring the lesion, smoothing sharp teeth, using oral appliances, extracting problematic teeth, or inhibiting behaviors such as self-mutilation of lips, cheeks, and tongue are solutions for such soft tissue trauma. Intermaxillary fixation and restoration with mandibular or palatal prostheses are among many of the methods considered for reducing or eliminating mandibular deviation. The purpose of rehabilitation in this report was: (1) to achieve an appropriate intermaxillary relation in a patient with left lateral mandibular discontinuity with a maxillary guidance ramp prosthesis (2) to establish a stable occlusal relationship by controlling the muscle forces on the resected side.

CLINICAL REPORT

A 37-year-old man was referred to the Department of Prosthodontics of this institute. The chief complaints were masticatory difficulties, unclear speech and poor esthetics. The patient had an extensive mandibular resection without radiation therapy 6 years previously, for a Stage 1 squamous cell carcinomatous (SCC) lesion. Closure was primary. Resection had involved most of the left mandible, including the ramus and body, from the processus condylaris down to the symphysis (Figure 1,2,3). Radiological examinations showed that a mandibular discontinuity with defect reaching the distal border of the mandibular left lateral incisor tooth. The patient was uninterested in a second surgery to place a mandibular graft. He had worn several partial dentures in the past but discarded all, for either loose fit or lack of function. The overlying keratinised gingival tissue connected the floor of the mouth directly to the buccal mucosa in the defect area. Other missing teeth were 16,17 and 46 (FDI notation).

The patient was evaluated for the fabrication of guide flange prosthesis. It was noted that the patient’s mandible could be manually placed into centric occlusion without excessive force. Maxillary Cast metal guidance prosthesis with palatal ramp was suggested for reducing the mandibular deviation and maintaining the cheek and the tongue out of the path of closure as the treatment of choice, because the patient’s right first molar was absent and the periodontal condition of the lower anterior teeth was not adequate to hold the mandibular guidance prosthesis. The rehabilitation was completed in two steps,(1) fabrication of the palatal ramp and (2) restoration of zone of neutralization on the resected side.

Preliminary impressions were made with addition silicone impression material. Casts were poured with Type IV dental stone and articulated. The casts were surveyed (Surveyor; Bego, Bremen, Germany), and the removable partial denture (RPD) frameworks for the maxilla and the mandible were designed after requisite moth preparation. The framework was designed for maximal distribution of occlusal forces. An anteroposterior strap major connector was designed for the maxillary arch, with lattice shaped minor connectors over the residual ridge and clasp assemblies on 16,14,23-25. The mandibular lingual plate major connector extended from 48 to 32 with clasp assemblies on 47,48 and 44. Multiple loops were created on a 0.9 mm orthodontic wires which were soldered onto the saddle to provide mechanical retention for acrylic resin in the defect area. The frameworks were adjusted and tried intraorally.

The mandible was guided laterally towards the desired position and the extent of the occlusal contact with the palatal prosthesis was calculated. The prosthesis was removed and wax was placed on the major connector just palatal to 17-13, to form a ramp on the unresected side. The prosthesis was replaced and the mandible was guided towards its desired position several times, establishing an index in the warmed wax ramp on the palate. It was then removed, the wax index was duplicated in acrylic resin, and the palatal ramp was finished(Figure 4).

An acrylic trial denture base was then attached to the lower cast framework on the resected side on the diagnostic cast. The resin base was built to support the putty addition silicone to be added for recording the neutral zone. Putty was selected because of better molding of the “zone of neutralization”, minimal trauma and convenient handling. The mandibular fragment was guided through opening to the closest possible position to centric occlusion and the patient performed various functional movements such as speaking, swallowing.
lip licking and cheek sucking to the best of his capability (Figure 5). This molded the putty added in the form of an occlusal rim. A plaster index was made of this functional record. Teeth were then set on the subsequently fabricated wax occlusion rim, within this zone with the help of the index (Figure 6) according to the established occlusal plane and esthetics. Non anatomic acrylic teeth were used for the mandibular arch. The wax occlusal rim was modified to provide proper facial support with a shortened dental arch on the resected side, considering the severity of scar bands posteriorly and absence of bony bed. The posterior occlusal table was extended till the second premolar. The set-up was tried in the mouth and the anterior teeth were adjusted in harmony with the patient’s face. Care was taken that the mandibular posterior teeth on the resected site were non functional and only improved esthetics. After satisfactory try in, the processed maxillary and mandibular dentures were inserted and equilibrated (Figures 7,8,9). The lower denture was lined with a soft liner in the resected portion, at the time of insertion. Denture and oral hygiene related instructions were reinforced and the patient was followed up at monthly intervals.

DISCUSSION

The tissues that contour the internal and external surfaces of the prosthesis greatly influence its stability and help determine the peripheral borders, tooth position, & polished surfaces of the dentures. The forces developed during mastication, speaking and swallowing directly act on the dentures. These forces either help stabilize or dislodge removable prosthesis. Neutral zone by definition, is the region in the mouth where the forces of the tongue pressing outward are neutralized by the forces of cheeks and lips pressing inward during function. If the denture teeth are kept within the neutral zone, displacement of the lower prosthesis due to muscular activity will be reduced. Arranging artificial teeth within the neutral zone achieves two important objectives: (1) prosthetic teeth do not interfere with muscle function and (2) oral and perioral muscle activity impart forces against the prosthesis that serve to stabilize and retain it rather than cause its displacement.

The length, strength and position of the perioral musculature especially buccinator and the orbicularis oris are the main determinants. The neutral zone method applied in this case and in most hemimandibulectomy cases locates posterior denture teeth slightly lingually, when compared to teeth arranged over the crest of the residual ridge in complete dentures. This is due to the soft tissue contracture and formation of scar band. Only the mandibular prosthesis was modified here according to the neutral zone procedure. The neutral zone procedure is more beneficial to the mandibular prostheses, because many other factors favor the retention and stability of the maxillary denture, compared with the mandibular prostheses.

Mandibular resections may be categorized as marginal mandibulectomies or discontinuity mandibulectomies. Marginal mandibulectomies maintain the inferior cortex of the mandible and its continuity, while discontinuity mandibulectomies involve entire resection of concerned part of the mandible. Mandibular resections can be classified according to Cantor and Curtis as follows: Class I- radical alveolectomy with preservation of mandibular continuity; Class II- lateral resection of the mandible distal to the cuspid; Class III- lateral resection of the mandible to the midline; Class IV- lateral resection with surgical reconstruction; Class V- anterior resection with bone graft surgical reconstruction; and Class VI - anterior resection without reconstruction.

Patients belonging to Class I may function almost normally after rehabilitation, though resection of mylohyoid muscle and scarring can interfere with floor of the mouth elevation and tongue mobility. Resections in all other classes may have multiple impairments such as disarticulation of mandible; loss of the muscles of mastication; sensory and motor innervation loss; distortion of mandibular movement; impairment of speech, swallowing, saliva control, manipulation of food and respiration; facial disfigurement and impaired psychic functioning. There are numerous methods for reducing and minimizing mandibular deviation resulting from discontinuity defects, including mandibular guidance therapy, intermaxillary fixation, resection guidance restorations, splinting, “swing lock” removable partial dentures and maxillary prostheses with a palatal ramp.

The objectives of the developed treatment plan were to record the dynamic activities of the post surgical tissues enveloping the mandibular denture space, including changes in muscle tonicity, deficiencies in neuromuscular control and restrictive movements due to scarring; to record the unilateral movement of the remaining mandibular fragment as related to occlusion and to guide the occlusion
into maximum possible intercuspation position. Retention of the mandibular partial denture had to be obtained by the accurate selective pressure record of the bearing surface and by achieving maximal extensions compatible with functional and anatomical limitations.\textsuperscript{14,15} The outrigger extension was developed on the mandibular denture on the resected site to resist the lateral forces exerted upon the mandibular prosthesis during mastication and also to create a plumping effect to reduce the facial asymmetry.\textsuperscript{15}

The occlusal/palatal ramp was developed on the maxillary denture to guide the mandible into maximum intercuspation, and provide a broader occlusal contact area, thus achieving correct sagittal relationship, enhancing stability of dentures and improving masticatory ability.\textsuperscript{16,17} The mandibulectomy resulted in a residual segment which was impossible to guide into an accurate maxillo-mandibular relation. Therefore a balanced occlusal scheme had to be sacrificed for an occlusion only in centric position, which was free from all lateral contacts in eccentric movements and also provided for freedom in centric position. This position, though not truly repeatable like the centric relation was at least comfortably achievable by the patient.\textsuperscript{18,19}

Many post-insertion adjustments were required to complete the adjustments and make the patient comfortable with the prosthesis. Oral hygiene measures were also emphasised during these appointments. A satisfactory aesthetic and functional treatment outcome was attained. The neutral zone technique not only enhanced esthetics and provided support for the lower lip and cheek, but also lead to improved speech articulation and better control of salivary flow. The disadvantages of this technique were the extended number of visits and required comprehensive laboratory support.\textsuperscript{20} The patient was satisfied with the retention and fit of the prosthesis. Function was moderately improved because of better intercuspation by the guidance prosthesis. As the contractures were released, the patient was gradually able to close his mandible nearer the original centric occlusion. This required occasional modification of the maxillary palatal ramp. The patient has been reporting at monthly intervals since the last one year at the time of reporting this case, without any significant complaint.

**SUMMARY**

Prosthodontists have been utilising the neutral zone concept for denture fabrication since 1930s. While the partial denture design in case of intact mandibles is an easier proposition, certain difficulties can be encountered in case of patients with mandibular resections particularly those with discontinuity defects. The extent of the surgical resection and the location and quality of the remaining structures dictate the need to alter some basic principles of partial denture design. Altered treatment sequencing, using a modified neutral zone technique for fabrication of mandibular prosthesis and restriction of mandibular deviation by maxillary palatal ramp was presented for the successful rehabilitation of this hemimandibulectomy patient.

**REFERENCES**


