Enhanced CPD DO C

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Neutral Zone Concept for Implant Placement in Mandibular Overdentures: A Case Report

Abstract: The objectives for complete denture fabrication are to provide comfort, function and aesthetics. The availability of implant-assisted overdentures has benefited complete denture wearers; however, the success of the prostheses can be further enhanced when the neutral zone concept is incorporated as a mean to locate the correct position of the implants, as well as the tooth arrangement for optimal outcome of the prescribed prostheses.

CPD/Clinical Relevance: Use of the neutral zone concept to assist implant placement and teeth setting in a severely resorbed edentulous mandible is beneficial.

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The success of complete dentures is dependent on stability, retention and support. Stability can be achieved when the integration of satisfactory final impressions, jaw relation, tooth selection and setting, as well as the patient's neuromuscular control is achieved. Retention is achieved by an adequate peripheral seal, while support is obtained through a sufficient covering of the soft tissues and underlying bone.[1–3] In 1931, Sir Wilfred Fish was the first to describe the importance of the polished surface and its influence on stability and retention.[4] Furthermore, he described the role of muscles in stabilizing a lower complete denture by constructing the denture in the 'dead space'.[5] The dead space, commonly known as the neutral zone, 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, cheeks and lips are equal.[6] As implant position affects both the aesthetics and function of the implant-supported overdenture, a radiographical guide and surgical stent were fabricated using neutral zone concept to facilitate proper implant placement. This clinical case report describes the determination of the implant placement position using the polished surface of the mandibular complete denture. Determining the position of the polished surface will help to locate the position of the teeth and occlusal surfaces, which, in turn, will help to indicate the optimal implant positioning.

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Clinical case report

A 64-year-old man presented with a completely edentulous maxilla and mandible, with a Class IV severely resorbed mandible[7] (Figure 1), complaining of poor retention and stability of his previous dentures, which he was not wearing at the time of clinical examination. Upon further history-taking, the patient had had five sets of complete dentures made during the previous 18 years. After discussion with the patient about the various treatment options to replace his missing teeth, a conventional complete denture and two implant-assisted overdentures were selected for the rehabilitation of the maxilla and the

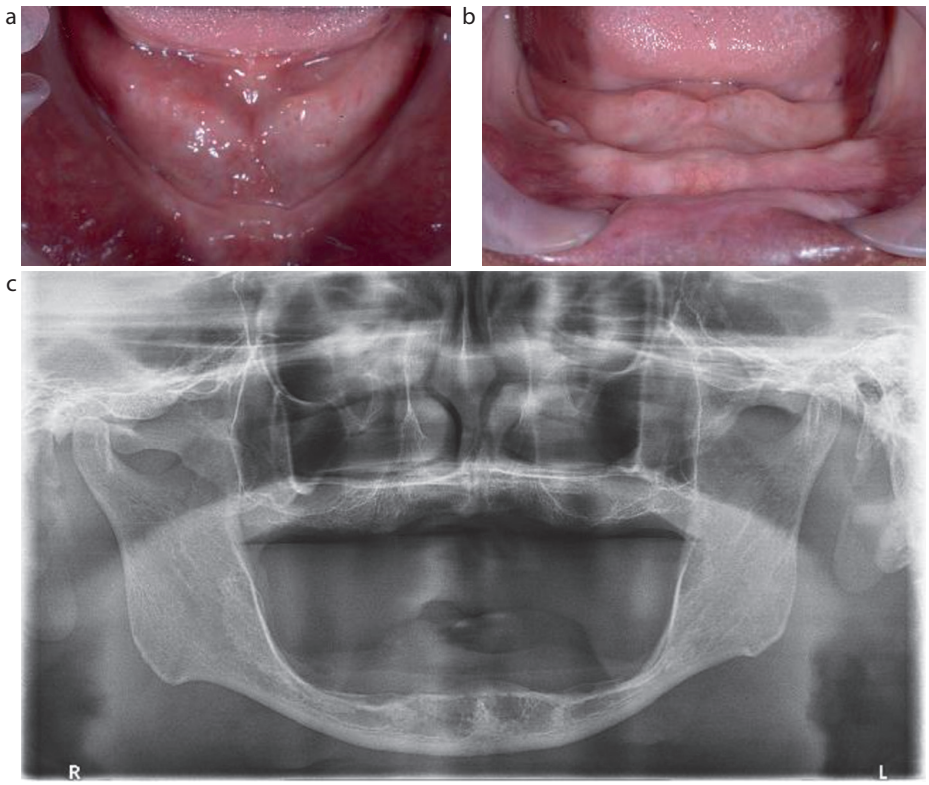

Figure 1. Edentulous mandibular arch: **(a)** occlusal view; **(b)** labial view; and **(c)** panoramic radiograph.

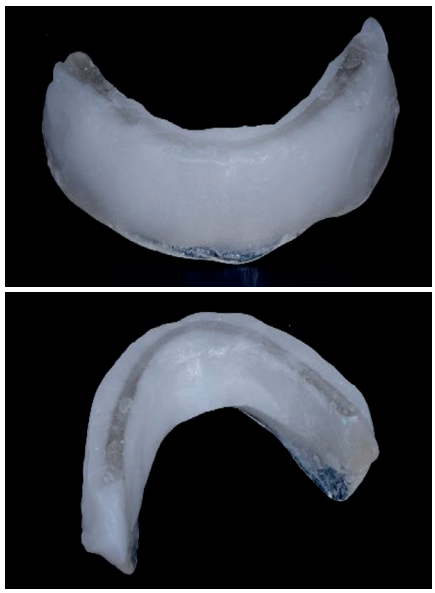

Figure 2. Neutral zone impression. **(a)** Labial view. **(b)** Lingual view.

Figure 3. The lower teeth set corresponding to the neutral zone.

Figure 4. The dentures at the fit appointment.

Figure 5. The non-limiting design radiographic guide.

mandible, respectively, for both anatomical and economic reasons. The prosthetic phase preceded the surgical phase.

A new set of maxillary and mandibular dentures were fabricated using the neutral zone impression technique. After the jaw relation stage, the neutral zone impression was recorded using self-cure denture reline, Viscogel Tissue Conditioner (Dentsply, UK). During the impression-making, the patient was instructed to count from 60 to 70, smile, lick his lips, grin and purse the lips, and finally swallow with a small amount of water. These actions were repeated until the material was set to ensure proper tissue and muscle moulding of the material (Figure 2). Then the teeth setting was carried out according to the neutral zone impression (Figure 3). Following that, the complete dentures were fabricated and fitted (Figure 4). The mandibular denture, which was fabricated in the neutral zone, was duplicated using self-cure clear acrylic, ProBase (Ivoclar Vivadent, Liechtenstein) in order to construct a radiographic guide for cone beam computed tomography (CBCT). Gutta percha (GP) was used as a radiographic marker. The proposed implant position was governed by the boundaries of the polished surface, which were captured during neutral zone impression-taking and between the mental foramina in the areas of the left and right canines (Figure 5). The boundaries of the polished surfaces determined the position of the teeth and occlusal surfaces, which then guided the location of the implants in relation to the position of the ridges. The CBCT was obtained (Figure 6), revealing the position and inclination of the implants, which were optimal. The surgical phase was initiated and two implants (NobelActive, Nobel Biocare, Switzerland; diameter 3.5 mm and length 10 mm) were placed corresponding to the polished surface of the surgical guide (the radiographic guide after removal of the GP) (Figure 7). The fitting surface of the denture was relieved anteriorly with a silicone-based soft denture reliner (Sofreliner Tough Soft, Tokuyama Dental, Japan). After 2 months' healing and osseo-integration, healing abutments were placed after creating an I-incision using a surgical blade no. 15 under local anaesthesia to preserve the keratinized gingiva. Two weeks after the abutment placements, two locator abutments (Locator R-TX, Zest Anchors, USA) were chosen with a height of 3 mm, which corresponded to the thickness of the soft tissues. The chairside pick up (direct technique) approach was used to process the denture attachment housings into the denture. A self-cure acrylic (GC Reline Hard Denture, Chairside Reline, GC, Japan) was used for the pick up after creating the

recesses and lingual vent holes using an acrylic round bur. The denture was removed, finished and polished. The low (blue) retention inserts were inserted into each denture attachment housing using the insertion (IN) end of the tool (Figure 8). The stability, retention, occlusion and aesthetics were satisfactory. In this case, the concerns of the patient were addressed, and he was satisfied with the outcome. Subsequent recall visits were performed every 6 months and the patient was satisfied with the result (Figure 9).

Discussion

During oral rehabilitation, the position and angulation of the implant placement dictates the aesthetics and functional outcomes.[8–10] Optimal positioning and angulation of implant is important in determining the aesthetics and functional outcomes of any implant-assisted prosthesis. Hence, the functionality of a dental prosthesis with respect to biomechanical and aesthetic characteristics requires well-designed implant positioning.[11]

In this case, the neutral zone concept was used during conventional denture fabrication. As part of the pre-surgical treatment planning, the fabricated mandibular denture at the neutral zone was duplicated to act as the radiographic guide. The polished surface of the radiographic guide was used to establish an ideal implant positions which adhered closely to the concept of prosthetically driven implant treatment planning. In this case, the neutral zone concept was adopted to ensure proper angulation and position of the proposed implants alongside traditional techniques to make a radiographic guide. This technique is particularly useful when access to technologies, such as computer-aided design (CAD) and computer-aided manufacturing (CAM) are limited, or when cost is a barrier, which is a common scenario. Although the predictability of the fixture placement can be enhanced using CAD/CAM during pre-surgical planning,[11] it might not be the ideal position according to the neuromuscular activity zone. In this case, CBCT confirmed the ideal position for the proposed implant in relation to the anatomical and neuromuscular considerations.

Frascaria and co-workers have reported that using the neutral zone technique significantly influenced the positioning of implant placement. In their study, the traditional digital workflow using CAD/CAM was compared to the digital workflow incorporated with piezography (a brand of monochromatic inks and software that produce high-standard black and white printing) to record the neutral zone. The results showed better implant positioning and notably different use of the dead space, which potentially offers better management of soft tissues and enhanced functionality of the implants.[12]

The proposed approach to the neutral zone concept can assist clinicians to identify the potential space within the mouth

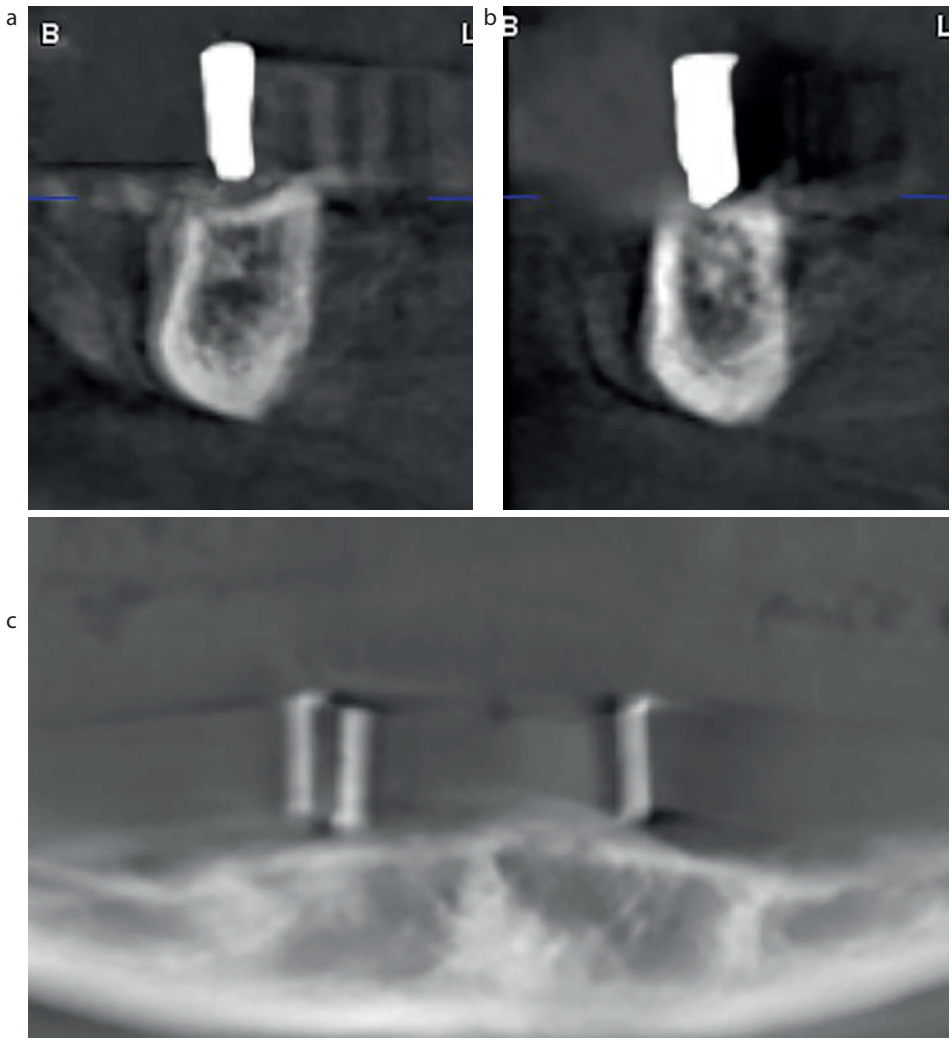

Figure 6. CBCT **(a)** Sagittal view of radiographic marker at LL3. **(b)** Sagittal view of radiographic marker at LR3. **(c)** Coronal view of radiographic marker at LL3 and LR3.

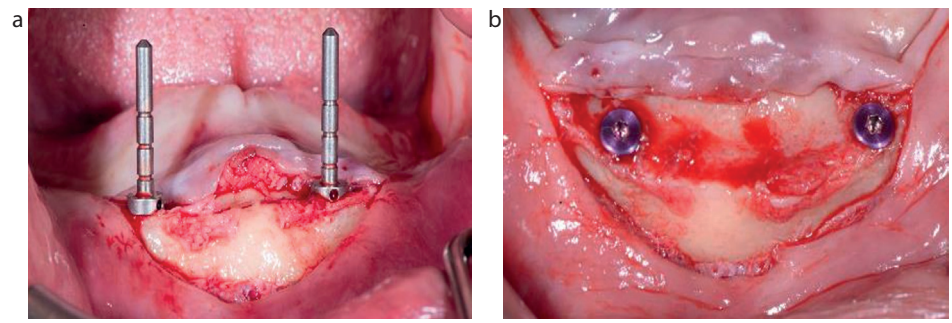

Figure 7. (a) Implant placement procedure direction indicator after preparing implant fixture space for LL3 and LR3. **(b)** Surgical cover screw placed for implant fixtures for LL3 and LR3.

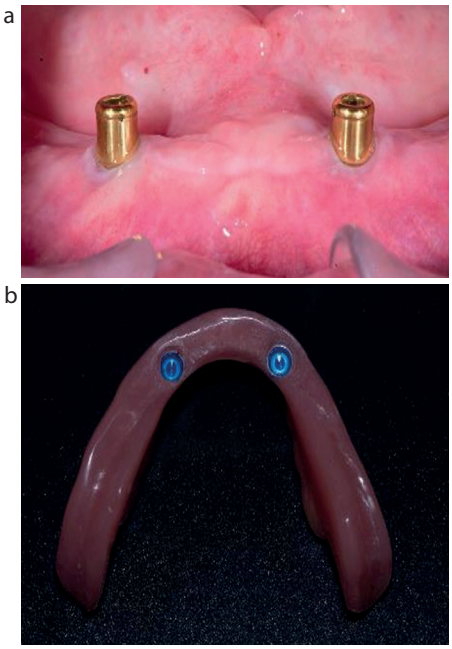

Figure 8. Chairside pick up technique to process denture attachment housings. **(a)** The locator abutments fitted into the implant. **(b)** Intaglio surface of the mandibular denture with the 'Low' retentive locator inserts.

Figure 9. The definitive dentures. **(a)** The dentures *in situ*. **(b)** The dentures *in situ* on smiling.

where the forces from the tongue and the forces from the lips, cheeks and mentalis muscles are equal.[13] In return, this allows the arrangement of teeth within the neutral zone rather than an arrangement of denture teeth over the edentulous ridge crest, which is the most traditional commonly practised method.[14] Traditional methods of tooth arrangement consider only the static evaluation, and ignore the influence of neuromuscular activity, which changes throughout life. Therefore, prosthetic teeth should be placed on the edentulous arches according to individual neuromuscular function.[15]

The advantages of this technique allow optimal positioning of the implant fixtures according to the polished surface. However, this technique does require more clinical visits and skill from both the dentist and dental technician.

Patient satisfaction with complete dentures fabricated using the neutral zone has been studied and reported to be higher compared to conventional complete dentures in terms of comfort, speech, retention, stability and masticatory ability.[16–18] However, while Rehmann *et al*[16] found that oral health-related quality of life (OHRQoL) for complete dentures fabricated using the neutral zone was higher than that for conventional complete dentures, Geerts[17] found no difference in OHRQoL between either treatment. Further studies are needed to evaluate the short- and long-term clinical effects of neuromuscular involvement on the functionality and durability of implants, as well as preservation of soft tissues when implants are placed in the neutral zone.

Conclusion

Use of the neutral zone concept for implant placement in mandibular overdentures allowed optimal implant placement. This traditional technique can be useful when access to technologies such as CAD/CAM-incorporated piezography is unavailable.

Compliance with Ethical Standards
Conflict of Interest: The authors declare that they have no conflict of interest.
Informed Consent: Informed consent was obtained from all individual participants included in the article.

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