CASE REPORT

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Neutral Zone Technique in Mandibular Complete Denture Fabrication by Dental Students of Different Levels: A Case Series

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ABSTRACT

The neutral zone impression technique is a predictable, less invasive, and cost-effective option for patients who have a severely resorbed mandibular ridge. The utilisation of neutral zone impression allows the visualisation of an individual neutral zone, which assists in forming a polished denture surface and the position of acrylic teeth, significantly improving the stability of the mandibular denture. This case series highlights the role of neutral zone impression in managing various conditions interfering with the stability of the mandibular denture. The clinical procedures completed by both undergraduate and postgraduate students successfully addressed the patients' concerns. With proper supervision, the neutral zone impression technique for mandibular complete dentures can be managed by undergraduate dental students despite the technical demands.

Keywords: *Dental student; denture stability; neutral zone impression; severely resorbed mandibular ridge*

INTRODUCTION

Although the prevalence of edentulism has recently decreased, the demand for complete denture services should not be underestimated. An optimally made complete denture can improve denture wearers' quality of life. Studies have shown that those who adapt well to their dentures report satisfactory oral and masticatory function (Al-Jammali *et al.*, 2022; Nedeljković *et al.*, 2023). However, constructing a satisfactory mandibular complete denture remains challenging, especially when dealing with a severely resorbed mandibular ridge. Patients' satisfaction with mandibular dentures is closely linked to the quality of the supporting tissue, and a severely resorbed ridge provides minimal stability and retention.

The York Consensus (2002) recommends two implant-supported overdentures placed in the inter-foraminal region as the standard care for edentulous mandibles (Thomason *et al.*, 2009). Research has shown that implant-supported overdentures improve objective chewing efficiency (Bajunaid *et al.*, 2022). However, several barriers prevent patients from opting for implants, such as economic concerns, fear of surgery, and the belief that their current dentures function well (Alamoush *et al.*, 2022). Additionally, medical conditions such as uncontrolled diabetes (Naujokat *et al.*, 2016), leukemia (Zimmermann *et al.*, 2015), or ongoing radiation therapy to the jaw or neck (Toneatti *et al.*, 2021) can hinder successful implant therapy. In such cases, conventional dentures remain a more predictable, less invasive, and cost-effective option.

The concept of the neutral zone plays a critical role in denture retention. This is the area in the oral cavity where the forces from the tongue and surrounding muscles balance, allowing the mandibular denture to sit in harmony with the soft tissues, thereby improving stability and retention. After tooth extraction, the neutral zone may shrink as the lateral movement of the tongue increases. Patients who have experienced a cerebrovascular accident may develop abnormal tongue and mandible movements, further compromising denture stability and retention (Toncheva *et al.*, 2022). These factors can make it challenging to create a well-functioning mandibular denture (Jacobson & Krol, 1983).

The neutral zone impression technique captures the specific position of the neutral zone, allowing clinicians to design a polished denture surface and tooth positioning in a way that maximizes stability (Lynch & Allen, 2006). Denture retention that meets the psychological need will provide comfort and confidence, while the stability fulfills the physiological need, allowing the denture to function properly (Jacobson & Krol, 1983). Although these factors are interrelated, stability is generally considered the more critical factor in achieving a successful prosthetic outcome. A denture that shifts easily when lateral forces are applied can disrupt the border seal, leading to loss of retention.

In Malaysia, dental students and practitioners have limited exposure to the neutral zone impression technique, leading to its underutilisation. However, incorporating this technique into dental education, it could significantly improve patient's satisfaction theoretically and practically. This paper aims to describe the neutral zone impression technique as used in the management of mandibular complete dentures by dental students at various levels of training, including two undergraduate and one prosthodontics postgraduate student.

CASE REPORT

The following case reports describe the successful rehabilitation of edentulous patients, focusing on the challenges and clinical solutions in constructing new complete dentures.

Case 1: Management of Atrophic Mandibular Ridge with Complete Denture by Final-Year Undergraduate

An 89-year-old Chinese woman presented to the undergraduate polyclinic with complaints about her mandibular complete denture. She reported that the denture rotated while eating, causing food impaction beneath its surface and resulting in pain and discomfort. This was her fourth denture in five years, with each proving difficult to adapt to. However, her existing dentures had worked well for over 10 years before becoming irreparable. The mandibular denture lacked retention and stability, despite optimal extension. The patient is healthy, with no known allergies to medication or food.

The extra-oral examination revealed no abnormalities and symmetrical facial features. Intraorally, she has normal soft tissues. The maxillary ridge was moderately resorbed (Cawood and Howell Class IV anterior, Class III posterior) while the mandibular ridge was severely resorbed (Cawood and Howell Class VI anterior, Class IV posterior) (Fig. 1) (Cawood & Howell, 1988).

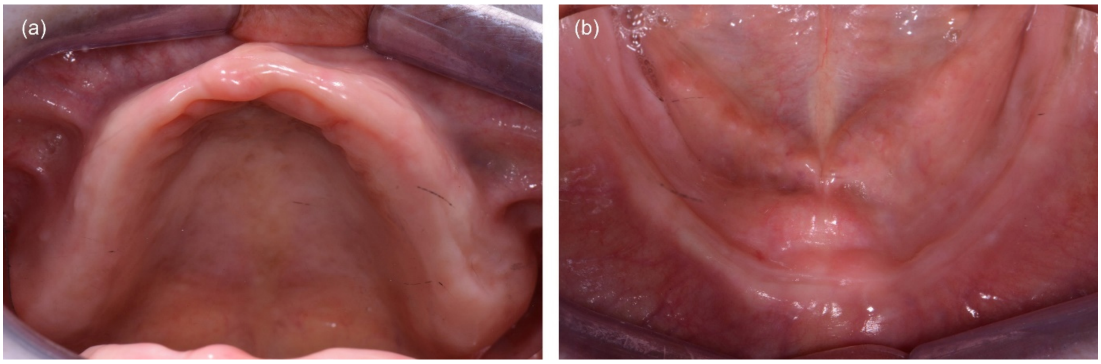

Fig. 1 (a) Pre-treatment maxillary occlusal view; (b) Pre-treatment occlusal mandibular view. Note the severely resorbed residual ridge.

A new mandibular complete denture was planned using the neutral zone impression technique. This method determines the optimal position of the denture flange and tooth, minimising lateral forces from soft tissues and ensuring better stability and functionality. The patient also refused to undergo invasive surgery for the placement of implants.

Primary impression was taken using compound material (Kemdent, UK) on a non-perforated stock tray. Custom trays (LC tray, Kemdent, UK) were fabricated, trimmed 2.0 mm short of the sulcus. Border moulding was done with green stick compound (Kemdent, UK). Definitive impression was completed using zinc oxide eugenol paste (SS White, England). Heat-cured permanent baseplates were made. Wax rims were attached for Maxillo-Mandibular Relation (MMR) recording. Study models were mounted on an average-value articulator (Handy II, Shofu, Japan). Maxillary acrylic teeth (New Ace shade A3, Yamahachi, Japan) were set. A stent was constructed on the mandibular model with two vertical pillars to maintain Occlusal Vertical Dimension (OVD). The pillars were connected with an acrylic fin to hold the impression material.

The maxillary denture was tried in, and its aesthetics, retention, and stability were assessed. The neutral zone stent was used to verify centric relation and OVD. Polyvinyl siloxane (PVS) adhesive (DMG, Germany) and monophase PVS (Aquasil, Dentsply, US) were used to record the neutral zone. During recording, the patient performed functional movements, such as drinking water, smiling, moving the tongue, and speaking sibilant sounds (Fig. 2).

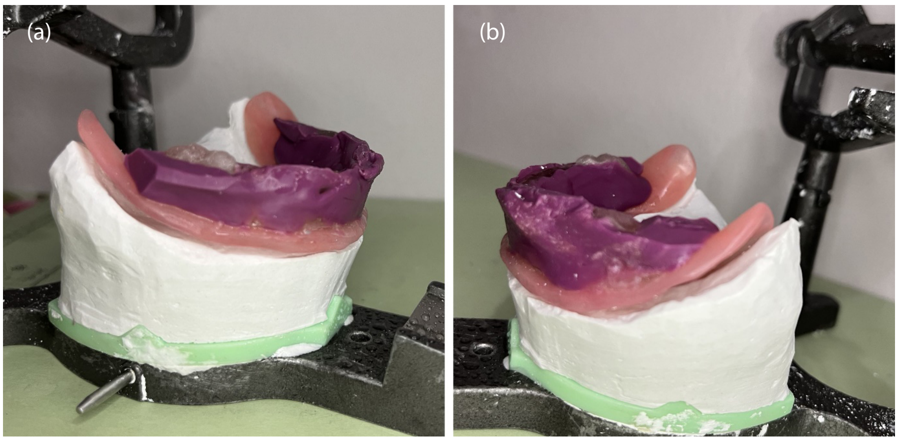

Fig. 2 (a) Right recorded neutral zone impression; (b) Left recorded neutral zone impression.

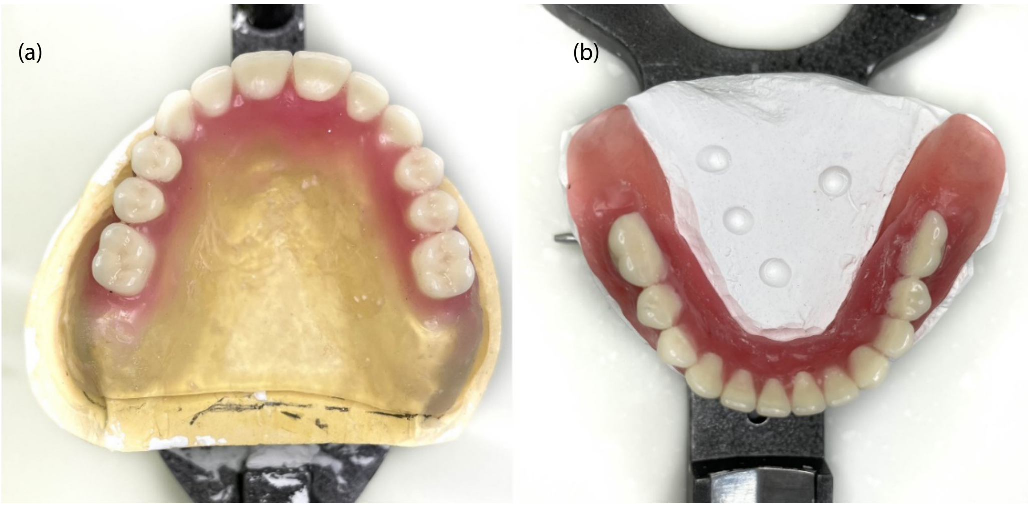

Fig. 3 (a) Maxillary teeth set-up; (b) Mandibular teeth set-up. The lower teeth in the posterior region were trimmed to accommodate the narrow posterior neutral zone.

The recorded neutral zone was transferred to the articulator. A silicone putty matrix (Aquasil putty, Dentsply, US) was used to shape the wax setup. Acrylic teeth (New Ace, Yamahachi, Japan) were arranged in the neutral zone, using a bilateral balanced articulation occlusal scheme. OVD, centric relation, occlusal scheme, aesthetics, and stability were reassessed (Fig. 3). After verification, the trial denture underwent final processing and was subsequently delivered.

During the delivery stage, dentures were assessed for their retention, stability, occlusion, and aesthetics. The patient expressed satisfaction with the new dentures (Fig. 4). Although the retention of the mandibular denture remained suboptimal due to severe mandibular ridge resorption, its stability was markedly improved. There was no rotation during chewing, and food impaction under the fitting surface was minimal.

This case demonstrates how the neutral zone impression technique can provide effective solutions for patients with severely resorbed ridges, improving denture stability and patient comfort.

Fig. 4 Post-treatment portrait of the patient.

Case 2: Managing a Complete Denture Case Complicated by Tongue Enlargement as Attended by a Year 3 Undergraduate Student

A 63-year-old woman has been edentulous for over 20 years and lost her previous dentures two years ago, leading to reliance on a soft diet. She has had two sets of dentures before losing the most recent denture set. She has hypertension and diabetes mellitus, both controlled with oral medications—history of cerebrovascular accident, resulting in left lower limb weakness.

The patient had no facial asymmetry and a competent lip. However, she had mouth deviation to the right during opening as well as clicking in the left temporomandibular joint (TMJ) without associated pain. Intraorally, her buccal and labial mucosa were soft, homogeneous, and exhibited racial pigmentation. The tongue was enlarged, obscuring the mandibular ridge. She had a flabby premaxilla, moderately resorbed posterior maxillary ridge (Cawood and Howell Class V anterior, Class III posterior) and severely resorbed mandibular ridge (Cawood and Howell Class V anterior, Class III posterior) (Cawood & Howell, 1988).

A new complete denture was planned using the neutral zone impression technique to address the anatomical challenges, particularly the enlarged tongue. This technique helps position denture teeth and flanges to balance the forces from the tongue and cheeks. Thus, the denture stability will be improved.

The clinical and laboratory stages of the new complete denture were completed until the try-in stage, as described in Case 1. A wire loop was used instead of an acrylic fin for the stent to maintain OVD (Fig. 5). The maxillary denture was tried in, and its aesthetics, retention, and stability were assessed. The neutral zone stent was used to verify centric relation and OVD. A neutral zone impression was made using regular-bodied PVS while the patient made functional oral movements. During recording, the patient performed functional movements, such as drinking water, smiling, moving the tongue, and speaking sibilant sounds. The completed stent was repositioned on the articulator. A silicone putty matrix was created on the lingual and buccal sides of the stent to serve as a guide for tooth setup. Mandibular acrylic teeth were arranged using a bilateral balanced articulation scheme (Fig. 6).

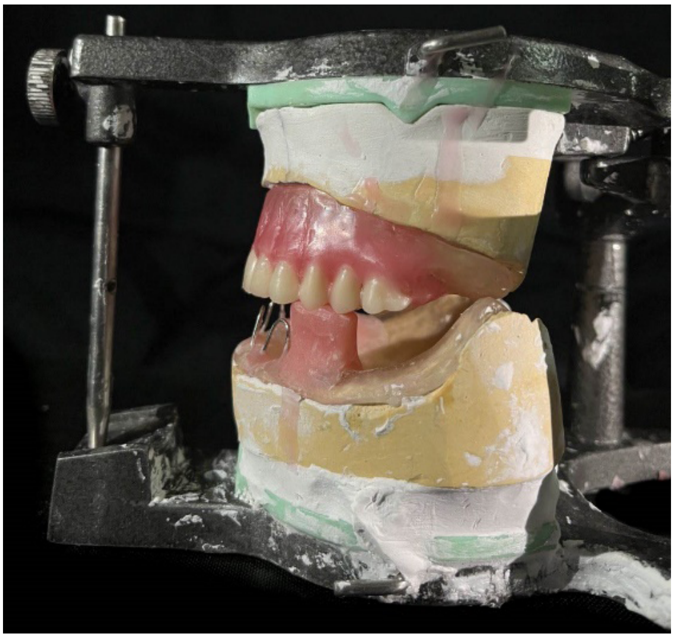

Fig. 5 The neutral zone impression stent with a pillar at the premolar region and a wire loop anteriorly.

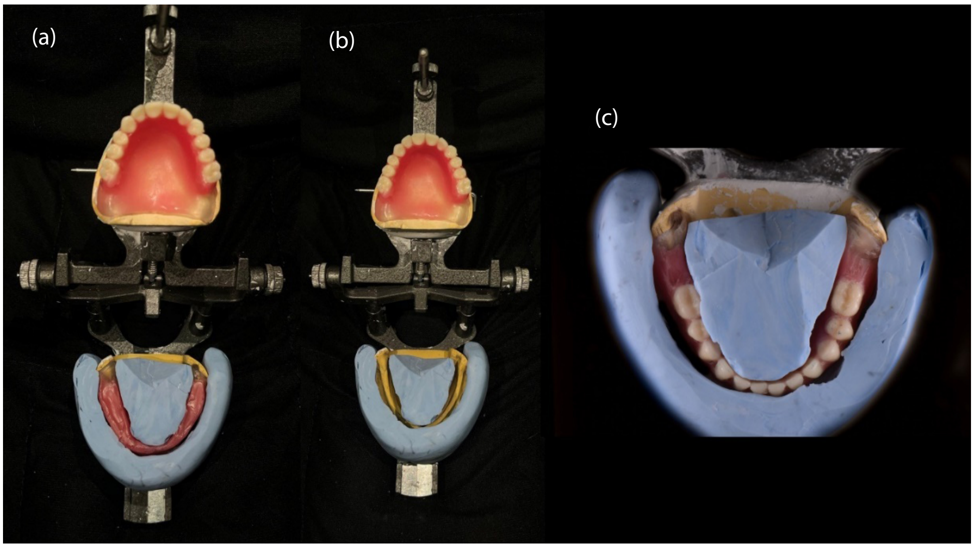

Fig. 6 (a) Wax used to flow into the recorded neutral zone; (b)The neutral zone after removal of impression material; (c) Mandibular teeth were set into the neutral zone using putty as a guide.

OVD, centric relation, occlusal scheme, aesthetics and stability were reassessed during try-in. The denture was delivered after ensuring retention, stability, and functional positioning without interference from the tongue (Fig. 7).

Fig. 7 Pre-operative frontal view of the residual ridge. The resorption is minimal, with adequate ridge width and height

During the delivery stage, dentures were assessed for their retention, stability, occlusion, and aesthetics. The patient expressed high satisfaction with the new dentures. The denture has satisfactory retention and stability due to the absence of tongue interference during function. Post-operative instructions included special emphasis on proper denture storage to prevent loss.

Case 3: Managing Neuromuscular Challenges in Complete Denture Treatment as Attended by a Second-Year Prosthodontics Postgraduate

A 65-year-old Malay male was referred to the prosthodontics postgraduate programme, requesting complete dentures to help with chewing, as he had been fully edentulous for five years and had not sought treatment until recently. The patient was wheelchair-bound following a cerebrovascular accident two years ago, which required brain surgery. He was left with left-sided hemiplegia and poor orofacial musculature control.

The patient had facial asymmetry, with drooping of the left corner of the mouth and loss of the right nasolabial fold. Intraorally, she had poor musculature control on the left cheek, with sagging soft tissues and minimal tongue deviation on protrusion. Both residual ridges showed minimal resorption, Cawood and Howell Class III (anterior and posterior) for both arches (Fig. 8) (Cawood & Howell, 1988).

Fig. 8 The trial maxillary denture in situ with lower neutral zone impression stent.

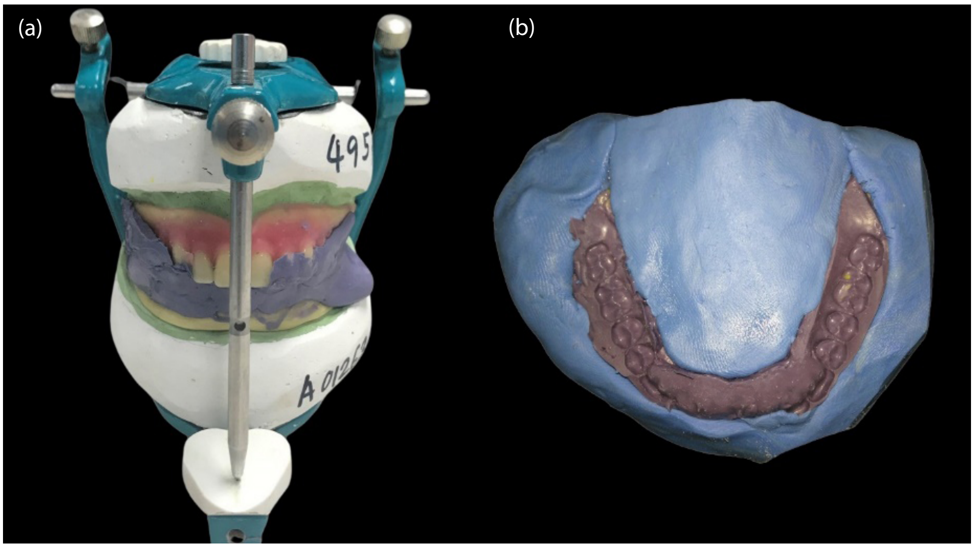

Fig. 9 (a) Completed neutral zone impression positioned back onto the articulator; (b) The created putty guide was based on the recorded neutral zone.

The proposed treatment involved constructing complete dentures using the neutral zone impression technique. This approach was chosen to ensure the dentures harmonised with the patient's compromised musculature, improving both stability and retention. The clinical and laboratory stages of the new complete denture were done until the try-in stage as described in Case 1. The lower neutral zone stent was designed as described in Case 2 (Fig. 9).

The maxillary denture was tried in, and its aesthetics, retention, and stability were assessed. The neutral zone stent was used to verify centric relation and OVD. A monophase PVS material (Examix, GC, Japan) was used for the neutral zone impression. During recording, the patient performed functional movements, such as drinking water, smiling, moving the tongue, and speaking sibilant sounds. The completed stent was repositioned on the articulator. A silicone putty matrix was created on the lingual and buccal sides of the stent to serve as a guide for tooth setup. Mandibular acrylic teeth were arranged using a bilateral balanced articulation scheme.

OVD, centric relation, occlusal scheme, aesthetics, and stability were reassessed. The subsequent clinical procedures followed those described in earlier cases, culminating in the delivery of the final dentures (Fig. 10).

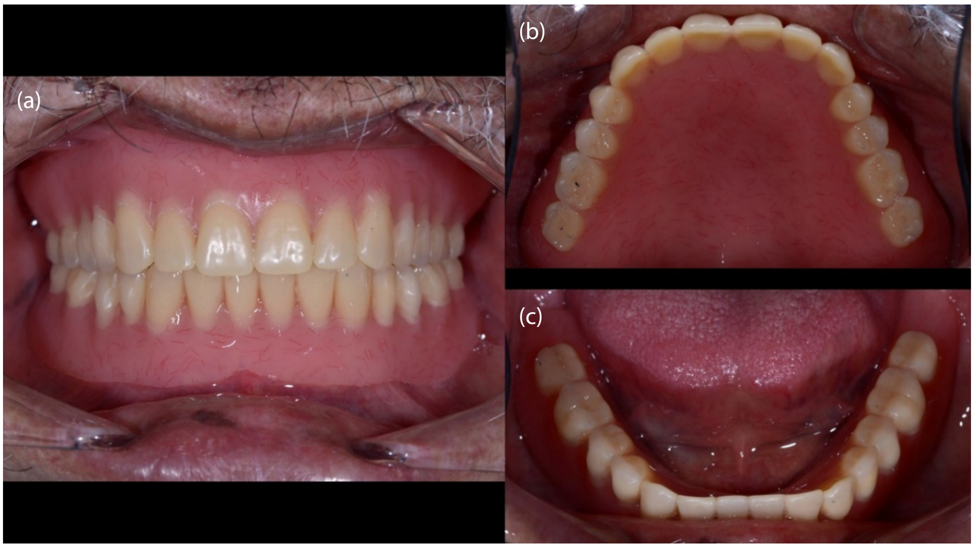

Fig. 10 (a) Final denture at the frontal view; (b) Maxillary occlusal view; (c) Mandibular occlusal view.

During the delivery stage, dentures were assessed for their retention, stability, occlusion, and aesthetics. The completed dentures demonstrated excellent retention and stability. The neutral zone technique prevented denture dislodgement, particularly on the left side, where soft tissue interference from the sagging cheek was a concern.

At a subsequent review, the patient reported high satisfaction, expressing gratitude for regaining the ability to eat and speak effectively.

DISCUSSION

The presented cases highlight the educational potential of incorporating the neutral zone impression technique into undergraduate and postgraduate prosthodontic training. These cases, although limited, demonstrated the feasibility of teaching and practising this technique at the undergraduate level despite its seeming complexity. The conventional training for dental students in complete denture construction primarily consists of lectures, demonstrations, and hands-on laboratory training, followed by the fabrication of dentures for actual patients. Currently, practical training in neutral zone impressions is provided on a case-by-case basis. To the best of the authors' knowledge, most institutions do not incorporate formal teaching or structured practical sessions on the neutral zone impression technique. The two undergraduate students involved in this case reported that the one-on-one training during both the laboratory and clinical stages significantly enhanced their learning experience, making it more effective and beneficial.

Case 1 was performed by a Year 5 undergraduate dental student; the neutral zone impression was completed in a single 30-minute attempt. Case 2 was completed by a Year 3 undergraduate dental student, who required two attempts to achieve a clinically acceptable neutral zone impression. Both these cases were supervised by the same prosthodontics lecturer for the construction of the recording stent in the dental laboratory and during the clinical session for neutral zone impression recording. Case 3 was executed by a Year 2 prosthodontics postgraduate student independently, and only a detailed briefing was provided during the treatment planning stage. This student completed the neutral zone impression in 20 minutes, reflecting the value of prior exposure and expertise (Table 1). In Case 2 and Case 3, a wire loop stent was used instead of the acrylic fin design employed in Case 1. This simplified design offered ease of adjustment and removal during clinical sessions. As well as comparable clinical outcomes to the acrylic fin, without compromising efficiency or effectiveness. The differences in stent design are primarily influenced by personal preference and the aim of maximising design variations to enhance the operators' experience.

In a study assessing the undergraduate dental students' perception of prosthodontic teaching, many respondents expressed concerns about the heavy emphasis on the laboratory teaching component. The outcome of the teaching was not clinically relevant despite substantial time and efforts being dedicated (Puryer *et al.*, 2018). Most dental students and clinicians agreed that dental schools should prioritise clinical training rather than laboratory teaching (Puryer *et al.*, 2018; Kohli *et al.*, 2023). The ongoing debate revolves around whether it remains relevant to incorporate dental prosthetic laboratory skills into the dental prosthodontics curriculum, given the high number of trained dental technologists and their ability to manage the laboratory stages of prostheses. However, the authors believe that without laboratory teaching, especially in managing these depicted cases, the students can hardly appreciate the concept of a neutral zone in a complete denture. Much of the students' understanding was developed during the laboratory stages, where they worked under supervision. These students expressed that their involvement in the laboratory steps significantly enhanced their comprehension of this technique. Thus, supervision during these stages was crucial in ensuring accuracy, building confidence and reinforcing their learning.

According to a study conducted in an Indian dental college, the respondents were aware of the benefit of the neutral zone impression technique, its practical application was found to be limited (Shenoy & Sengottaiyan, 2018). A comprehensive review of the literature yielded no report on teaching the neutral zone impression technique in the dental undergraduate curriculum. Hence, a question arises as to whether it should be taught in detail at the undergraduate level. Currently, the theoretical aspects of the technique are taught through traditional lectures. However, students often struggle with confidence and practical application, which can hinder their ability to perform the procedure effectively in clinical settings. To address this issue, problem-based learning (PBL) or clinical demonstrations in small groups are best suited to complement theoretical lectures (Puryer *et al.*, 2018). Conducting PBL-like discussions during treatment planning and before critical steps allows students to gain deeper understanding of the technique. Such improvements in teaching methods can enhance the flow of actual clinical sessions. With a better understanding, students' readiness and competence were improved, even when working under minimal supervision.

Incorporating the neutral zone impression technique in the complete denture fabrication requires an additional visit to record the neutral zone using various materials. However, concerns have been raised about the traditional method of teaching, including its time-consuming nature and difficulties in mastering techniques such as border moulding and impression-making. These prompted a study to assess the effectiveness of an abbreviated clinical method in reducing clinical time while maintaining the quality of the dentures produced. The result of the study demonstrated that the abbreviated method with fewer clinical steps was comparable to the traditional method in terms of reduced post-insertion adjustments. Therefore, it is possible to incorporate the technique in teaching undergraduate dental students (Duncan & Taylor, 2001). In Case 1, three post-insertion visits were required to adjust sore spots that caused discomfort to the patient. In contrast, Case 2 required only one review visit. The higher number of post-insertion visits in Case 1 was due to the significant mandibular residual ridge resorption. Despite the increased number of visits, patients' satisfaction remained high in both cases. These findings highlighted the potential of abbreviated methods to streamline clinical procedures without compromising outcomes, making them a valuable addition to dental education.

All the patients in these cases expressed satisfaction with their dentures despite the technical complexity, additional clinical steps and students' level of experience in complete denture construction. This highlighted that patient's satisfaction with their complete dentures depends not solely on the technical aspects but also on the psychological, emotional, and communication aspects. Interestingly, studies have shown that patients' satisfaction was not significantly related to the clinicians' level of experience (Oweis *et al.*, 2022). On another note, good communication skills, empathy, and understanding of patients' social conditions are of added value, in addition to the technical satisfaction of a denture. A clinical study reported that complete dentures made using the neutral zone impression technique significantly improved patients' satisfaction compared to conventionally made complete dentures (Al-Magaleh *et al.*, 2019). This suggests that adopting this technique alongside empathetic care can lead to better outcomes.

As dental students progressed through their course, their confidence in managing patients requiring prostheses increased (Puryer *et al.*, 2018). This is due to the increasing number of patients they manage and the hands-on clinical experience they gain over time. While the confidence level is an essential outcome of the course, it is important to note that it does not have a direct relationship with clinical competencies (Puryer *et al.*, 2018). Students or clinicians with overconfidence may endanger patients by attempting clinical procedures beyond their ability without fully understanding the underlying principles. It is, therefore, essential to nurture dental students to value post-graduation training and to prioritise safe, ethical practices in dentistry. Instead of pursuing herodontics, students should focus on developing a solid foundation, understanding their limitations and practising safe dentistry for patients.

CONCLUSION

The neutral zone impression technique in mandibular complete dentures is technically challenging and requires additional chairside time. However, with proper supervision, dental students can successfully perform the procedure, improving patients' satisfaction. Therefore, when appropriately supervised, such cases can be managed not only by postgraduate students but undergraduate students as well. Incorporating this technique into undergraduate training provides students with valuable experience and equips them with the skills to handle complex denture cases.

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