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(CASE REPORT)

Complete Denture Rehabilitation Using a Semi-Adjustable Articulator with Centric Tray, Gnatometer, and Neutral Zone Technique: A Case Report

Cindy Karina Hartono [1,*], Imme Kris Wicaksono [2], Bernadeth Vindi Januarisca [3] and Ivan Djuarsa [1]

[1] *Department of Prosthodontics, Faculty of Dentistry, Petra Christian University, Indonesia.*
[2] *Department of Oral Medicine, Faculty of Dentistry, Petra Christian University, Indonesia.*
[3] *Department of Oral Biology, Faculty of Dentistry, Petra Christian University, Indonesia.*

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Abstract

Background: Complete denture fabrication remains challenging, particularly in first-time edentulous patients, due to difficulties in achieving optimal retention, stability, and patient adaptation. Accurate transfer of maxillomandibular relations and functional impression techniques are essential to improve clinical outcomes.

Purpose: This case report presents a clinical workflow for complete denture rehabilitation using a semi-adjustable articulator combined with centric tray, gnatometer-assisted jaw relation recording, closed-mouth functional impression, and the neutral zone technique.

Case Description: A 66-year-old female patient presented with complete edentulism of the maxilla and mandible and no previous experience with dentures. Anatomical impressions were obtained, followed by tentative vertical dimension determination using a centric tray. Facebow transfer was performed to mount the maxillary cast on a semi-adjustable articulator. Functional impressions were made using a closed-mouth technique to achieve optimal peripheral seal. Definitive jaw relations were recorded using a gnatometer with gothic arch tracing to determine centric relation and protrusive movement. The neutral zone was recorded to guide tooth arrangement and denture base contouring. Teeth were arranged following bilateral balanced occlusion principles, and definitive acrylic dentures were fabricated.

Results: The dentures demonstrated good retention, stability, and esthetics. The patient reported satisfactory comfort, improved phonetics, and the ability to chew effectively without denture dislodgement during follow-up visits.

Conclusion: The integration of centric tray, gnatometer-assisted jaw relation recording, closed-mouth impression, and neutral zone technique using a semi-adjustable articulator can enhance the accuracy of complete denture fabrication and facilitate patient adaptation, particularly in first-time edentulous patients.

Keywords: Complete Denture; Semi-Adjustable Articulator; Gnatometer; Closed-Mouth Impression

1. Introduction

Complete dentures are removable prostheses designed to replace all missing teeth and the associated lost tissues in both the maxillary and mandibular arches. The primary objectives of complete denture therapy are to restore masticatory function, improve esthetics, and maintain the health of the oral tissues. [1]

* Corresponding author: Cindy Karina Hartono

In the current era, complete denture fabrication is directed toward a biofunctional principle, which aims to provide maximum comfort for patients both functionally and esthetically. This objective can be achieved when the clinician is able to accurately transfer the intraoral conditions of the patient to an articulator, thereby obtaining appropriate guidance for tooth arrangement. Adjustable articulators facilitate the mounting of working casts in jaw relations that closely simulate the patient's actual mandibular movements through the use of facebow records.[2] In the present case, a semi-adjustable articulator was utilized as an aid to achieve complete dentures that closely approximate the patient's occlusion and articulation.

Despite advances in complete denture techniques, achieving optimal retention, stability, and patient adaptation remains challenging, particularly in first-time edentulous patients. Inaccurate impression procedures and imprecise jaw relation records may compromise denture performance and lead to patient discomfort and prolonged adjustment periods. Therefore, the integration of functional impression techniques and accurate jaw relation recording methods is essential to enhance clinical outcomes.[3]

The purpose of this case report is to describe a comprehensive clinical workflow for complete denture rehabilitation using a semi-adjustable articulator combined with centric tray-based vertical dimension determination, closed-mouth functional impression, gnatometer-assisted jaw relation recording, and the neutral zone concept. This approach is considered important because it aims to improve the accuracy of complete denture fabrication, enhance denture stability and comfort, and facilitate patient adaptation during post-insertion use.

2. Case Description

A 66-year-old female patient presented with complete edentulism, reporting reduced self-confidence during social interaction. She requested complete dentures for both arches to improve speech and masticatory function. Her medical history was noncontributory, and she had no prior denture experience.

Figure 1 Pre-treatment extra-oral and intra-oral views and panoramic radiograph showing complete edentulism of the maxillary and mandibular arches with reduced lip support

Written informed consent was obtained, and complete medical and dental histories were recorded. Anatomical impressions of both arches were made using alginate and poured with type III dental stone to obtain study models. The vertical dimension of occlusion was measured and tentatively established using a centric tray with putty impression material, guided by the Niswonger method (rest position minus a 2–4 mm freeway space) under caliper control.

The casts were mounted on a semi-adjustable articulator using a facebow transfer (UTS 3D), with Camper's line as the reference plane and the pointer positioned at the ala of the nose.

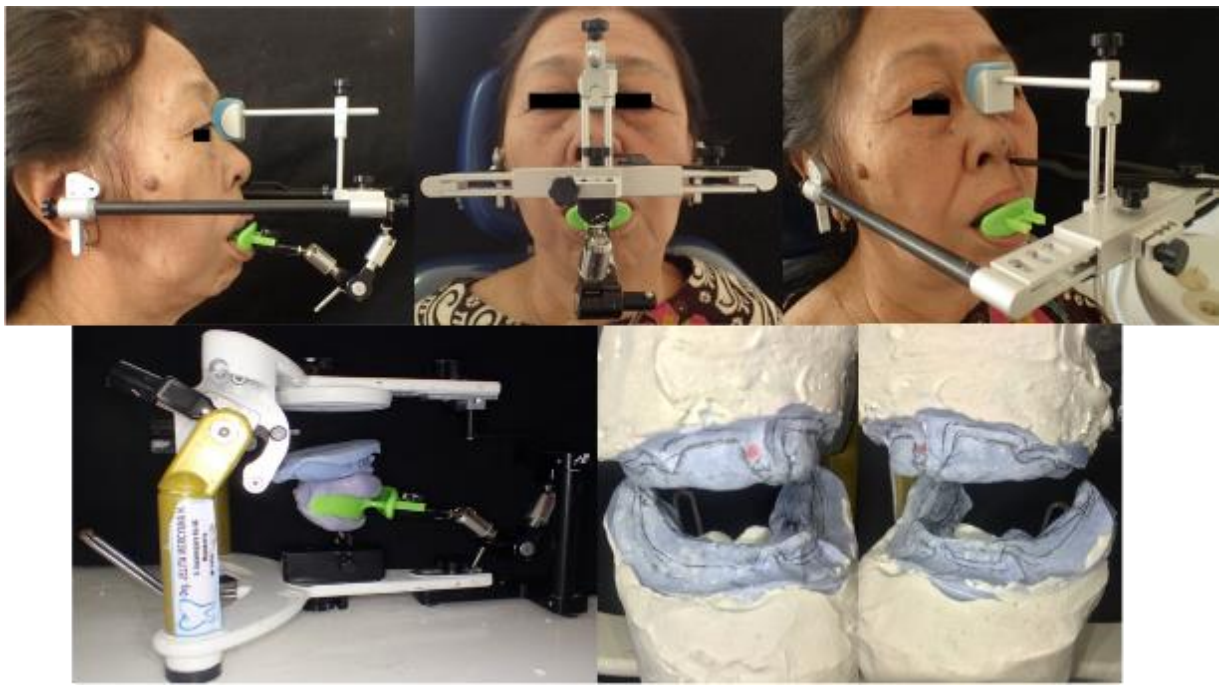

Figure 2 Facebow transfer attached to the centric tray and mounting of the casts on a semi-adjustable articulator using facebow guidance

An individual tray functioning as an occlusal rim was fabricated using light-cured custom tray material, ensuring proper tray outline, full coverage of the retromolar pad, and adequate lingual concavity. A gnatometer was attached to the maxillary and mandibular trays using a mounting plate positioned at the posterior one-third of the retromolar pad, and its occlusal surfaces were replaced with bite rims. Tray extensions were evaluated intraorally and adjusted as needed.

Border molding and closed-mouth functional impressions of both arches were performed at the predetermined vertical dimension using tray adhesive and border molding material. For the maxillary arch, functional movements included lip protrusion ("U"), lip retraction ("E"), and suction. For the mandibular arch, additional movements included tongue movements, posterior tray guidance, and swallowing.

Figure 3 Border molding and functional impression results of the maxillary and mandibular arches

Jaw relation recording was performed using a gnatometer after replacing the bite rims with a maxillary registration plate and a mandibular registration stylus. Final vertical dimension of occlusion was verified and required no adjustment from that established with the centric tray. Sagittal and transverse mandibular relationships were determined using the gothic arch tracing technique. After training, mandibular movements were recorded on the maxillary registration plate using marker ink, producing an arrow-shaped tracing that was secured with a transparent fixation plate at the tapping point. Final bite registration was obtained at centric relation and protrusive positions using a bite registration material to determine condylar guidance, with the midline marked according to the facial midline.

Figure 4 Gothic arch tracing recorded on the maxillary registration plate and corresponding bite registration

A second facebow transfer was performed using the maxillary individual tray with bite rim, with Camper's line as the reference plane. The casts were mounted on a semi-adjustable articulator using a 3D registration joint, with maxillary mounting performed first. The mandibular mounting was completed using a bite fork support and registration joint holder.

The maxillary working cast was poured with type IV dental stone. Protrusive bite registration was used to determine condylar guidance, recording 30° on the right and 25° on the left; a value of 30° was used for articulator settings, with a Bennett angle of 15° calculated using Hanau's formula. The neutral zone was recorded using impression compound wax, followed by arrangement and clinical try-in of the maxillary anterior teeth. Final tooth arrangement for both arches was completed, and a wax denture try-in was performed to evaluate esthetics, phonetics, and occlusion. The dentures were then processed in acrylic resin, finished, polished, and inserted.

Figure 5 Extraoral and intraoral photographs of the patient before and after complete denture insertion

At the first follow-up visit (1 day post-insertion), the patient reported no pain, with healthy oral mucosa and satisfactory phonetic function. At the second visit (1 week post-insertion), no discomfort was reported, the patient had begun consuming soft foods, and occlusion and articulation were evaluated, indicating improved adaptation. At the third follow-up, the patient reported no complaints, demonstrated good comfort and phonetic function, and was advised to attend routine dental check-ups every three to six months.

3. Discussion

In this case, a semi-adjustable articulator was used to achieve denture occlusion and articulation that closely approximated the patient's mandibular movements, offering greater accuracy than a mean-value articulator while streamlining the fabrication process. The tentative vertical dimension was established using a centric tray, which also facilitated efficient recording of the centric jaw relationship and reduced treatment time by allowing the individual tray to function as both an occlusal plate and bite rim. Functional impressions were then made using the closed-mouth technique, and jaw relations were recorded with a gnatometer, enabling gothic arch tracing to accurately determine centric, protrusive, and lateral mandibular positions.[4]

The closed-mouth impression technique is a functional method performed with the patient's mouth closed, allowing self-muscle trimming and facilitating an optimal peripheral seal that reflects normal functional movements. Tongue-guided recording of the lingual and retromylohyoid areas is more effective in this position, while the absence of external forces minimizes ridge displacement. This technique captures soft tissues in a compressive state, resulting in a more accurate impression.[5]

Impression techniques should follow fundamental principles of maximum coverage and intimate tissue contact to achieve optimal retention, support, stability, esthetics, and preservation of the residual ridge. In the closed-mouth technique, physiological jaw forces distribute pressure evenly across denture-bearing areas, helping compensate for variations in submucosal thickness and improving the mucosa's ability to withstand functional loads. [6]

The closed-mouth technique offers advantages as a mucocompressive approach, applying uniform pressure to the mucosa and producing accurate impressions. [7] Accurate impressions minimize the space between the denture base and basal seat mucosa, creating a vacuum effect that enhances denture retention and stability. In fully edentulous cases, impression accuracy relies on correct identification of functional soft tissue boundaries, appropriate materials and techniques, and proper border molding with functional muscle trimming to avoid overextension. [8] In this case, border molding was performed using the closed-mouth technique, producing highly precise denture borders.

A suction-effective impression concept was also applied, emphasizing complete peripheral sealing through functional adaptation of the oral mucosa. This approach focuses on creating buccal mucosa and tongue-side contact points (BTC) and achieving intimate contact in the retromolar pad region, rather than merely maximizing denture base extension. [4]

In recent decades, several authors have recommended the use of newer elastomeric impression materials, such as polyvinyl siloxane, to replace more traditional materials. In closed-mouth techniques, mucocompressive materials like

polyvinyl siloxane are preferred due to their ability to apply uniform pressure to the mucosa. Variations in thickness and resilience of the submucosa in denture-supporting tissues can affect stress transmission to the underlying alveolar bone, highlighting the importance of material selection.[8]

Accurate transfer of the patient's maxillomandibular relationship was achieved using a facebow transfer, which transfers the spatial relationship of the maxilla to the cranial base onto a semi-adjustable articulator. [4] By reproducing the patient's jaw orientation more closely, tooth arrangement can be performed in harmony with the patient's functional anatomy, resulting in improved denture stability, comfort, and faster patient adaptation.

Tooth arrangement was guided by a two-dimensional template, and bilateral balanced occlusion (BBO) was selected as the occlusal scheme. Tooth arrangement followed a systematic sequence, beginning with the maxillary anterior teeth, followed by the mandibular canines, mandibular posterior teeth, maxillary posterior teeth, and finally the mandibular anterior teeth. Both tooth arrangement and denture base contouring were performed within the patient's neutral zone. The neutral zone is defined as the area in the oral cavity where outward forces exerted by the tongue are balanced by inward forces from the lips and cheeks. Recording the neutral zone allows for physiologic contouring of the denture base and optimal faciolingual positioning of the teeth.[9]

Proper denture hygiene is essential for maintaining oral tissue health. Similar to natural teeth, dentures require adequate cleaning to prevent biofilm accumulation. Dentures should be cleaned using a soft-bristle brush and non-abrasive soap without excessive force. The use of toothpaste is generally discouraged, as many formulations contain abrasive agents that can roughen acrylic resin surfaces.[10]

At the conclusion of treatment, the patient reported satisfaction with the dentures in both esthetic and functional aspects. The dentures exhibited strong retention on the residual ridges, allowing the patient to eat comfortably without fear of dislodgement. This outcome can be attributed to intimate contact between the denture base and the underlying mucosa, achieved through accurate impression techniques, proper border protection with boxing wax, and adherence to denture base fabrication and tooth arrangement principles facilitated by the use of a semi-adjustable articulator and neutral zone concept.

4. Conclusion

The use of an integrated clinical approach combining a semi-adjustable articulator, centric tray, gnatometer-assisted jaw relation recording, closed-mouth functional impression, and neutral zone technique enables the fabrication of complete dentures with improved accuracy, retention, and stability. This approach supports optimal occlusion, articulation, and peripheral seal while respecting the functional dynamics of the oral tissues. As a result, patient comfort, functional performance, and adaptation (particularly in first-time edentulous patients) can be significantly enhanced, underscoring the clinical relevance of this method in contemporary complete denture therapy.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declares no conflicts of interest related to the publication of this manuscript

Statement of informed consent

Informed consent was obtained from the individual participant included in this study.

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