RMOS

Publié le 02/06/2025

Article original / Original article

Revue Méditerranéenne d'Odonto - Stomatologie

Ball Attachments in Tooth-Supported Overdentures: A Case report on enhancing partial denture retention

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Publié le 02/06/2025

Abstract

Introduction

Rehabilitation of partially edentulous patients presents both biomechanical and aesthetic challenges. Although metallic partial removable dentures (PRDs) provide durability and functional stability, traditional clasp-based retention may compromise aesthetics and patient comfort. Tooth-supported overdentures with ball attachments offer an alternative by enhancing retention, distributing occlusal forces more evenly, and improving the overall aesthetic outcome.

Observation

This case report describes the prosthetic rehabilitation of a patient with extensive edentulism using a metallic PRD supported by tooth-retained overdentures. Teeth 13 and 25 were prepared to receive ball attachments, ensuring optimal retention and stability. The clinical protocol included post space preparation, wax coping fabrication, polyvinyl siloxane impressions, and framework try-in. The final prosthesis was designed to maintain biomechanical balance while concealing metal components for a natural appearance.

Discussion

The use of ball attachments allowed for improved retention and stress distribution, preventing excessive load on the abutment teeth. The patient reported high satisfaction with both the functional performance and aesthetic integration of the prosthesis. Follow-up assessments confirmed the stability of the restoration, proper occlusal relationships, and enhanced comfort.

Conclusion

Tooth-supported overdentures using ball attachments represent a valuable approach in prosthetic rehabilitation, combining biomechanical efficiency with aesthetic considerations. This case highlights the clinical benefits of these attachments in improving retention, comfort, and patient satisfaction. Their integration into metallic PRDs offers a functional and aesthetic alternative to conventional clasp-based designs.

Keywords

Partial removable denture, tooth-supported overdentures, ball attachments, prosthetic rehabilitation, biomechanical balance, aesthetic outcome

Introduction

Rehabilitating partially edentulous patients presents a significant challenge for prosthodontists, as it requires balancing biomechanical stability, functional efficiency, and aesthetic integration. Removable partial dentures (RPDs) often serve as a preferred therapeutic solution, particularly for financial reasons and their ability to preserve residual tissues (1). Among the different types of RPDs, metallic framework prostheses remain a widely used option due to their strength, durability, and superior load distribution. However, despite these advantages, conventional RPDs present several limitations, both biomechanically and aesthetically.

One major biomechanical issue is tissue duality, where the difference in compressibility between soft tissues and natural teeth can lead to uncomfortable rocking movements, compromising the prosthesis' stability and patient comfort (2). Additionally, from an aesthetic standpoint, the visibility of clasps—especially in the anterior region—can negatively impact the patient's smile and overall satisfaction (3). These drawbacks necessitate alternative retention systems that optimize both function and appearance.

Ball attachments used in tooth-supported overdenture provide an effective solution to these challenges. By eliminating the buccal arm of cast clasps, these attachments improve aesthetic integration, offering a more natural appearance while enhancing retention and stability. Biomechanically, they contribute to a more even distribution of occlusal forces, reducing stress on the abutment teeth and minimizing the risk of prosthesis instability. From a clinical perspective, their use allows for better preservation of residual roots, which can play a crucial role in maintaining alveolar bone integrity and periodontal proprioception (4).

This case report details the prosthetic rehabilitation of a patient with extensive edentulism using a metallic partial removable denture combined with tooth-supported overdentures incorporating ball attachments. It emphasizes the clinical decision-making process and highlights the advantages and potential limitations of this treatment approach, focusing on both functional and aesthetic outcomes.

Observation

A 55-year-old patient presented to the Department of Dentistry at EPS Farhat Hached in Sousse seeking prosthetic rehabilitation. The patient's medical

history was unremarkable, with no contraindications for dental prosthetic treatment. Extraoral examination showed a balanced facial profile with adequate lip support.

Intraoral examination showed bilateral bounded edentulism in the maxilla and bilateral distal-extension edentulism in the mandible. Tooth 13 exhibited advanced structural deterioration. Tooth 28 presented with occluso-mesial amalgam restoration. (Fig.1a-b)

Figure 1(a-b): The initial state of the maxillary and mandibular arches, (a): Lateral view, (b): Frontal view

Preliminary impressions were taken using irreversible hydrocolloid (alginate), and diagnostic casts were fabricated to evaluate the oral structures and available prosthetic space. Examination of these casts mounted on an articulator revealed insufficient prosthetic space due to approximately 2 mm of egression of tooth 25. (Fig.2a-b)

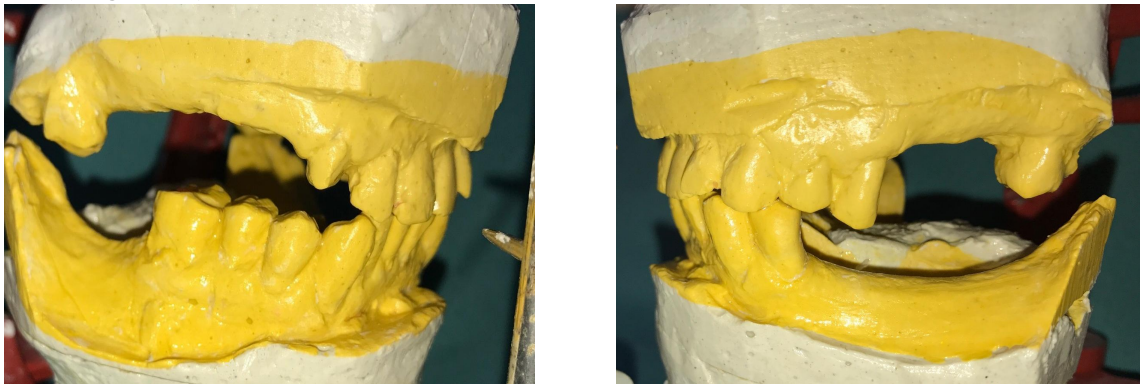

Figure 2(a-b): Examination of the diagnostic casts on the articulator reveals insufficient available prosthetic space opposing tooth 25

Treatment Planning:

Given the extensive edentulism and the condition of the remaining dentition, a combined prosthetic approach was planned for the maxilla. This included a ceramo-metallic crown on tooth 28 and a metal framework supported by tooth-retained overdentures incorporating two ball attachments on teeth 13 and 25. The ball attachment on tooth 13 was specifically chosen to avoid the unsightly visibility of a clasp that would otherwise have been placed on tooth 12, which has limited retentive value. This solution optimizes both aesthetics and retention. Additionally, it allows distalization of the junction between the artificial gingiva and the dentate segment, positioning it outside the aesthetic zone. Similarly, the ball attachment on tooth 25, which is egressed by approximately 2 mm, enhances the overall aesthetic harmony of the prosthetic restoration.For the mandible, a partial remo vable prosthesis with a metal framework was planned.

Clinical Procedure

The treatment began with dental preparation of teeth 13 and 25 to accommodate the male components of the supra-radicular ball attachments. The preparation of the post space was performed on two-thirds of the root height, ensuring adequate retention and stability. A juxta-gingival peripheral bevel was established as the cervical limit of the preparation to facilitate a precise fit. The vestibular wall was prepared obliquely, while the palatal wall remained horizontal. Additionally, a notch was incorporated into the vestibular wall to prevent rotational movements of the coping, ensuring optimal adaptation of the attachment. (Fig.3)

Following tooth preparation, coping fabrication was initiated. Wax patterns of the copings were sculpted using pattern resin to allow precise adaptation to the prepared teeth. (Fig4)

Figure 3: Abutment Tooth Preparation

Figure 4 : Sculpting of the copings using pattern resin.

To verify an accurate fit within the oral cavity, a dynamic impression was taken using silicone while the resin copings were in place. This step was crucial for accurately transferring their position to the laboratory. (Fig.5)

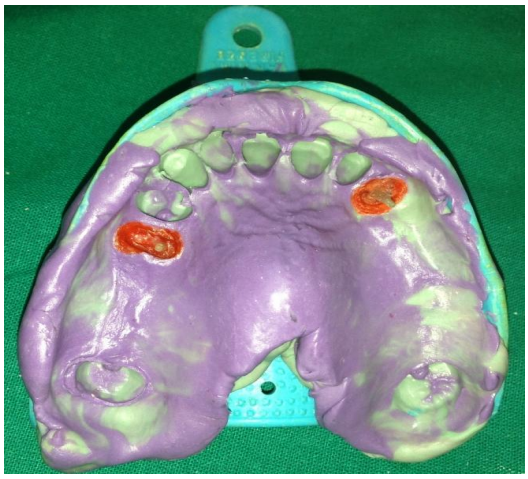

Figure 5: Precision Transfer of Resin Copings Using Silicone Impression.

In the laboratory, the positioning of the patrices (male components) of the attachments was meticulously executed using a dental surveyor. This ensured parallel alignment and proper integration of the attachments within the prosthesis. The wax patterns, along with the attachments, were then cast in metal. (Fig.6)

Figure 6: Placement of the patrice according to the path of insertion of the prosthesis.

Once the casting process was completed, the try-in of the metal copings with the male elements was conducted in the patient's mouth. This step verified the precise adaptation of the copings and attachments, ensuring their stability before proceeding with the final impression phase. (Fig.7)

Figure 7: try-in of the metal copings.

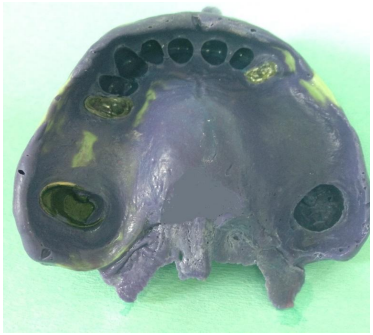

Figure 8: Final impression

Final impression were then taken using polyether, a high-precision elastomeric material, along with a custom impression tray. This impression captured intricate anatomical details essential for the accurate fabrication of the metallic framework and precise positioning of the ball attachments. Additionally, the impression material effectively recorded soft tissue morphology, which is crucial for achieving a well-adapted prosthesis that ensures both comfort and functionality.(Fig.8)

Subsequently, a framework try-in was performed. The fabricated metal framework, incorporating the previously positioned attachments, was placed in the patient's mouth to assess its fit, stability, and occlusal relationships. This verification step ensured that the framework provided adequate support for the

prosthetic teeth and attachments. Minor adjustments were made as needed to enhance adaptation and optimize patient comfort before advancing to the final prosthesis stage. .(Fig.9a-b)

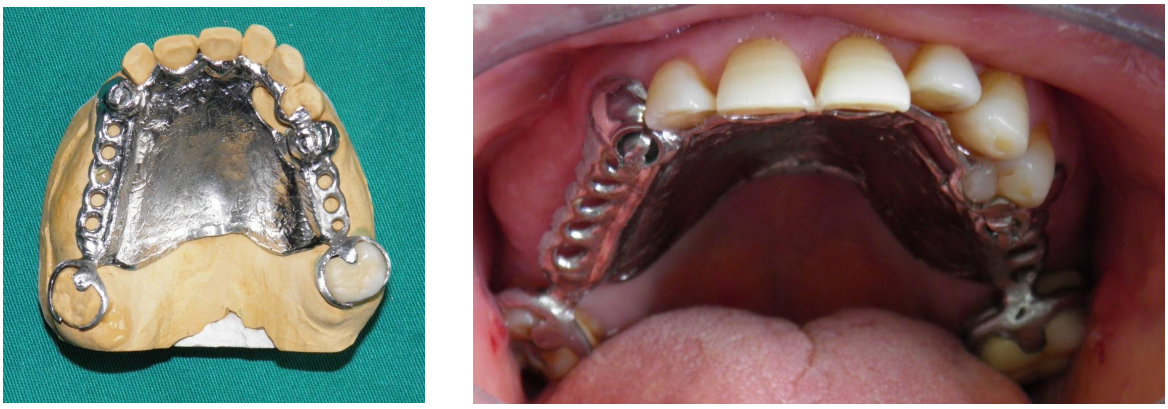

Figure 9(a-b): Try-in of the maxillary metal framework, (a): Metal framework on the working cast, (b): Intraoral try-in of the framework to verify adaptation and stability.

The final prosthesis fabrication and try-in were meticulously executed to achieve both functional efficiency and aesthetic harmony. The denture was designed to conceal metallic components while ensuring proper alignment with the remaining dentition. During the try-in session, esthetics, phonetics, and occlusion were carefully evaluated. Any necessary refinements were made to enhance the overall integration of the prosthesis before proceeding with its finalization. .(Fig.10a-b)

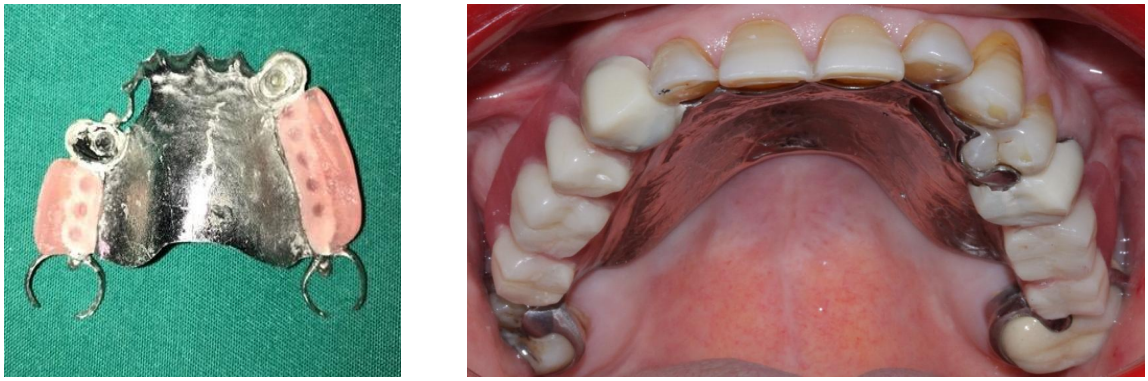

Figure 10(a-b): Try-in of the maxillary metal framework, (a): Metal framework on the working cast, (b): Intraoral try-in of the framework to verify adaptation and stability.

Finally, the insertion and adjustment phase marked the completion of the treatment. The prosthesis was carefully placed, and occlusal adjustments were performed to achieve balanced articulation and functional harmony. The patient

received comprehensive instructions regarding denture care, including hygiene maintenance and handling precautions, to ensure the longevity and optimal performance of the restoration. Follow-up appointments were scheduled to monitor adaptation and address any potential concerns, ensuring long-term success and patient satisfaction. (Fig.11)

Figure 11: Final result

Discussion

The integration of an overdenture ball attachment into a metal framework removable partial denture (RPD) is a precise and demanding procedure that requires thorough pre-treatment planning. Careful preparation ensures that the prosthesis fulfills both biomechanical and aesthetic criteria essential for long-term success.

Pre-analysis and Diagnostic Wax-Up:

A critical step in the planning phase involved mounting study models on an articulator to create a diagnostic wax-up. This served multiple purposes: it illustrated the intended prosthetic design, assessed the available space for axial attachments, and accurately represented the prosthesis volume. The wax-up also enabled the clinician to identify spatial limitations and evaluate the mechanical feasibility of the treatment plan. Additionally, it functioned as a powerful communication tool, offering the patient a clear visual representation of the proposed rehabilitation, thereby facilitating informed consent and engagement (5,6).

In this case, the wax-up confirmed that sufficient prosthetic space and occlusal clearance were available for the placement of axial attachments on teeth 13 and

25, allowing the team to proceed confidently without compromising prosthesis strength or function.

Challenges in Occlusal and Proximal Space Management:

One common challenge in fabricating a metal framework RPD with an integrated ball attachment is the lack of sufficient occlusal and proximal prosthetic space. Limited space can lead to the use of thin denture resin, which is less resistant to masticatory forces, increasing the risk of fractures and compromising long-term durability.

To address this issue, veneered denture teeth provide an effective solution. By balancing the distribution of chewing forces and enhancing durability, veneered teeth contribute significantly to the prosthesis's structural integrity (7).

Exploitation of Residual Roots:

Residual roots can be effectively utilized to enhance prosthetic retention, provided certain clinical criteria are met. These include adequate intra-osseous root height to ensure mechanical stability and resistance to occlusal forces, the absence of mobility or carious lesions to maintain long-term structural integrity, sufficient attached gingiva to support tissue health and minimize irritation, and a favorable root axis that facilitates preparation and secure placement of a retention system (2, 8).

In this case, tooth 15 met all necessary criteria, allowing the use of a ball attachment effectively. Biologically, this approach preserved the alveolar bone and maintained periodontal proprioception, both crucial for long-term oral health. Aesthetically, the attachment prevented the dissolution of the false gingiva and negated the need for a buccal arm on the anterior clasps, enhancing the overall appearance. Mechanically, it optimized the prosthetic balance, distributing occlusal loads evenly across the prosthesis, crucial in extensive edentulism cases [4, 9, 10].

Prosthetic Rehabilitation and aesthetics during smiling:

A critical aspect of prosthetic rehabilitation is the aesthetic outcome during smiling, which significantly impacts the patient’s confidence and social interactions. In this case, the use of overdentures ball attachments facilitated the distal positioning of the transition between the artificial gingiva and the dentate

segment outside the aesthetic zone. This strategic placement ensures that the denture's components, including metal clasps or attachments, remain concealed during speech and smiling, enhancing the overall aesthetic appeal.

The careful design of the prosthetic framework allowed for a harmonious smile line, supporting the lip adequately without revealing metallic components. This consideration is essential in achieving patient satisfaction and underscores the importance of integrating aesthetic principles into prosthetic planning (11).

Placement of Female Parts in the Prosthetic Intrados:

The placement of the female parts of the attachments within the prosthetic intrados plays a crucial role in the denture's retention and overall success. Positioning the female components inside the denture's internal surface maximizes retention while maintaining the external appearance of the denture.

In this case, the female housings were carefully positioned to align precisely with the ball attachments on teeth 13 and 25, ensuring a secure and stable connection. This setup facilitated easy insertion and removal of the prosthesis while maintaining a firm fit during function. Additionally, embedding the components within the intrados minimized prosthetic bulk, enhancing patient comfort during everyday activities such as speaking and chewing.

The use of ball attachments in overdenture-supported prostheses provides multiple biomechanical advantages. It eliminates the need for visible clasps, thereby improving aesthetic outcomes, and ensures more uniform distribution of occlusal forces, reducing stress on abutment teeth. Furthermore, this approach contributes to alveolar ridge preservation and maintains periodontal proprioception, both critical for long-term oral health and prosthesis stability (11).

Clinical Implications:

The decision to utilize ball attachments in this case exemplifies an advanced prosthetic design approach, emphasizing both function and aesthetics. This strategy offers an alternative to traditional clasp-based retention methods, which can be less aesthetically pleasing and exert uneven forces on abutment teeth (11,12).

By integrating these attachments, clinicians achieve better load distribution, reduce the risk of abutment tooth overload, and enhance the overall retention

and stability of partial removable dentures. This approach is particularly beneficial for patients with extensive edentulism, where maintaining residual ridge integrity and proprioception is critical for the long-term success of the prosthesis (12).

Challenges and Limitations:

Despite its advantages, this technique presents challenges. Implementation requires precision during both planning and execution stages, with strict adherence to design specifications. The retention system also requires regular follow-ups to monitor wear and ensure optimal prosthesis performance. Over time, components may degrade, requiring adjustments or replacements (13,14,15).

Patient cooperation is crucial for long-term success. Commitment to regular check-up appointments and adherence to recommended hygiene and maintenance protocols are necessary. Effective patient education about the importance of ongoing care ensures optimal outcomes (16,14).

Conclusion:

The prosthetic management of extensive edentulism poses a dual challenge of achieving biomechanical stability and aesthetic satisfaction. The use of Tooth Supported Overdenture with ball Attachments in metallic partial removable dentures successfully addresses this challenge by enhancing retention, stability, and aesthetics.

In this case, the careful planning and precise execution of the prosthetic design allowed for an optimal balance between function and appearance. The ball attachments not only improved the denture's retention but also concealed the metal components from view, thereby enhancing the smile's aesthetic quality. Additionally, the preservation of the alveolar ridge and proprioception contributes to the long-term stability and comfort of the prosthesis.

Successful prosthetic rehabilitation requires meticulous case evaluation, a well-structured treatment plan, and effective communication between the clinician, patient, and dental technician. The integration of over denture ball attachment in this case exemplifies a technique that combines technical precision with aesthetic sensitivity, leading to high patient satisfaction and improved oral function.

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