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Treatment Modalities for Overdentures on Screw-Retained Bars on Implants

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Abstract

Implant overdentures offer a practical and effective solution for edentulous patients with limited bone volume or contraindications for grafting. These cases demonstrate the successful use of both flapless and open flap implant techniques for overdenture rehabilitation, with the added benefit of immediate loading in the mandible. The combination of high primary stability, optimized thread design, and proper load distribution creates a favorable environment conducive to successful early loading.

Keywords

Rehabilitation in atrophied bone; Overdenture; Screw-retained bars; Palatal approach; Compressive Implants; Minimally invasive implant treatment options in mandible and maxilla.

Introduction

Full-arch rehabilitation for the maxilla and mandible using fixed implant-supported prostheses offers superior function, prosthetic stability, and enhanced quality of life. However, these treatments are often cost-prohibitive, making them inaccessible for many patients [1,2].

Implant overdentures present a more affordable alternative, providing improved function and stability with the use of two or more implants for retention. Unlike fixed full-arch restorations, implant overdentures are relying primarily on soft-tissue for support and can be removed by the patient for routine hygiene purposes [3-5].

Challenges in Implant Overdenture Cases

Patients considering implant overdentures frequently exhibit insufficient bone width in the residual alveolar ridge, especially in the maxilla. Bone grafting is often necessary to facilitate implant placement when only conventional implants are available [6]. However, grafting procedures may not always be feasible due to health, age, or financial limitations [7].

Compressive Implants: A Novel Solution

The following case reports demonstrate compressive implants with compressive thread designs (ROOTT implants R, P, M, and MS, Trate AG). These implants provide enhanced primary stability and retention in cases with limited bone volume. In the maxilla and in the mandible, these implants can be placed in bone widths as narrow as 4 mm, while in the mandible, they allow for early loading, with prosthesis delivery possible within three weeks using either a flapless or open-flap surgical technique. For maxillary overdentures, delayed loading is generally recommended [8,9].

Conditions for successful early loading with ROOTT compressive implants in bar-supported prosthetics

The success of early loading with ROOTT compressive implants relies on achieving both primary and secondary stability. Primary stability refers to the mechanical stability achieved immediately after implant placement, while secondary stability develops through biological osseointegration, typically within the first 100 days of healing.

Pioneering studies conducted in the 1980s highlighted the long-term efficacy of compressive implants. Ledermann (1983) and Ledermann, Kallenberger, Rahn, and Steinemann (1985) demonstrated that this type of implant could achieve permanent fixation in bone over several years. Similarly, Tetsch [10]. emphasized the importance of implant design in ensuring stable outcomes.

Critical Factors for Success

Key elements that contribute to the success of compressive implants for early loading in the mandible include:

1. **Thread Design:**
    - Compressive implants feature a thread design that minimizes undesirable shearing forces on the surrounding jawbone.
    - The compressive action optimally distributes stress, which prevent damage to the bone tissue.

2. **Self-Tapping Threads:**
    - The self-tapping nature of the threads enhances the anchorage of the implant within the bone.
    - This design promotes strong mechanical stability, which is essential for early loading.
3. **Load Neutralization:**
    - High primary stability is further enhanced when multiple implants are rigidly connected using a bar passively.
    - This configuration neutralizes shear and torsional forces, thereby creating favourable conditions for osseointegration.

Indications for Implant Overdentures

Although fixed restorations offer superior function and stability, implant overdentures are particularly suitable in the following scenarios:

1. **Limited bone in the edentulous arch**
    - When insufficient bone volume prevents optimal implant positioning for achieving adequate anterior-posterior (A-P) spread for a fixed restoration [11,12].
2. **Contraindications for bone grafting**
    - When bone augmentation is required for fixed restorations, however the patient is ineligible due to systemic health issues, advanced age, or financial constraints [13,14].
3. **Preference for removable dentures with improved stability**
    - Patients preferring removable prostheses, but experience retention issues can benefit from implant overdentures whilst maintaining the aesthetics of traditional dentures [15,16].
4. **Palataless Maxillary Appliance**
    - Implant overdentures designed with a horseshoe-shaped configuration improve comfort, speech, and taste perception for patients that desire a palataless prosthesis [17,18,16].

Historical Perspective

The concept of bar-retained overdentures on implants dates to 1975, when Philippe D. Ledermann first described their use with crystalline bone screws (CBS) developed by Sandhaus [19]. By 1977, titanium plasma spray (TPS)-coated screws were introduced which further advance the technique [19].

Key advancements include:

- 1975: Ledermann's CBS implants for mandibular overdentures.
- 1986: Publication of comprehensive guidelines for TPS screw implants by Ledermann (Quintessenz) [20].
- 1996: Over 20 years of successful outcomes with bar-retained overdentures in the mandible reported by Ledermann [21].

Benefits of Bar-Retained Overdentures

1. **Enhanced Stability**

- Bar-retained overdentures are firmly anchored to implants, providing superior stability compared to traditional removable dentures [22,23].

2. **Comfort and Convenience**
   - These overdentures reduce irritation and soreness, thereby offer a more comfortable fit for patients [24,25].

3. **Improved Bone Health**
   - Implants stimulate the jawbone, preserve bone density and prevent resorption, thereby contributing to long-term oral health [26,27].

4. **Longevity**
   - With proper care, bar-retained overdentures demonstrate excellent durability, they require fewer adjustments than conventional dentures [28].

5. **Improved Hygiene**
   - The secure fit of bar-retained overdentures eliminates the movement typical of traditional dentures, this enhances functionality and patient satisfaction [29].

Case Report 1: Screw-Retained Bar Rehabilitation

The patient, a 63-year-old male, presented with dissatisfaction regarding his maxillary removable prosthesis due to poor retention and lack of stability. Clinical and radiographic assessments showed insufficient bone width (approximately 4 mm) in the maxilla. Traditional implant placement would have required a bone grafting procedure to achieve adequate bone volume for rehabilitation, which the patient wished to avoid.

A practical solution was achieved using One-Piece Tissue-Level ROOTT S implants, without the need of bone grafting. These implants provided effective stabilization and retention of the prosthesis, successfully addressing the patient's concerns. Following a thorough radiographic evaluation, ROOTT S 3.0/16 mm implants (Figure 1) were selected for the procedure.

Figure 1: ROOTT S 3.0/16 mm.

Surgery was performed using an open-flap approach (Figure 2), and the implants were successfully placed. During insertion, a high primary stability was achieved, with torque values reaching approximately 50 N/cm.

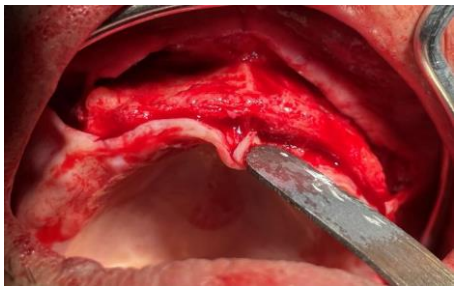

Figure 2: Narrow bone width.

After implant placement (figure 3), the surgical site was closed with sutures, healing caps was omitted to allow the patient to be able to wear the existing prosthesis over the implants.

Figure 3: Implant placement in maxillae.

After a healing period of four months, the surgical site was reopened, and impressions taken with screw-retained transfer copings (figure 4a and b) an open tray technique was used.

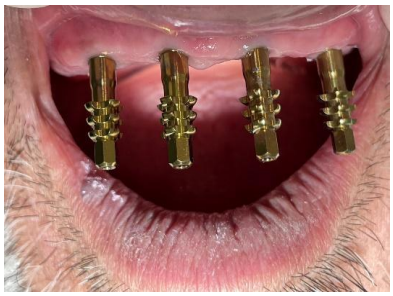

Figure 4A: Screw-retained transfer copings. **B**: Impression taken with open tray technique.

Following the impression procedure, healing caps were placed on the implants. During the second appointment, a verification jig was used to confirm the accuracy of the implant positions (Figure 5), and the patient's bite was recorded and adjusted as necessary (Figure 6).

Figure 5A: Verification jig. **B:** Verification jig in the mouth.

Figure 6: Bite plate and wax for bite record.

At the third appointment, the milled bar (Figure 7) and the provisional overdenture were evaluated for fit and function.

Figure 7: Milled bar.

During the fourth appointment, the bar was fixed on the implants, and the final overdenture was delivered to the patient (Figure 8).

Figure 8A: Soft tissue before bar placement, **B:** fixed bar in the mouth, **C:** the final prosthesis.

The bar was securely screwed onto the implants with a torque of 15 N/cm. The overdenture was delivered and securely retained on the bar, which provide optimal stability and function. (Figure 9) show clinical and radiological image after completion of treatment.

9A **B**

C

Figure 9 (A-C): show clinical and radiological images after placement.

An alternative to the above treatment approach, in the absence of these specialized implants, would involve a bone graft procedure, as demonstrated in the accompanying illustration (Figures 10 -13).

Figure 10: Bone graft from the skull.

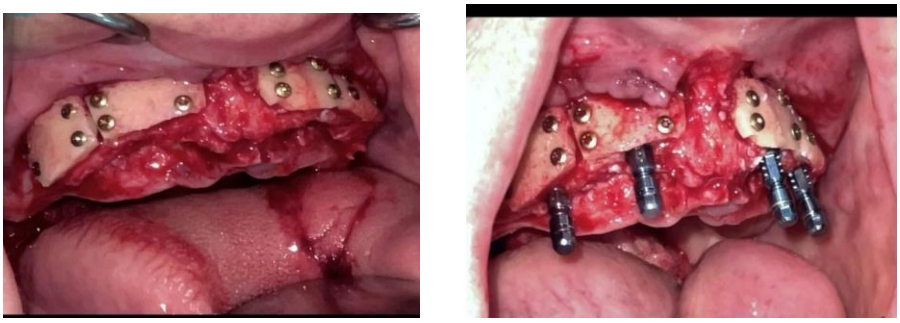

Figure 11A: Maxilla bone width enlarges with bone graft from skull. **B:** Implant placement and transfer coping before impression taken.

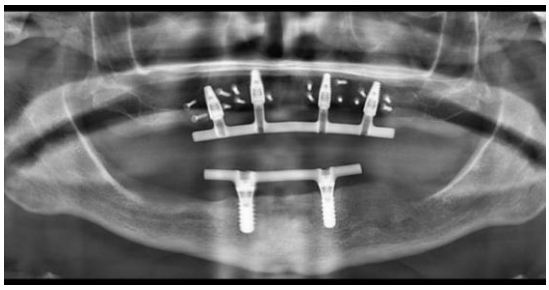

Figure 12: An OPG showing the results after bone graft.

Figure 13: Picture of the screw-retained bar at completion.

Case Report 2

A 90-year-old woman expressed dissatisfaction with her dentures. Despite being in good physical health and mood, she struggled with unstable dentures that required adhesive to keep it in place for speaking and eating. Previously, multiple dentists had informed her that she was too old for dental implants and lacked sufficient bone width, conventional two-piece implants typically require at least 6 mm of bone width.

After radiological evaluation, it was determined that it was feasible to place implants in both the mandible and maxilla. Implant A treatment plan was proposed using small-diameter implants (ROOTT M and ROOTT S). Given the patient's apprehension about invasive procedures, a minimally invasive approach was adopted, starting with the mandible.

Figure 14: ROOTT M implant.

Mandibular Treatment

In the mandible, four ROOTT M implants (3.5 mm diameter, 14 mm length) were placed (Figure 14) using a flapless surgical technique, since the anatomy of the bone allows this approach. Local anaesthesia was administered, and the implants were inserted (Figure 15 – 16).

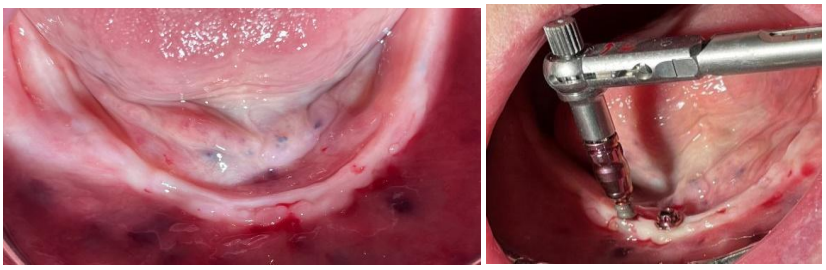

Figure 15A: Mouth situation before and **B:** After implantation.

A high primary stability with torque values around 60 N/cm was achieved. This stability was attributed to the design of the implant threads, which compress the bone effectively.

Figure 16: Result of four Implants ROOTT M 3.5/14 mm in place.

The treatment process included the following steps:

- **Initial Implant Placement:** Flapless surgery was performed, and the implants were placed.
- **Immediate Impression:** After implantation, an impression was taken using screwed transfers.
- **Verification Jig:** At the second appointment, a verification jig ensured the accuracy and passivity of the impression (Figure 17 – 18).

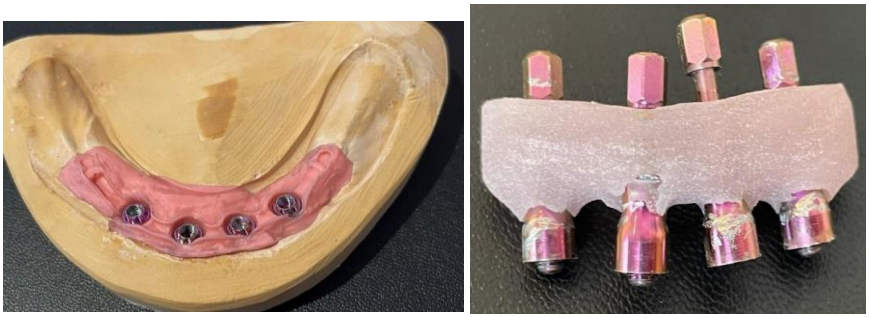

Figure 17A: plaster cast **B:** Verification jig.

Figure 18: Control check of verification jig in mouth.

Secondary Impression and Bite Registration: A new impression with a positioning key and the bite registration were completed at the third appointment (Figure 19).

Figure 19: Secondary impression and bite registration.

Final Prosthesis Delivery: A metal-reinforced overdenture with attachments was prepared (Figure 20-21). A bar was screwed onto the implants with 15 N/cm torque.

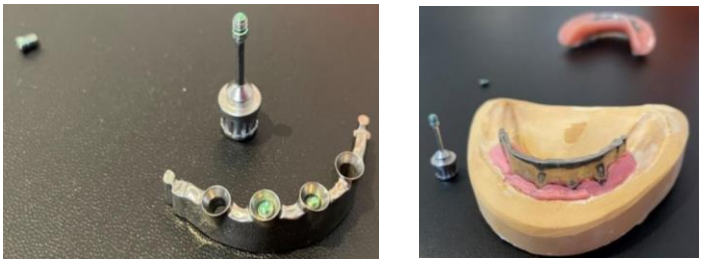

Figure 20A: Bar fabrication and **B:** Try in on plaster cast.

Figure 21: The final prosthesis reinforced with metal and with attachments and bar.

After three weeks, the final prosthesis was delivered to the patient (Figure 22). The mandibular treatment was successful, with no reported pain or swelling, and the patient expressed significant satisfaction. Encouraged by this outcome, we proceeded with treatment for the maxilla.

Figure 22A: Bar and **B:** Final prothesis in the mouth.

Maxillary Treatment

For the maxilla, a different approach was required due to the narrow bone width. To avoid bone grafting, ROOTT S implants with narrow necks and thin diameters were used (Figure 23). This treatment involved delayed loading.

Figure 23: ROOTT S implants.

Surgery was performed with an open-flap technique. Four ROOTT S implants (3.5 mm diameter, 16 mm length) were placed using a palatal approach due to the narrow bone width (Figure 24). The flap was closed without placing healing abutments, this allows the patient to wearing her existing prosthesis.

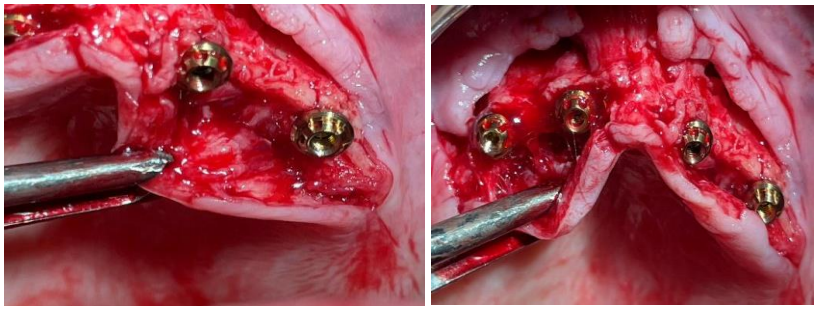

Figure 24: Palatal approach due to narrow bone width.

Three months after, the flap was reopened, and impressions were taken using screwed transfers.

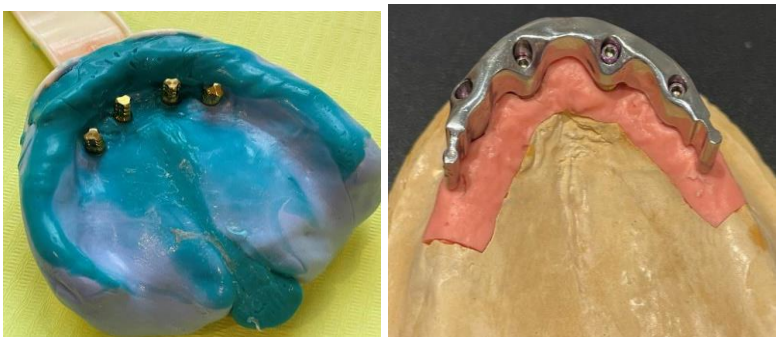

Figure 25A: impression with screwed transfers **B:** bar on cast model.

Figure 26A: Milled titanium bar **B:** Final prosthesis with attachments.

A milled titanium bar was fabricated and screw-retained on the implants (Figure 25 -26).

The completed prosthesis was delivered one month after the second appointment, approximately four months after the initial implant placement. Postoperative X-rays confirmed the successful placement and integration of the implants (Figure 27). The patient was pleased with the outcome, which significantly improved her quality of life.

Figure 27A: The final prosthesis in the mouth; **B:** Postoperative X-ray.

Case Report 3

A 54-year-old female patient sought a solution for her edentulous condition, she prefers overdentures due to financial constraints, which made full fixed rehabilitation unfeasible. Following radiological assessment, it was determined that there was adequate bone volume in both the maxilla and mandible for implant placement. The patient's primary concern was the potential for pain and swelling associated with surgery. However, the patient expressed concerns regarding surgical pain and postoperative swelling.

Figure 28: ROOTT M 3.5/14 mm implants.

Given the adequate bone width in the mandible, a flapless implantation technique was selected to minimize invasiveness. Five ROOTT M implants (3.5/14 mm) were placed in the mandible (Figure 28-30). A high primary stability was achieved with an insertion torque of 60 N/cm, which makes early loading of implants possible.

Figure 29: Mouth situation before implantation.

Figure 30: ROOTT M implants (3.5/14 mm) placed with flapless technique.

After implant placement, impressions were taken using screw-retained transfer copings, which were stabilized with resin for accurate positioning (Figure 31).

Figure 31: Impression with screw-retained transfers stabilize with resin.

A model was prepared, and an aesthetic try-in with bite registration was completed during the second appointment (Figure 32).

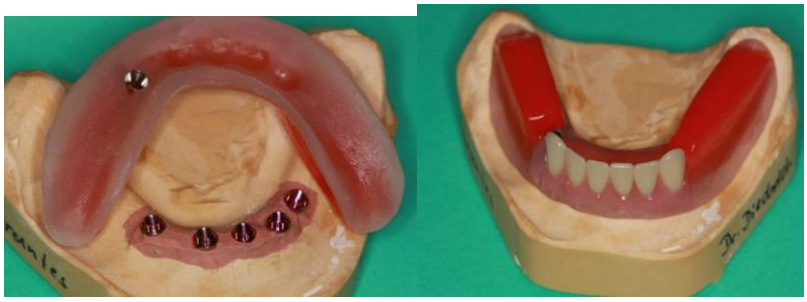

Figure 32A: Model, aesthetic try-in, and **B:** Bite registration.

A verification jig was used to ensure accuracy (Figure 33).

Figure 33: Control check of verification jig in the mouth.

A titanium milled bar was fabricated and checked intraorally for proper fit (Figure 34–36).

Figure 34: Milled bar in titanium.

The final prosthesis was delivered within three weeks, ensuring adequate space for oral hygiene maintenance (Figure 36).

Figure 35A: Finished prosthesis, **B:** Bar fixed in the mouth.

Figure 36A: Bar with enough space for cleaning; **B:** The final prosthesis in the mouth.

After a successful treatment outcome in the mandible, the patient was convinced to proceed with maxillary treatment.

In the maxilla, an open flap technique was used, and there was sufficient bone width as a result ROOTT R implants were inserted (Figure 37).

Figure 37: ROOTT R implant.

The flap was closed after the implants were placed. A healing period of three months was allowed for osseointegration.

Three months after surgery, impressions were taken using screw-retained transfer copings, which were stabilized with Luxabite material to enhance accuracy (Figure 38-39).

Figure 38A: Screw-retained transfer copings; **B:** Transfer copings stabilized with Luxabite.

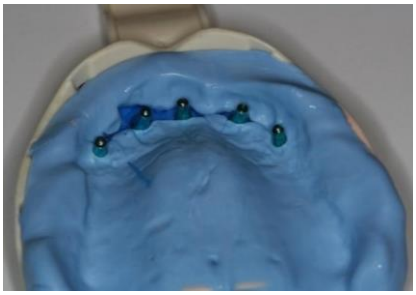

Figure 39: Impression with transfers.

A model was fabricated with multi-units screwed onto the implants (Figure 40).

Figure 40: The model with Multi units screwed on the Implants.

After four months, a titanium milled bar was fabricated and aesthetic try-ins were performed followed by bar fixation in the mouth (Figure 41–43).

Figure 41A: Soft tissue after 4 months; **B:** Titanium milled bar.

An aesthetic try-in was performed.

Figure 42A: Esthetical try in; **B:** Multi unite screwed on R implants.

The final overdenture was delivered with multi-units screwed onto the ROOTT R implants. Multi-unit abutments ensured optimal prosthetic alignment. The maxillary prosthesis was delivered four months after implant placement, following soft tissue healing.

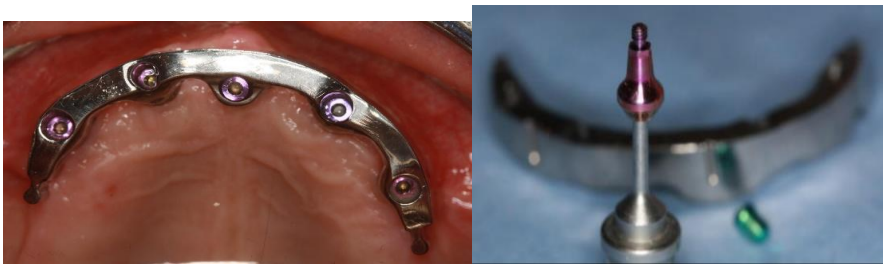

Figure 43A: Bar fixed in the mouth; **B:** Multi-unit screw and bar.

At the two-year follow-up, the patient's implants, bar, and prosthesis remained stable, and the patient reported significant improvements in function, retention, and quality of life.

Figure 44A: Clinical photograph and **B:** OPG after 2 years of placement.

This case demonstrates the successful use of both flapless and open flap implant techniques for overdenture rehabilitation, with the added benefit of immediate loading in the mandible. The patient achieved a functional and aesthetically pleasing result, which improved both comfort and oral health without the need for full fixed rehabilitation.

Conclusion

Implant overdentures offer a practical and effective solution for edentulous patients with limited bone volume or contraindications for grafting. Advancements in implant technology, including compressive implants, have significantly improved stability and retention enabling clinicians to achieve functional and aesthetically pleasing outcomes in both the maxilla and mandible.

The combination of high primary stability, optimized thread design, and proper load distribution creates a favorable environment conducive to successful early loading. These factors facilitate compressive implants to Osseo integrate effectively and support functional prosthetics in the mandible.

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