Case Studies on the Use of Skeletal Anchorage Orthodontic Techniques Prior to Prosthetic Rehabilitation

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**INTRODUCTION**

Many patients require prosthodontic rehabilitation with varying levels of complexity. Clinical examinations of partially edentulous patients often reveal dental overeruption, which can be caused by the prolonged absence of the antagonist tooth, migration, and inclination into the edentulous space. These changes reduce the maxillary or mandibular interocclusal space, thereby limiting available options for the rehabilitation of the edentulous space. The loss of multiple teeth typically leads to occlusal collapse, associated with overerupted molars and premolars. The involvement of anterior maloccluded teeth, in case of loss of support in the posterior region, can complicate this clinical condition, as indicated by incisor overeruption, deep overbite, occlusal reduction of the buccal side of the incisors, and increased diastema.

The esthetic problems associated with tooth loss or edentulism are the primary reason that patients seek rehabilitation. Correcting the conditions associated with tooth loss requires a comprehensive treatment plan that includes the installation of prosthetic elements in edentulous areas. Interdental spacing and the inclination of the surrounding teeth should be corrected, to obtain a balanced occlusal plane for prosthetic rehabilitation and to ensure a positive long-term result. As recently as the 1990s, the recovery of interarch spaces in partially edentulous patients required excessive tooth reduction, prosthetic crowns, and endodontic or surgical procedures. These invasive therapeutic modalities involved severe discomfort, high cost for the patient, and strict adherence to a treatment plan.

With the recent advent of temporary skeletal anchorage devices (TADs), tooth intrusion and movements have become less invasive and expensive, while generating improved anchorage, control, and patient cooperation. Temporärue skeletal anchorage devices originally appeared with the use of conventional implants. However, their use was limited because of their size and the complexity of surgical procedures.

These techniques were replaced by Onplants, Orthosystem, miniplates, and miniscrews (Figure 1a and b). However, the Orthosystem and Onplants systems still have limitations, including an invasive surgical procedure, prohibitive expense, waiting time to osseointegration, and limited insertion sites. In contrast, mini-implants and miniplates have features that allow the immediate application of orthodontic force and the possibility of in-office installation. Mini-implants and miniplates have similar indications, and the decision to use one or the other should be based on anatomical characteristics (eg, the space between the roots), case complexity, cost-effectiveness, and professional and patient preferences.

In light of the viability of TADs in the oral rehabilitation of partially edentulous patients, the aim of this article was to describe 3 clinical cases in which TADs were applied.

**CASE REPORTS**

In the following case studies, the advantages of using temporary anchorage systems such as mini-implants and miniplates are highlighted.

**Case 1: Use of miniscrews for intrusion of the posterior teeth**

A 43-year-old female patient presented with a partially edentulous mandibular arch (Kennedy Class II). She sought treatment from the Prosthodontics Clinic of the Latin American Institute for Dental Research and Education (ILAPEO; Curitiba, Brazil) to rehabilitate the edentulous spaces in the jaw. Clinical examination and study model analysis revealed the overeruption of the teeth Nos. 2, 3, and 14 (Figure 2a and b), which negatively affected the prosthetic rehabilitation of the antagonist arch. Concerning the hemiarch right involving teeth Nos. 2 and 3, a high-complexity tooth movement was required since their positioning was invading the interocclusal space both vertically and in the vestibulo-lingual direction (Figure 3).

Before rehabilitation with prostheses could be performed, the intrusion of the dental elements was required using temporary anchorage devices (miniscrews, dimensions of 1.6 × 7 mm; Figure 3). The force was applied with the aid of a power chain on the buccal aspect at the height of the molar roots on both sides. Orthodontic load was applied 2 weeks after installation of the miniscrews. After 30 days of movement,
another mini-implant (dimension of 1.6 × 9 mm) was installed on the lingual face of element No. 3 to complement the orthodontic mechanics and prevent tooth proclination when intruding teeth. Orthodontic load was achieved with the aid of a power chain. The force used was 15 cN per root of the teeth.

After 3 months of orthodontic movement, the level of intrusion required was achieved (3 mm for teeth Nos. 2 and 14, and 5 mm for No. 3). The mini-implants were removed in the same session and subsequently the implants were installed. Temporary prostheses were installed over the implants, and occlusal loading was carried out immediately (Figure 4). The final step in rehabilitation was achieved with the installation of a screwed fixed prosthesis over the implant. Figure 5 shows the case after 6 months of treatment.

Case 2: Use of mini-implants for the intrusion of the mandibular incisors

A 39-year-old woman presented with a partially edentulous maxilla (Class IV Kennedy). She sought prosthetic treatment for the anterior maxillary segment at the Denture Clinic of ILAPEO. Clinical examination and model analysis (Figure 6) revealed overeruption of the lower anterior teeth (Nos. 23, 24, 25, and 26), which limited options for rehabilitating the upper arch. The degree of overeruption of the lower elements compromised the space available for producing the ideal overjet and correct anterior guidance. Therefore, we decided to use controlled orthodontic movement to restore the interocclusal space of the anterior maxillary arch and to enable rehabilitation with a prosthetic implant (Figure 7).

Two mini-implants (1.6 × 7 mm for the lower brace) were installed in the buccal aspect of the alveolar bone between the roots of tooth Nos. 23, 24, 25, and 26. Fifteen days after installation, orthodontic force was applied to achieve 4-mm intrusion of the anterior mandibular segment. During the period of orthodontic movement, the dental implants were installed in the anterior maxilla, although they stayed submerged until the end of the orthodontic treatment (Figure 7). The planned level of intrusion was achieved after 75 days. Prosthetic rehabilitation began with surgery to reopen the dental implants. Universal posttype abutments (straight abutment for Nos. 7 and 10, and 17° angled abutment for Nos. 8 and 9) were chosen to construct the cemented prosthesis unit (Figure 8). The mini-implants and orthodontic devices were removed, and the cemented prostheses were installed, which completed the rehabilitation (Figure 9).

Case 3: Use of a miniplate for intrusion of posterior maxillary teeth

A 57-year-old female patient presented with a partially edentulous arch in the lower right side (Class II Kennedy). She sought prosthetic rehabilitation at the ILAPEO Clinic. During the clinical examination, a significant overeruption of posterior
FIGURES 4–8. **FIGURE 4.** Lateral view of the interoclusal space available after orthodontic intrusion. (a) Right side. (b) Left side. **FIGURE 5.** Frontal view of the rehabilitation in the posterior region of mandibular arch. **FIGURE 6.** Frontal view of the model analysis in the anterior region of maxilla. **FIGURE 7.** Frontal view of the clinical evaluation. **FIGURE 8.** Interoclusal space available after the prosthetic abutments selection.

FIGURES 9–13. **FIGURE 9.** Frontal view of the final rehabilitation. **FIGURE 10.** Initial clinical examination. (a) Frontal view. (b) Lateral view of the region with interoclusal space deficiency. **FIGURE 11.** Lateral view of the miniplate 7 days after installation. **FIGURE 12.** Lateral view of the interocclusal space obtained after skeletal anchorage with miniplate. **FIGURE 13.** Lateral view of the final rehabilitation.
maxillary teeth (Nos. 4, 3 and 2) was noted, which limited space for prosthetic rehabilitation (Figure 10a and b). Thus, we chose to perform orthodontic intrusion of maxillary posterior teeth using the skeletal anchorage system with a miniplate anchored to the zygomatic bone.

Prior to the surgical and orthodontic interventions, a panoramic radiograph was taken. As part of the miniplate installation, presurgical intra- and extraoral antiseptic measures were performed, followed by infiltrative local anesthesia. Miniplates were attached to the zygomatic bone through a linear incision and total mucoperiosteal detachment. Subsequently, the miniplate was positioned and fixed to the bone. Ten days after surgery, orthodontic force was applied through an elastic band attached to the orthodontic element of No. 3. This procedure was performed in the same session as removal of the suture (Figure 11). At the end of the surgical procedure, a computerized tomography scan was performed to verify the correct installation of the miniplate. The level of intrusion required was obtained after 5 months of orthodontic movement (Figure 12). Regaining the interocclusal space was achieved in the vertical and buccolingual dimensions (Figure 13).

**DISCUSSION**

An irregular occlusal plane due to prolonged tooth absence usually presents a large occlusal interference and invasion of the interocclusal space. These deleterious effects of tooth loss, if not rehabilitated immediately, will require an interdisciplinary rehabilitation plan for denture construction and, often, conservative orthodontic interventions. With the constant progress in the use of anchorage devices (TADs, mini-implants and miniplates), effective tooth movement can be produced for rehabilitation.

Several techniques for management of the occlusal plane prior to prosthetic rehabilitation are now available in orthodontics. The movement provided by TADs allows the immediate application of orthodontic force,9 requires minimal patient cooperation, provides maximum anchorage control, and reduces treatment time.9 This prosthetic rehabilitation and tooth movement can be implemented in isolation and at different locations of the mandibular and maxillary arches, to solve problems related to poor tooth positioning in all anteroposterior, transverse, and vertical dimensions.4,16 Mini-implants and miniplates have been used frequently for prosthetic rehabilitation of overerupted and migrated teeth.18,20,21 For anterior teeth, these devices have been used for intrusion of the lower incisors, for correction of increased overbites, and to obtain a physiological guide protrusion.16 However, it is essential that orthodontic mechanics be adopted prior to oral rehabilitation with TADs. Moreover, the patient should be informed that treatment could take longer to finish as light forces of 10 g per root should be used.12 The literature offers a variety of starting points for the initial loading of these devices, and some reports claim that they may even allow immediate loading.22 In the case of miniplates, these devices can receive loading immediately after soft-tissue healing.16

The choice to use mini-implants or miniplates is determined by the number of teeth that must be moved simultaneously.9,17 However, during orthodontic treatment, the unwanted tooth movement should be managed and controlled.23 Patients requiring more intensive treatments may require different vector strengths, or the roots that are experiencing higher anchoring forces may need to be changed.24 Miniplates are a safe and effective method to prevent the movement of posterior teeth that are normally positioned in the zygoma. These devices have become incorporated into orthodontic treatment due to extensive prior use in stabilizing facial fractures and osteotomy segments. They are available in various sizes and shapes, can adapt to most surfaces, and can be installed in the office environment. The main advantage of miniplates vs miniscrews is that there is no interference with tooth movement. Moreover, the use of multiple screws provides a safe anchorage, which is beneficial in patients with thin cortical bone.9

The anchoring mechanics used for mini-implants depend on the initial mechanical stability and the quality and quantity of the load.25 The implications of the morphofunctional and biomechanical strategies needed to achieve the desired goals are also important. There are differences between the intrusion of posterior teeth in patients without tooth loss with an anterior open bite and the molar intrusion in patients with loss of antagonists. In the latter case, stabilization occurs through the rehabilitation of occlusal tooth antagonists.27–29

Prosthetic rehabilitation should be performed as soon as possible after orthodontic mechanics are completed, with an emphasis on creating an ideal occlusion and maxilla-mandible position to exclude the possibility of recurrence.4,10 In this case series, all patients obtained positive follow-up assessments at 3 years after prosthetic installation, in terms of the preparation required prior to the installation of dentures and the function of the prostheses. Furthermore, the 3 cases were stable in terms of bone occlusion and functionality.

**ABBREVIATIONS**

ILAPEO: Latin American Institute for Dental Research and Education

TAD: temporary skeletal anchorage device

**REFERENCES**


9. Faot et al.