Implants to Improve Removable Partial Denture Retention

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LEARNING OBJECTIVES:
After reading this article, the individual will learn:
• Clinical advantages and disadvantages of implant-retained removable partial dentures (IRRPDs).
• A clinical technique for improving partial denture retention by using an IRRPD.

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INTRODUCTION
In a partially edentulous patient presenting with a free-end condition, the different resiliencies of alveolar mucosa and periodontal ligament of abutment teeth can produce rotation of the partial removable denture base around the theoretical fulcrum line determined by the most distal rests.1 If optimal stabilization and retention are not achieved, this rotation can negatively affect patient comfort and mastication. Further, force equilibrium is necessary in the removable partial denture (RPD) framework to avoid the excessive lever arm trauma in abutment teeth, especially when they are few in number and are in the anterior region.2

The incorporation of the implant-supported partial denture in prosthodontics offers improvements related to patient satisfaction and masticatory capacity compared to the conventional RPD.3 However, medical contraindications and the lack of ideal bone height and width needed for implant installation limit this therapy option.4 When additional surgery necessary for rehabilitation with a fixed implant-supported partial denture is not a possible option, an implant-retained removable partial denture (IRRPD), also called a partial overdenture, can be proposed as a reliable treatment for partial edentulism. The IRRPD may cause some discomfort due to the presence of a metallic major connector, and it will require periodic maintenance of the attachment retainers. However, this treatment option provides rehabilitation in a cost-effective manner.4

The objective of IRRPD treatment is to place the implants in strategic positions that at least provide vertical stabilization of the partial denture by avoiding rotations.5 Implants placed distally (ideally in the area of the second molar) would
effectively change Kennedy Class I or II cases to Class III situations,\textsuperscript{6} which have a better biomechanical outcome. Therefore, fewer implants can preserve the long-term status of remaining teeth by this biomechanical improvement.\textsuperscript{7}

With the aim of offering a RPD rehabilitation with improved biomechanical aspects, the current case report describes a maxillary rehabilitation with an IRRPD, in which 3 single implants with o-ring retainers allowed the removal of visible metal clasps and helped preserve the long-term status of the remaining 2 incisor teeth and one molar tooth.

**CASE REPORT**

A 58-year-old partially edentulous woman was referred to the Dentistry Clinic of Piracicaba Dental School, Campinas State University, Brazil. The patient revealed no systemic disease, symptoms of temporomandibular dysfunction, dental pain or xerostomy, and presented with satisfactory oral hygiene. The patient wanted to retain her remaining teeth; her primary complaints were poor retention and aesthetics of the existing maxillary prosthesis as well as a general reduced masticatory function.

The patient was classified as Kennedy Class II modification \textsuperscript{1} in the maxilla with large edentulous areas, presenting with only the right second molar tooth (No. 2) and the left central and lateral incisors (Nos. 9 and 10) (Figure 1). These teeth were without caries, mobility, or active periodontal disease at clinical and radiographic examinations. The ridges were atrophic and the panoramic radiograph showed maxillary sinus pneumatization projected on premolar and molar regions in both sides (Figure 2). In the mandible, the patient was classified as Kennedy Class I and had a distal caries lesion on the right canine (No. 27) that was restored with composite.

The necessity for gingival tissue replacement and the patient’s refusal to accept sinus lift surgery led to the rejection of the option involving bilateral sinus lift and placement of 7 to 10 implants in the maxilla for fixed rehabilitation with an implant-supported partial denture. Therefore, the proposed treatment was a conventional RPD rehabilitation associated with a few strategically positioned implants for biomechanical improvement with more predictable aesthetics. For the mandible, the plan was to replace the existing RPD; to achieve the patient’s aesthetic desires, a partial removable denture with aesthetic resin clasps was proposed.

Three external hexagon implants (TitamaxEX [Neodent]) were placed in the maxilla using the 2-stage technique with torque of 45 N. In the region of the right central incisor (No. 8) one 3.75 x 13 mm implant was placed using a palatal approach. In the regions of the left first premolar (No. 12) and second molar (No. 15) 2 3.75 x 11 mm implants were placed. These implants were positioned due to bone availability, and biomechanical and aesthetics benefits. The implants in the regions of teeth Nos. 8 and 12 were placed to provide the anterior retention of the RPD, eliminating the need for metal clasps on the remaining anterior incisors. The implant in posterior region of the left second molar (No. 15) provides the distal support and retention at the free-end, improving the biomechanical behavior of the RPD by the elimination of the lever arm movement due to mucosa resilience, which helps to preserve the status of the remaining teeth (Figure 3).

The implants were uncovered 6 months following their
placement and the remaining teeth were adjusted to receive the IRRPD. An occlusal saddle was made on the molar tooth, and cingulum saddles were made on the incisor teeth and on all mandibular teeth after addition of composite to increase the lingual contour. In the mandible, the buccal retention was provided by composite increments on the buccal face of the right canine (No. 27) due to its lingual inclination. Both final impressions were made by a selective-pressure single procedure with thermoplastic compound (Kerr [Kerr Corp]) and low-viscosity elastomer (Impregum [3M ESPE]).

The maxillary metal framework was made avoiding the coverage of implant healing caps, which facilitates the o-ring capture. The mandibular framework was made by conventional methods; however, the Roach clasps on the buccal face of the canines were cut away after the aesthetics and functional try-in (Figure 4). The maxillary denture received a conventional poly (methylmethacrylate) resin (Vipi Wave [VIPI]) and the mandibular denture was made with polyamide resin (Flexite [Flexite]).

After the occlusal adjustments, the ball attachments (Neodent) were installed with the manufacturer’s recommended torque of 32 N, and the capture of o-ring retainers (Neodent) was accomplished one by one directly in the mouth (Figure 5) until all 3 were fixed in the partial denture (Figure 6). The patient was instructed regarding removal and insertion, hygiene routine, and maintenance regimen. Both partial dentures were placed, presenting satisfactory aesthetics without the appearance of metal clasps (Figures 7 and 8).

**DISCUSSION**

Since the first reports regarding the association between RPDs and implants8-10 this treatment option has been related in clinical reports11-16 and evidenced by in vivo5,6 and in vitro7,17,18 experiments. However, strategic implant placement to improve biomechanical and aesthetic conditions by eliminating metal clasps has been presented in few clinical reports.15,16 In this clinical case, the placement of 3 implants providing additional anterior and posterior retention achieved these benefits in a partially edentulous patient presenting with only 2 incisors and one remaining second molar in the maxilla. Although in this
case a new RPD was fabricated, this treatment process can also be used with a preexisting removable partial denture. This proposed design provided partial overload relief on abutment teeth, which could improve the periodontal health and long-term prognosis. Also, the presence of the second molar was a clinical advantage, avoiding the placement of one more implant on the posterior right maxillary side; implants placed in the posterior regions might necessitate further augmentation procedures such as sinus floor elevation and vertical and/or horizontal ridge augmentation. The overlay grafts require good bone quality and quantity that is usually achieved only from skullcaps, iliac crests, or at bone banks, requiring specific technique and procedures that result in increased cost and time, and may affect predictability.

The use of a conventional rehabilitation with a partial removable denture in this patient would represent an adverse mechanical situation due to high lever force on the lateral incisor abutment tooth, mainly due to the presence of an unsatisfactory metal post in this tooth. Therefore, the implants placed at the regions of the left first premolar and second molar provide relief of lever effect on the lateral incisor tooth by the elimination of the free-end condition, transforming this maxillary arch to a Kennedy Class III modification.

Many clinicians avoid the association between RPDs and implants because the lever effect of RPDs over the implant may expose them to unfavorable forces that can be harmful to osseointegration. The RPD supported by structures with different resilience levels requires that the occlusal force be equally distributed among mucosa, teeth, and implants. Therefore, the use of resilient attachments on implants, captured in function and after dynamic impression, allows little vertical and horizontal movement which facilitates the dissipation of occlusal force to the other structures. Another way to prevent the lateral force transmission to implants is the use of a major connector with adequate flexural and torsion strength; in this clinical case a double bar was used.

The attachment system must provide appropriate retention, satisfactory durability, and easy maintenance. Also, the height of the attachment system is an important factor to be considered during treatment planning. It should be as short as possible to minimize the oblique forces which may cause failure due to screw loosening or even fracture. In this case, a mini-ball attachment system was used due to its lower height and the resilience provided by the rubber retainer; however, any other resilient attachment may be used, such as ERA (Sterngold) or Locator (Biomet 3i) systems. Regardless of the attachment system, it is recommended to exchange the rubber retainers every 6 months or when the patient perceives the lack of retention. The useful life of the retainers may be prolonged if the direction of insertion of IRRPD remains unique, with all the attachment retainers parallel to each other and in the same insertion direction as the metal framework.

The advantages of implant therapy in this case include preservation of alveolar bone, prevention of overload on the remaining teeth, improvement of proprioception, and removal of visible metal clasps. The advantages of RPD rehabilitation include lower cost, maintenance of labial support, simplified oral hygiene, psychological advantages for patients who do not want to see themselves as totally edentulous, the future option to easily convert to fixed implant-supported partial dentures or overdentures, and relatively simple clinical and laboratory procedures. Also, the IRRPD offers the minimum number of implants required and reduced number and length of office visits.

The IRRPD has been shown to be a reasonable treatment with satisfactory aesthetics and re-establishment of physiologic function in a more economical and less invasive manner, suggesting that in certain cases the temptation to use fixed implant-supported restorations may result in overtreatment. That is, the surgical procedures to which the patient will be submitted will not necessarily result in greater patient satisfaction, in terms of cost/benefit, than the IRRPD rehabilitation. However, the main disadvantage of this alternative treatment is the absence of clinical outcomes and biomechanical in vitro tests for
extreme edentulism conditions; additional clinical data will provide more information about the consequence of this treatment on specific teeth, implants, and components. Therefore, more studies are needed, with longer follow-up periods for specific situations to ensure clinical predictability. Further, adequate oral hygiene and maintenance recall protocol are mandatory for the long-term success of IRRPD treatment.

CONCLUSION
IRRPDs can improve the biomechanics and aesthetics of conventional RPDs, even in extreme edentulism cases. In selected cases where implant-supported fixed prostheses are not a viable option, IRRPDs can achieve the patient's and clinician's objectives in the most cost-effective and least invasive manner. Additional clinical data are needed to verify the clinical predictability of this treatment for specific situations.

REFERENCES
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**POST EXAMINATION QUESTIONS**

1. In the case presented, implants placed in the regions of the left first premolar and second molar:
   a. Relieved the lever effect on the lateral incisor.
   b. Eliminated the free-end condition.
   c. Transformed the maxillary arch to a Kennedy Class III modification 2.
   d. All of the above.

2. Which of the following statements is TRUE?
   a. When using implant-retained removable partial denture (IRRPD) treatment, a new prosthesis must be fabricated.
   b. IRRPD treatment is more costly than a fixed implant-retained partial denture.
   c. IRRPDs require periodic maintenance of attachment retainers.
   d. IRRPDs may cause some discomfort due to a metallic major connector.

3. Resilient attachments on implants allow little vertical and horizontal movement. A major connector with adequate flexural and torsion strength helps prevent lateral force transmission to implants.
   a. The first statement is true, the second is false.
   b. The first statement is false, the second is true.
   c. Both statements are true.
   d. Both statements are false.

4. In a case such as the one presented, the attachment system must provide:
   a. Appropriate retention.
   b. Satisfactory durability.
   c. Easy maintenance.
   d. All of the above.

5. In the case presented, a mini ball attachment system was used. However, any other resilient attachment may be used.
   a. The first statement is true, the second is false.
   b. The first statement is false, the second is true.
   c. Both statements are true.
   d. Both statements are false.

6. When using IRRPDs it is recommended to exchange the rubber attachment retainers:
   a. Every month.
   b. Every 3 months.
   c. Every 6 months.
   d. Every year.

7. Which of the following statements is TRUE?
   a. IRRPDs can improve the biomechanics and aesthetics of conventional removable partial dentures.
   b. IRRPDs always require metal clasps for retention.
   c. The main disadvantage of IRRPDs is the lack of clinical outcomes and biomechanical in vitro tests for extreme edentulism conditions.
   d. Both a and c are true.

8. IRRPDs offer the future option of converting to fixed implant-supported partial dentures. The height of the attachment system used with IRRPDs should be as high as possible to minimize oblique forces.
   a. The first statement is true, the second is false.
   b. The first statement is false, the second is true.
   c. Both statement are true.
   d. Both statements are false.
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