# Use of Dental Implants to Improve Unfavorable Removable Partial Denture Design

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**Abstract:** *This study aimed to determine whether the use of a limited number of dental implants, with no rigid connection between implants and teeth and as few as possible prosthetic element requirements, is a viable solution for improving unfavorable removable partial dentures (RPD) design. Fifteen partially edentulous patients with an unfavorable number and distribution of abutment teeth were treated, each with a limited number of implants, from 1997 to 2004, resulting in an improved RPD design. Implant survival rate was 100%, and prosthetic complications were minor. All patients reported great satisfaction with the partial dentures and good chewing efficiency. The results indicate that the use of dental implants to improve unfavorable RPD design is a viable and cost-effective treatment modality.*

There are several ways to restore function and esthetics in partially edentulous patients.[1] A fixed partial denture (FPD) supported by adjacent teeth can be constructed, but in situations of large edentulous areas, a tooth-supported long span FPD could fail and the entire restoration would have to be replaced because of loss of a strategic abutment tooth and lack of retrievability.

A well-constructed removable partial denture (RPD) can be an excellent treatment alternative.[2,3] Although the RPD is a valuable treatment for patients with a markedly reduced number of teeth,[4,5] many patients present with large edentulous areas, an unfavorable distribution, and too few remaining abutment teeth to provide proper retention and support for a conventional RPD. However, these same teeth may be sound and stable. A challenging situation in which treatment with an RPD is useful is classified as Kennedy Class 2. In this situation there are abutments only on one side of the arch. If treated conventionally, the long lever arm to the unilateral edentulous side results in an unstable removable prosthesis.

The use of dental implants to improve RPD design, with no rigid connection between implants and teeth and as few as possible prosthetic element requirements, is a viable solution for these patients.[6] (Figures 1 through 7). A limited number of strategically placed dental implants in conjunction with the remaining natural teeth can establish a favorable RPD design by significantly reducing the effort arm and improving the fulcrum line position. This prevents rotation toward the tissue during function around the fulcrum line, which is created between the abutement teeth closest to the edentulous area. In these large edentulous areas, bone is preserved as a result of the remodeling stimulus around the implants,[7-10] and repeated relining of the denture to restore posterior support is prevented.

When an implant or several implants are used to support the RPD, additional retention is achieved and the need for buccal retentive arm-clasps is avoided in the esthetic zone.[8-14]

Rigidity of the major connector resists flexing and torque[11] that would otherwise be transmitted to abutment teeth and implants in the form of leverage. An implant-supported FPD in partially edentulous patients presents the problem of creating a prosthesis that must adapt to existing natural teeth and reproduce esthetics and phonetics in the reduced alveolar ridges. The result often is an unfavorable crown/implant ratio. Contraindications for such a prosthesis can be based on cost involved with implant treatment, as well as anatomic factors such as the mandibular nerve or extension of the maxillary sinus. The purpose of the study is to evaluate the treatment outcome of RPDs in partially edentulous patients treated with dental implants. The implants act as additional supporting abutments to improve RPD design.

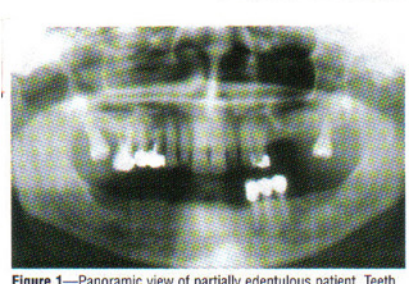

**Figure 1**—Panoramic view of partially edentulous patient. Teeth Nos. 33 through 35 are clinically sound and periodontially stable.

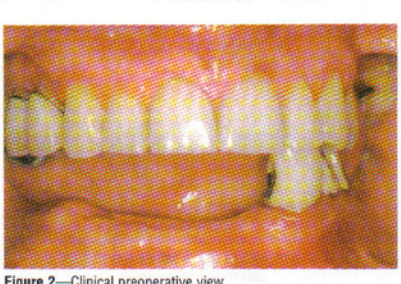

**Figure 2**—Clinical preoperative view.

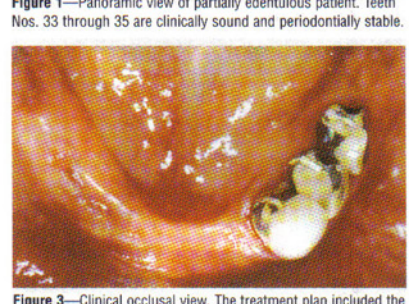

**Figure 3**—Clinical occlusal view. The treatment plan included the insertion of 2 implants in the area of teeth Nos. 43 and 45 to improve the support and retention of an RPD.

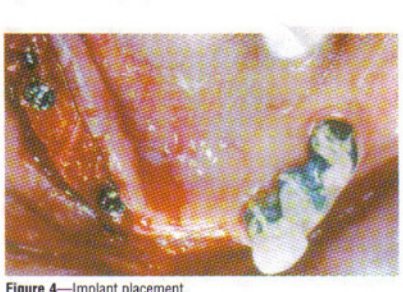

**Figure 4**—Implant placement.

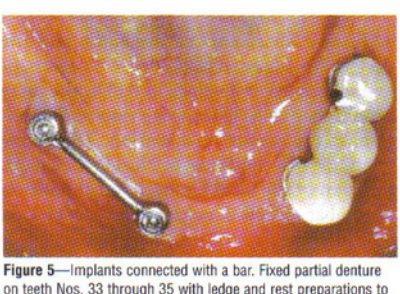

**Figure 5**—Implants connected with a bar. Fixed partial denture on teeth Nos. 33 through 35 with ledge and rest preparations to accommodate reciprocal arms and rests of an RPD.

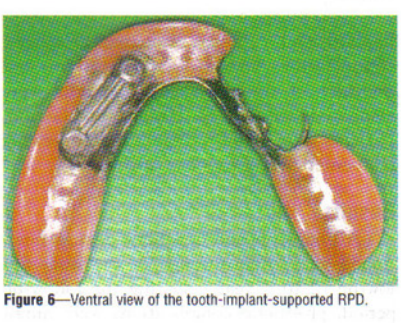

**Figure 6**—Ventral view of the tooth-implant-supported RPD.

## Materials and Methods

Fifteen partially edentulous patients with 33 dental implants and RPDs participated in this study. Implants were placed to improve unfavorable RPD design, which resulted from unfavorable teeth distribution, biomechanical considerations, or esthetic or periodontal challenges. The length of each implant was 10 mm or more and the diameter was 3.7 mm or more. Ball attachments and bar design connections were used with the implants to support the RPDs.

All patients were followed up every 6 months. The presence of clinical signs of mobility and gingival inflammation around implants and teeth was evaluated. Prosthetic complications such as loss of retention and fractures of the prosthetic elements were evaluated, as well as patient satisfaction. Patients were asked to report about chewing convenience and stability of the RPD.

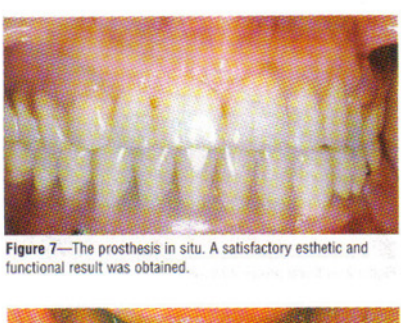

**Figure 7**—The prosthesis in situ. A satisfactory esthetic and functional result was obtained.

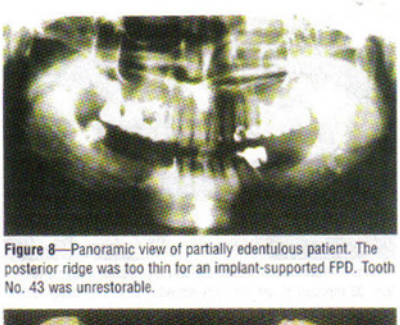

**Figure 8**—Panoramic view of partially edentulous patient. The posterior ridge was too thin for an implant-supported FPD. Tooth No. 43 was unrestorable.

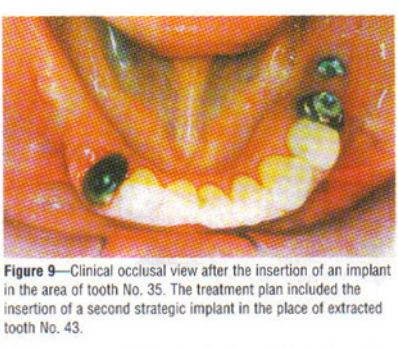

**Figure 9**—Clinical occlusal view after the insertion of an implant in the area of tooth No. 35. The treatment plan included the insertion of a second strategic implant in the place of extracted tooth No. 43.

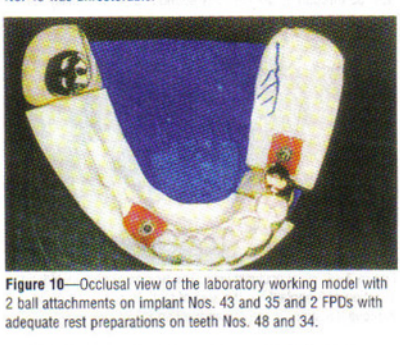

**Figure 10**—Occlusal view of the laboratory working model with 2 ball attachments on implant Nos. 43 and 35 and 2 FPDs with adequate rest preparations on teeth Nos. 48 and 34.

## Results

All implants and prosthetic devices functioned successfully throughout the study follow-up (2 to 7 years). During the follow-up period, prosthetic complications were minor and included only 1 rest rupture. No clinical signs of mobility or gingival inflammation around implants or teeth were reported. Patients reported good chewing ability and stability of the prosthetic devices.

## Discussion

In this article, a simplified treatment modality is presented, in which a limited number of strategically placed implants serve to improve an otherwise unfavorable functional or unesthetic RPD design.

According to the proposed design, the implants and their relative prosthetic elements (infrastructure) should be regarded as additional abutments of the RPD, and the design should preserve the basic biomechanical principles of leverage of RPDs, the same principles that help to locate rests and retention on the remaining dentition. The placement of the implants is chosen based on function of the ideal biomechanical position of the bar or ball attachment for the chosen RPD design.

***When an implant or several implants are used to support the RPD, additional retention is achieved and the need for buccal retentive arm-clasps is avoided in the esthetic zone.***

When placing an implant, if there is a situation with doubtful prognosis for the natural dentition, the clinician should take into account a future FPD or complete denture supported by implants. The tooth-tissue-supported RPD tends to rotate toward tissue during function around the fulcrum line created between the abutment teeth closest to the edentulous area. Strategically placed dental implants can help to improve the position of the fulcrum line, eliminating the need for large areas of tissue support.

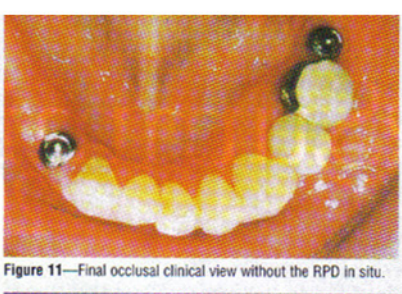

**Figure 11**—Final occlusal clinical view without the RPD in situ.

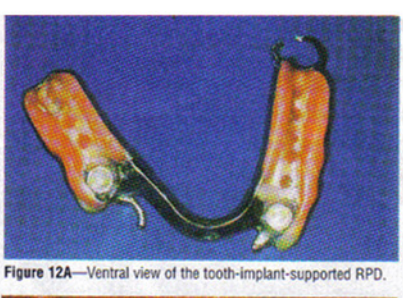

**Figure 12A**—Ventral view of the tooth-implant-supported RPD.

**Figure 12B**—Dorsal view of the tooth-implant-supported RPD.

**Figure 13**—The lower RPD in situ. A satisfactory esthetic and functional result was obtained.

***If there is a situation with doubtful prognosis for the natural dentition, the clinician should take into account a future FPD or complete denture supported by implants.***

Implant location is of great relevance because implants are direct retainers that assist in the retention of the denture against dislodging forces, and also can serve as indirect retainers that assist in stabilizing the denture against horizontal movement.The purpose of the implants as stabilizing components is to distribute stresses equally to all supporting teeth without overworking any one tooth. The use of strategic implants allows clinicians to avoid the use of visible retentive elements of the RPD, providing greater esthetics.

With this method, unfavorable Kennedy Class 4, 2, and 1 conditions can be changed into favorable situations closer to a stable Kennedy Class 3 by significantly reducing the effort arm and improving the fulcrum line position (Figures 1 through 6). The result is an entirely tooth-implant-supported RPD, which guarantees comfort and permits satisfactory distribution of the occlusal forces. When an implant or a limited number of implants are used to assist in the support of the RPD, additional retention is achieved and the need for unesthetic visible retentive arm-clasps is avoided (Figures 7 through 13).

Bone is preserved in large edentulous areas as a result of the remodeling stimulus around the implants, and repeated relining of the denture to restore posterior support is prevented. In cases with complete maxillary denture opposing a bilateral distal extension RPD, undesirable degenerative changes (described in the dental literature as *combination syndrome*)[12] are prevented or minimized by the placement of an implant to support each distal extension segment of the RPD.[13-15] This effectively limits rotation of the prosthesis toward tissue during function around the fulcrum line. Posterior occlusal vertical support, in this instance, is enhanced.

The implant-connected prosthetic elements proposed, such as cross-sectional round bars, convergent milled bars, and ball attachments, prevent rigid interlocking of the RPD to the infrastructure. This permits a limited degree of freedom of the denture during function. The design proposed in this article requires as few as possible prosthetic elements and avoids rigid prosthetic connection of natural teeth and dental implants. This prevents implant overload during function and risking of intrusion of natural teeth.[16-19]

Implant overload is avoided by keeping the force location close to the center of the implants with the use of low prosthetic elements, such as bars and ball attachments.

Lateral stabilization of the RPD, thanks to rigid major connector design and reciprocal arms, with passive fit of the bar, avoids jiggling forces on implants and teeth. Rigidity of the major connector resists flexing and torque that would otherwise be transmitted to abutment teeth and implants in the form of leverage. In this way excessive lateral forces and bending moments will be avoided from the osseointegrated implants, which do not possess the resiliency provided by a peri-implant soft-tissue attachment such as the periodontal membrane in natural teeth.

Patients in this study were able to maintain good plaque control around implants and teeth with no clinical signs of gingival inflammation, and they expressed great satisfaction with the RPDs. No prosthetic complications were reported during the study follow-up. Preprosthetic periodontal health establishment with strict hygiene recall and maintenance program are essential tools to achieve a good long-term prognosis. Esthetics, phonetics, and lip support were restored successfully, especially in the partial edentulous maxillae cases, because of the acrylic flange of the RPD.

The author's analysis of the cost of implants used in conjunction with RPDs compared with implants used in conjunction with FPDs generally shows that patients save more than 50% on treatment costs when RPDs are used. The longer the multi-unit implant-supported FPD required, the more money is saved with the proposed RPD approach. Cost becomes even more relevant when bone augmentation procedures are required in conjunction with implant placement. The present data gives great validity to this cost-effective treatment modality, though more prospective and long-term clinical studies are required to evaluate this approach.

## Conclusion

This article described a cost-effective clinical approach where dental implants were successfully used to improve unfavorable RPD design in patients with a markedly reduced number of teeth. The proposed design precludes rigid connection between implants and teeth and requires as few as possible prosthetic elements.

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