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Posterior Implants for Distal Extension Removable Prosthesis: A Retrospective Study



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Common complaints associated with the Kennedy Class I (bilateral free end) and Class II (unilateral free end) removable partial denture situations are lack of stability, minimal retention, and unesthetic retentive clasping. Some of the same complaints have been reported for implant overdentures with only anterior implants. Starting in 1995, 10 of these patients were treated at the University of Washington with posterior osseointegrated implants to provide stability and/or retention of the removable prostheses, eliminating the need for clasps when possible. This article describes implant alternatives and prosthesis designs and presents a follow-up clinical evaluation of at least 1 year consisting of patient satisfaction, radiographic examination, and soft tissue health. Two groups were evaluated. Group 1 included patients whose implants were used as vertical stops for mandibular distal extension prostheses. Care was taken to ensure that the implants were not loaded laterally by creating a single-point contact at the center of a modified healing abutment. In these cases, sufficient retention was available from the anterior teeth and/or implant abutments. Group 2 included patients whose implants required retention because of lack of adequate tooth abutments. In those cases, a resilient type of attachment was used, which allowed for a small divergence from the path of insertion. Results indicated consistent increased satisfaction in all patients, minimal component wear, no radiographic evidence of excessive bone loss, and stable peri-implant soft tissues. (Int J Periodontics Restorative Dent 2003;23:353-359.)

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The use of osseointegrated implants as abutments for fixed partial dentures is a predictable restorative alternative for the distal extension edentulous area.¹⁻⁵ It is well-documented that, even in cases where atrophy of either the maxilla or mandible is present, a number of different procedures can be performed to optimize the implant recipient site. Ridge augmentation, distraction osteogenesis, or nerve lateralization can be performed for the mandible, and distraction osteogenesis, sinus grafting, or ridge augmentation can be performed for the maxilla.⁶⁻¹⁰ However, it should be recognized that these procedures involve additional surgery, time, and cost, and often, patients who are not fully committed to these involved procedures are still unhappy about the problems associated with their distal extension situation.

Common complaints associated with the distal extension removable partial dentures (RPD) are lack of stability, minimal retention, unesthetic appearance of clasps, and discomfort upon loading.¹¹ One of the most common problems associated with

the distal extension partial denture, particularly the mandibular distal extension opposing a maxillary complete denture, is Combination Syndrome, which is characterized by downgrowth of the maxillary tuberosities, papillary hyperplasia, resorption of the premaxilla, overeruption of the mandibular anterior teeth, and resorption of the posterior mandible.^{12,13} These signs can be found in 24% of the population wearing a maxillary complete denture opposing a distal extension partial denture.¹⁴ Controversy exists regarding the potential development of Combination Syndrome in those patients using an implant-supported overdenture with two anterior implants, since this type of restoration may act as a bilateral distal extension situation.¹⁵⁻¹⁹ A posterior implant stop would most likely eliminate the potential for this to happen.

To date, only single case reports considering implants in distal extension RPDs can be found in the literature.^{20,21} Therefore, the purpose of this study was to retrospectively evaluate patients treated with implant-assisted RPDs from 1 to 4 years.

Method and materials

Ten patients presenting with a distal extension edentulous situation (either unilateral or bilateral) had been treated with posterior implants (16 total implants) at the University of Washington's Graduate Prosthodontics Program, Seattle, since 1995. After a comprehensive diagnostic workup of these patients,

which included panoramic radiographs and in some cases computerized tomograms, diagnostic setups, and/or wax-ups, patients were given alternatives of ridge augmentation and/or sinus elevation procedures and implant-retained fixed partial dentures, conventional RPDs, or the implant-assisted removable prostheses.

Among these patients, two were edentulous in both arches and an implant overdenture was the treatment planned for the mandibles. An implant was to be placed distal to each mental foramen to serve as a vertical stop for the implant-supported, implant-retained overdenture. All implants were placed as distal as the patient's anatomic limitations allowed, selecting the longest implant possible. Fourteen of the 16 implants placed were submerged using the two-stage protocol described by Brånemark, and two were single-stage ITI implants (Straumann).

With the exception of one implant, all implants integrated successfully. Three months were allotted before the replacement of the lost implant, resulting in successful osseointegration. After 3 to 4 months from placement of the implants, a second-stage surgery was performed, and healing abutments were placed. The patients used their prostheses for 1 to 4.5 years, with a mean time in function of 2.52 years.

Patients were divided into two groups. Group 1 included those patients where the implants were used solely as vertical stops. In these patients, sufficient retention was

available from the anterior teeth abutments or implant abutments using attachments, milled surfaces, and guide planes. The posterior implants were used solely as vertical stops to enhance the stability of the prosthesis. Group 2 included those patients where sufficient retention was not available from the existing abutment teeth (Figs 1 and 2). A retentive element was added to the implants using a resilient attachment (OSO, Attachments International; Zaag, Preat; Hader Bar and Clip, Attachments International; or ERA, Sterngold). An example of this situation is patient six, where it was decided that the implant would hold the retentive element because a minimal interocclusal distance did not allow for a resilient attachment to be placed on the distal aspect of the metal-ceramic retainers of the mandibular canines (Fig 3). Adequate guide planes and rests on the natural teeth abutments are critical for retention and stability for this prosthesis design (Figs 4 to 8). Group 1 included five men with a mean age of 68.8 years. Group 2 included four women and one man and had a mean age of 56.4 years.

For group 1 (patients using the implants solely as vertical stops), healing abutments were used as the definitive supporting element. Following the construction of the removable prostheses, and prior to their insertion, the healing abutments were torqued to 20 Ncm and their heads polished to create a dome shape in the attempt to have a single point of contact. This surface was then recorded on the



Fig 1 Group 2 patient at initial presentation.



Fig 2 Implants placed to plan for contingency of a fixed type of restoration.



Fig 3 OSO type of attachments in place. Retention is placed in the implants because of inadequate interocclusal space at the tooth abutment.



Fig 4 (left) Adequate guide planes and rests are essential in cases where implants are used as attachments.



Fig 5 (right) Prosthesis in place.



Fig 6 Clasless prosthesis provides an esthetically pleasing result.



Fig 7 Anterior view of the prosthesis in situ.



Fig 8 Prosthesis shows short flanges, since extension is not needed for stability.

undersurface of the partial distal extension base using a light-activated resin reline material (Astron LC, Astron Dental). For group 2 (patients where the implant included a retentive element), the components were added to the framework intraorally at the try-in appointment before flasking and processing.

As far as the occlusal scheme in all cases where anterior teeth were available, a mutually protected occlusion was designed. In the two patients with implant overdentures, a bilateral balanced occlusion was designed; however, the dome-shaped healing abutments, along with the point contact picked up with

the resin, offered minimal lateral loading of the implants.

Patients were recalled at least 1 year after insertion and evaluated in three different areas: patient satisfaction; clinical evaluation of the implant, looking at the condition of the visible implant components (healing abutments or attachments)

Table 1 Clinical assessment of groups 1 and 2*

| Patient | Age (y) | Location | Implant length (mm) | Time in function (y) | Complications |
|----------------|---------|----------|---------------------|----------------------|--|
| Group 1 | | | | | |
| 1 | 71 | Mandible | 10,10 | 4.5 | Pitting |
| 2 | 60 | Mandible | 8,8 | 2.2 | None |
| 3 | 86 | Mandible | 8,10 | 3.4 | Pitting |
| 4 | 59 | Mandible | 8,10 | 3.1 | Screw loosening/ framework fracture |
| 5 | 68 | Maxilla | 13 | 2.0 | Screw loosening |
| Group 2 | | | | | |
| 6 | 58 | Mandible | 13 | 1.0 | None |
| 7 | 46 | Mandible | 12,12 | 2.1 | None |
| 8 | 55 | Maxilla | 13,13 | 1.2 | None |
| 9 | 62 | Maxilla | 10 | 1.4 | None |
| 10 | 61 | Maxilla | 13 | 4.3 | Hyperplastic tissue |

*Group 1 = implants used as vertical stop; group 2 = implants used as retentive element.

Table 2 Radiographic assessment of groups 1 and 2 (mm)*

| Implant surface | Mean (SD) bone loss in group 1 | Mean (SD) bone loss in group 2 | Mean (SD) bone loss total |
|-----------------|--------------------------------|--------------------------------|---------------------------|
| Mesial | 0.32 (0.47) | 0.93 (0.64) | 0.61 (0.62) |
| Distal | 0.44 (0.45) | 0.88 (0.34) | 0.64 (0.45) |

*Group 1 = implants used as vertical stop; group 2 = implants used as retentive element; SD = standard deviation.

and peri-implant soft tissues; and radiographic evaluation. Also, adaptation of the denture base to the implant and abutment was evaluated by placing Fit Checker (GC) on the base and verifying contact with the supporting structures. Patient satisfaction was evaluated using a questionnaire that allowed patients to grade their partial dentures according to a scale from 1 to 5, in which 1 was the least favorable.

Patients were asked to give their satisfaction level prior to and after the insertion of the implant-assisted prosthesis. To evaluate the crestal bone level, the discernible bone resorption was measured on radiographs made by means of the parallel technique. One examiner determined bone resorption using a Mitutoyo Digimatic caliper with an accuracy of ± 0.02 mm. The bone height was measured from the top of

the implant to the level of the osseous crest. The differences between the measurements were calculated, and the means were determined and compared to the control radiographs taken at insertion of the prostheses.

Data were analyzed with a one-way analysis of variance (ANOVA) and the Wilcoxon signed rank test. Differences were considered statistically significant at $P < .05$.

Results

Patient satisfaction

All patients experienced a dramatic change in satisfaction after the insertion of the new prostheses. The mean satisfaction prior to the fabrication of the new prostheses was 1.2, which dramatically increased to a mean of 5.0 after insertion of the implant-supported prostheses. The Wilcoxon signed rank test showed a significant difference between pre- and postinsertion patient satisfaction.

Clinical evaluation

At the clinical exam appointment, each patient underwent an examination of the implant components and soft tissues (Table 1). The implant components were evaluated for wear, retentive abilities, and stability. Results of this evaluation showed that two patients from group 1 (vertical stop) experienced pitting of the surface of the healing



Fig 9 (left) In group 1, abutments are polished with rubber-point rotary instruments.



Fig 10 (right) Astron LC reline resin is used to register the head of the abutment.



Fig 11 (left) Intaglio surface shows Hader retentive clips and relined surface of posterior vertical stops.



Fig 12 (right) Pitting of the healing abutment at 2-year recall.

abutments, and two of the patients in this group had abutment loosening as well. The abutments were either tightened or polished and the bases relined with light-activated resin material (Figs 9 to 12). One patient presented with a fractured mandibular overdenture framework that required refabrication of the prosthesis. The tissue evaluation consisted of visual examination of peri-implant tissues and implant mobility. Only one patient had severe inflammation that required surgical excision of the hyperplastic tissue. All other implants showed acceptable peri-implant health. No mobility was noted for any of the implants.

Radiographic evaluation

Radiographs taken pre- and postinsertion were evaluated to determine radiographic bone loss. The differences between the measurements were calculated and the means determined. Results are shown in Table 2. A one-way ANOVA showed no statistically significant difference in the level of bone loss between groups 1 and 2.

Discussion

The creation of posterior implant support for removable prostheses would appear to be an obvious

improvement over the conventional distal extension base. This study attempted to quantify the results of a small sample of this type of treatment modality. Traditional treatment for the edentulous maxilla opposing a mandibular bilateral distal extension includes a maxillary denture and a cast-metal RPD in the mandible, which does not provide a stable posterior occlusion. Adjustments involving relining of the RPD and complete denture are often needed to avoid overloading of the premaxilla and to prevent the resorptive process so often seen.

Three of the patients in group 1 (implant used as a vertical stop) presented pitting of the healing

abutment surface, and when the intimate fit between the underlying acrylic resin of the partial denture and healing abutment was evaluated using disclosing media, space was evident. The potential for increased movement of the prostheses could lead to excessive loading of the premaxilla. The treatment in these instances consisted of polishing the head of the healing abutment with rubber points and relining the contact area with light-activated/autopolymerizing resin to eliminate rotational movement of the prostheses.

Two patients in group 1 initially experienced healing abutment loosening. These abutments were re-torqued at 20 Ncm using an electronic torque controller. One of these patients had an implant overdenture (bar and clip) that fractured through the framework casting, requiring a new prosthesis. With currently available two-piece healing abutments that engage antirotational features, there may be a decrease in loosening of the abutments. Also noted was pitting of the surface of the titanium healing abutments. These were repolished and the denture bases relined and adjusted for one-point contact. Since this clinical use was not the original intent for these abutments, it may be more prudent to evaluate other alloys or frame designs that may stand up to the rigors of masticatory function to better maintain prosthesis support.

An obvious advantage of implant-assisted prostheses is that the extension of the bases can be reduced, since the implant provides

the same stability as a terminal abutment would in a Kennedy Class III situation. The altered cast impression, a standard technique for maximizing posterior support in the Class I situation, can be omitted as well.

Even though the anteroposterior implant position is not as critical as in those cases planned for a fixed restoration, ideally the load should be along the long axis of the implant to ensure long-term success.^{22,23} On the other hand, it would be advisable to plan for adequate placement, allowing for the contingency of the patient deciding to be restored with a fixed restoration in the future.

The mean radiographic crestal bone loss noted in this study was 0.63 mm. Crestal bone loss has been reported to be of greater magnitude and to occur with greater frequency during the first year, averaging 1.5 mm. Bone loss averages 0.1 mm per year in subsequent years.¹

Conclusions

Within the limitations of this retrospective study, it may be concluded that:

1. The use of osseointegrated implants on distal extension removable prostheses resulted in dramatically increased patient satisfaction.
2. Patients exhibited healthy and stable peri-implant tissues as well as edentulous ridges.
3. Radiographic bone loss was within normal limits.

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