Implant-enhanced removable partial denture treatment

John F Carpenter presents a case report illustrating the retrofit of an existing removable partial denture with implants

We are all familiar with the science and great success of implant osseointegration. A multitude of articles and lectures have demonstrated the merits of fixed implant prosthodontics for the partially edentulous patient. There is, however, a paucity of studies discussing the utilisation of implants with removable partial dentures (Mijiritsky E, 2007).

This article describes one of these often-neglected patients who is partially edentulous and does not desire a fixed prosthetic solution. Treatment of this type of patient has been a major growth area of my practice. Demographic studies show a population growth in ageing baby boomers who have maintained many of their own teeth (Douglass CW, Shih A, Ostry L, 2002; Douglass CW, Watson AJ, 2002; Wöstmann B et al, 2005). Years ago, this age group was often fully edentulous but is now partially edentulous.

The advantages of a fixed implant restoration are numerous and patients often perceive them as actual body parts. However, the disadvantages of the construction of a fixed implant restoration option include anatomical challenges, such as proximity to vital structures and lack of bone. While many of these challenges can be overcome, not all patients are willing, for example, to undergo additional surgeries to grow bone. Bioengineering challenges of fixed implant restorations often preclude their use. In cases of excessive interocclusal space, a removable restoration puts less stress on the implant abutments and is often more aesthetic; a removable partial denture can make use of the acrylic denture base to support and enhance facial aesthetics in a non-surgical manner.

It has been my experience when discussing the option of fixed implant restorations requiring extensive bone grafting that the patient often asks for alternative treatment options. Patients often choose the less challenging removable option. Many reasons exist, including the following:
1. Financial limitations
2. Emotionally, patients are often unable to commit to additional surgery with associated morbidity
3. Patients’ unwillingness to commit to the six months of additional time needed for bone augmentation to heal.

Removable partial dentures (RPD) can be greatly enhanced by the addition of implants. Many of the problems with conventional RPDs can be overcome with the placement of one or more strategically positioned implants. These enhanced RPDs have been called implant-assisted removable partial dentures (IARP) (Schneid T, Mattie P, 2008), implant-retained partial overdentures (IRPOD) (Chikunov I, doan P, Văhidi F, 2008) and implant-supported assisted removable partial dentures (IARP) (Ohkubo C et al, 2008). There are many advantages to implant-enhanced RPD (IERPD) versus conventional RPD (see Table 1 overleaf).

A major advantage of implant-enhanced RPD as compared to a fixed implant restoration is that separate bone augmentation surgery is rarely needed. A small ‘island of bone’ is all that is required to anchor the implant fixture. Forces on the implant fixtures are much less in an IERP situation compared to a fixed implant restoration. Multiple long, wide and exactly placed implant fixtures are required to support fixed implant restorations. Often, only one or two small implants are necessary to help enhance a RPD.

The only contraindications I have found to an implant-enhanced RPD are:
1. A patient who is unwilling to wear any kind of removable prosthesis
2. Patients who oppose any surgical procedure to place an implant or whose medical condition...
prevents them from receiving elective implant placement.

**Case presentation**

**Pre-operative assessment**

A 65-year-old male patient presented for his three-month recall visit. Although the patient had no complaints, clinical examination revealed an increase in mobility of teeth UR4 and UL4. These teeth are the abutments for his maxillary removable partial denture (RPD). This Kennedy Class I RPD had been made 10 years previously, and replaced UR7, UR6, UR5, UL5, UL6, and UL7 (Figures 1, 2 and 3). The teeth are stained from chlorhexidine rinse but are, for the most part, plaque-free.

His remaining dentition, although periodontally compromised, had remained stable excepting one incident over the past 10 years. The UR7 was a compromised tooth when the partial was first constructed, but was maintained since it offered some additional retention and stability. After four years, UR7 required extraction and a tooth was added to the existing RPD (Figure 4). This converted the partial from a Kennedy Class II design with a tripodal configuration of clasps to a Kennedy Class I design with a bilateral configuration of clasps. Kennedy Class I is the least desirable RPD and placed increased leverage forces on the abutments at UR4 and UL4 (Figures 5 and 16).

The patient understood the situation and requested something be done to prevent the loss of teeth UR4 and UL4. He wished to maintain his natural dentition for as long as possible and was quite happy with his existing partial. It is important to note that the patient was on a fixed income. Aesthetics, such as the display of clasps, was not a concern for him (Figure 1).

Several treatment options were discussed and it was mutually decided that advanced bone grafting and fixed implant options would not be entertained. Financially and emotionally, he was interested in less challenging treatment options. Construction of a new partial would do little to improve the forces on the compromised abutments.

I felt that since he was so happy and functioning well with his existing partial, there was no need to complicate things. A careful examination of his mouth and existing partial was undertaken to see if implants could be placed and whether they would enhance his existing partial.

The following three areas were evaluated to assist in making this decision:

1. Partial design analysis: the existing RPD was quite sound, utilising full palatal coverage for its major connector (Figure 3). This distributes occlusal forces over a broad area, in much the same way a snowshoe functions. All clasps, rests and guide planes were intact and functioning well. A reline had previously been performed one year earlier so poor tissue fit was not contributing to movement of the natural teeth abutments.

2. Radiographic analysis: extreme bone loss posteriorly and the pneumatisation of the maxillary sinus was noted. Even with this severe bone loss, two ‘islands of bone’ were available just distal of the UR4 and UL4 to place implants (Figure 6).

3. Interocclusal space analysis – treatment using attachments to connect a partial denture to implants is quite space-sensitive. A careful assessment of interocclusal space was done (Figure 7). Using a Boley gauge, a space of 6.5mm was recorded. For strength, 2mm of acrylic should cover the attachment; therefore, the remaining 4.5mm of space was available for the attachment. This is sufficient for multiple implant attachment systems.

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**Table 1: Advantages of an implant-enhanced removable partial denture versus conventional removable partial denture**

- Improved comfort and confidence
- Patients who were formerly unable to wear a conventional RPD are often able to wear an enhanced RPD
- Enhanced retention, support and stability
- Improved aesthetics if clasps can be eliminated
- Preservation of bone
- Better distribution of forces and elimination of damaging leverage to natural abutment teeth
- Psychological advantage to patient of preserving compromised natural teeth that are not suitable to use as abutments to support an RPD
- An increase in chewing force
- A contingency plan where implant placement may be staged and this prosthesis can be used as an interim option
Based on these findings, it was decided to place two implant fixtures and retrofit his existing RPD with implant attachments. This would enhance his partial and mitigate destructive torquing forces on his abutment teeth. An additional benefit was to provide a contingency plan for the future. If anterior teeth are lost, implants could be added and an implant bar-retained overdenture could be constructed.

**Implant placement**

A surgical guide was first constructed. This guide took into consideration the normal concerns of spacing and 3D orientation of the implant fixtures. A surgical guide for an implant-enhanced RPD must also take into consideration the path of insertion and removal of the RPD. Every effort must be made to keep the implant fixture parallel to this path. This will prevent wear of the attachment components and minimise the use of angled implant abutments or some other compensating feature. This is best accomplished using a dental laboratory surveyor with mounted diagnostic models.

Two ScrewPlant implant fixtures were placed (4.7 x 8mm and 4.7 x 10mm) (Figures 8 and 9). Since it was necessary for the patient to wear his partial during osseointegration, the partial denture was relieved generously in this area and soft relined. After five months of healing, the partial was attached to the implant using Zest locator attachments.

**Retrofit of existing partial (RPD)**

The decision to use locator attachments was based on its low profile, allowing sufficient acrylic to cover the attachment housings for maximum strength. This was quite important since natural teeth oppose the attachment and the patient exhibited evidence of bruxism. The gold-plated female locator abutment (Figure 10) was selected and torqued into place. Adequate interocclusal space is obvious (Figure 11). Metal housings were snapped on and were ready to be picked up into the RPD (Figure 12). Relief of the partial denture was accomplished to allow for passive fit over the attachment housings (Figure 13). Note the metal mesh still present around the relieved area, providing reinforcement and acrylic fracture prevention.

To connect the attachment to the RPD, Zest light-cured composite was used. After the application of a bonding agent, the composite was injected through a hole in the side of the RPD (Figure 14). The flowable composite was light cured as the partial was firmly held in the rest seats and guide planes.

The patient should never close and clench when processing the attachment into the RPD. It is best to use one’s fingers pressing firmly on the metal rest seats. This will prevent over-compression of the soft tissue and the creation of a dislodging force that may cause the RPD to pop loose.

The partial denture is removed with both metal housings and black processing males in place. Light cure the intaglio surface and fill any voids to ensure the housings are secure. The locator tool is then used to remove the black processing parts and insert the appropriate retentive males. In this situation, blue males (1.5lbs of retention) were used (Figure 15).

At the three-month recall, natural teeth abutments UR4 and UL4 displayed much less mobility and an improved prognosis was noted.

**Discussion and conclusion**

Implant-enhanced removable partial denture (IERPD) treatment, while simple in theory, requires a comprehensive understanding of implant therapy and a mastery of removable prosthodontics. First, a proper pre-operative clinical assessment and evaluation of dental anatomy, including intra- and inter-arch spaces, should be performed. A good understanding of RPD design concepts (Daher T, Hall D, Goodacre C, 2006; Phoenix R, Cagna D, DeFreest C, 2008) and the biomechanical capability of implants, teeth and RPDs are necessary to execute this therapy.

IERPD is a space-sensitive treatment. Interocclusal space must be carefully assessed prior to treatment. Insufficient space could prevent implant utilisation or result in inadequate bulk of acrylic over the attachment. Acrylic requires bulk for strength; if this is not achieved, the unfortunate result will be continuous repairs for the life of the prosthesis.
When retrofitting an existing RPD with implants, be sure that there are no design flaws and the RPD fits well. It would be best to construct a new RPD if there are any problems. Design principles for an IERPD should be consistent with those of a conventional RPD. The partial should be well reinforced with metal around the location of the implant attachments. This will prevent one of the major complications – the fracture of acrylic around the implant attachment housing.

As discussed in this case presentation, this patient’s major problem was the increased mobility of RPD abutment teeth UR4 and UL4. By adding two implants, it was possible to improve the biomechanics of his existing RPD. A conventional RPD distributes chewing force between natural teeth abutments and soft tissues. An IERPD distributes the force among natural teeth abutments, soft tissues and implants. By adding an implant to a RPD, the retention, support and stability of the RPD are all enhanced.

A review of the oral biomechanics shows that healthy teeth may be vertically displaced 0.08mm to 0.28mm under load (Misch C, 2008). In contrast, healthy soft tissue covering ridges can be displaced 1.0mm and if flabby, soft tissue exists, this number is much higher. The significant difference between teeth and ridge mobility can lead to the pathologic mobility of abutment teeth (Figure 16).

The addition of implants to this patient’s RPD improved the biomechanics of the partial. These implants mitigated damaging leverage forces to his natural abutment teeth and mobility was decreased (Figure 17). Additional benefits to this patient included improved comfort, retention, support and stability, bone preservation, maintenance of existing teeth and RPD, contingency planning for the future, and cost effectiveness.

References