Advanced restorative techniques and the full mouth reconstruction: part nine – full arch bridge design on implants

In part nine, **Paul Tipton** looks at bridge design and describes a new technique for improving the aesthetics, maintenance and fit of the full arch porcelain-fused-to-metal implant retained restoration

Introduction

For many years the holy grail of implant prosthodontics has been a passive fit of the bridge framework onto titanium implants. The original 'Bränemark' protocol (1981) relied heavily on this goal to ensure a long lasting restoration and longevity of the implants. While a passive fit may have been achieved on many traditional acrylic on gold, screw-retained restorations, several further difficulties were encountered achieving the same passive fit with a porcelain-fused-to-metal bridge.

Jemt (1996) stated that, in fact, none of the prostheses he tested presented a completely passive fit. His study indicated that a certain biologic tolerance for misfit may be present in most restorations and, in conclusion, that an absolute passive fit was impossible to attain for a traditional screw-retained restoration.

Aims and objectives

To discuss bridge design with regard to advanced restorative techniques and the full mouth reconstruction

Expected outcomes

Correctly answering the questions on page xx will demonstrate you understand the design of full arch implant-supported porcelain-fused-to-metal bridgework

Verifiable CPD hours: 1

Casting techniques

Carr (1991) and Hsu (1993) have shown that full arch impression techniques using either pick-up or transfer style impression copings are also inaccurate, and many hours have been spent in sectioning frameworks from an inaccurate case, picking up these sections in the mouth prior to soldering in an attempt to achieve an adequately fitting framework.

Shiffleger (1985) showed that large one-piece castings are not accurate and that these need to be sectioned and soldered for a more accurate casting. Furhermore, Bridger (1981) showed that as soon as porcelain is added onto the framework it will distort, leading to further inaccuracies in the fit. These inaccuracies tend to be larger, more posteriorly in the arch.

Cement restoration

Misch (1995) suggested that a cement-retained implant-supported prosthesis offers several advantages when compared to a screw retained, in that the super-structure may be more passively attached. A screw is a combination of inclined planes and wedges, and one of the most efficient machine designs. Misch described that a torque force of 20 Newtons per centimeter squared applied to a screw when screwing down a framework is sufficient to move two railway cars apart! The same forces on a non-passive casting has a tendency to distort the super-structure and the bone and/or the implant. As a result, the fabrication of a passive final restoration is highly unlikely when the screw retention is the method of fixation.

Passive fit

The cement retained restoration may offer a better chance of a passive fit in some areas of the implant abutment crown interface, but because of the distortion previously described during impression techniques, casting and then porcelain application, spacers very often need to be incorporated under the framework to achieve adequate fits, leaving large cement spaces in the posterior areas of the bridge. Alternatively, by means of a fit checker, the internal aspects of the bridge can be adjusted to achieve adequate fit with the same result of open cement margins and loss of retention.

In order to achieve retrievability of the restoration, the cemented prosthesis is usually cemented with a soft cement, but unfortunately one of the problems of the softer cement is that of cement washout. Parel (2000) has maintained that this can then lead to excess stress being placed on certain abutments and implants due to cement washout under the crowns on top of other abutments. Again, this leads to potential problems with overstressing of implants.

Figure 1: Full arch porcelain-fused-to-metal bridge

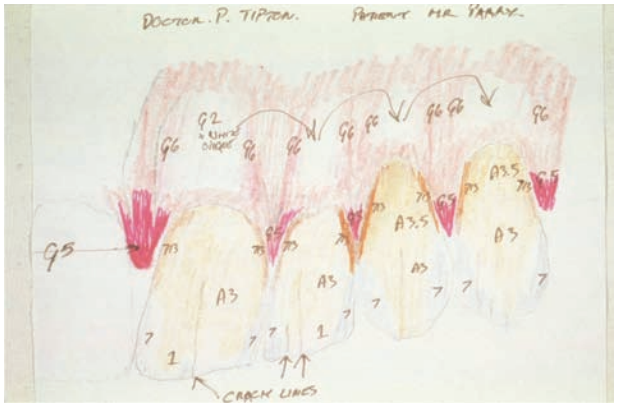

Figure 2: Colour shading prescription

Figure 3: Preoperative OPG

Figure 4: Eight implants inserted

Aesthetics

A further problem that has been observed with the large porcelain-fused-to-metal full arch bridge is that of less than ideal aesthetics. It is a daunting task for the technician to build pink porcelain to restore the lost soft tissues combined with the need to restore functioning prosthetic teeth at the same time (Figures 1 and 2). A technician only has a limited number of firings available to build up this final fixed restoration prior to the porcelain becoming too translucent and losing its natural colour. This could result in aesthetics that may not be as good as is possible with individual crowns in a full mouth reconstruction, because of these constrictions.

Maintenance

Porcelain is a very brittle material and has the potential to fracture under parafunctional and/or impact loading. Although acrylic has been recommended by Cibirca (1992) as the veneering material for a full arch bridge because of its dampening effect, this has been questioned by Davis (1988), as porcelain has been shown to be more beneficial under static loading.

Changing from a screw-retained design of restoration with access holes in the centre of the occlusal and palatal surfaces, to a cement-retained restoration, will increase the strength of the final porcelain-fused-to-metal bridge.

However, there is still the potential for fracture or cracking during long-term function. Should this occur then it may be impossible to retrieve this from the mouth and repair the porcelain in the laboratory due to the contamination of the porcelain by saliva. This contamination makes the porcelain more liable to explode while in the furnace. Very often, reshaping of the bridge or composite repair have been the only options to maintain the bridge long-term in function, with again loss of form, function and aesthetics. The alternative, which is both time-consuming and expensive, is stripping the porcelain and remaking it on the same framework.

This article describes a new technique for improving the aesthetics, maintenance and, most importantly, fit of the full arch porcelain-fused-to-metal implant retained restoration using a pick-up copying technique over custom-made abutments.

Case study one (Figures 3-20)

This male patient was referred to me from his general dental practitioner in Leeds for placement of implants and a fixed bridge in his lower jaw. The patient has most of his upper dentition and the referring practitioner had previously reconstructed this as a porcelain-fused-to-metal restoration. The patient was anxious to have a similar style of restoration in the lower jaw to oppose his upper porcelain-

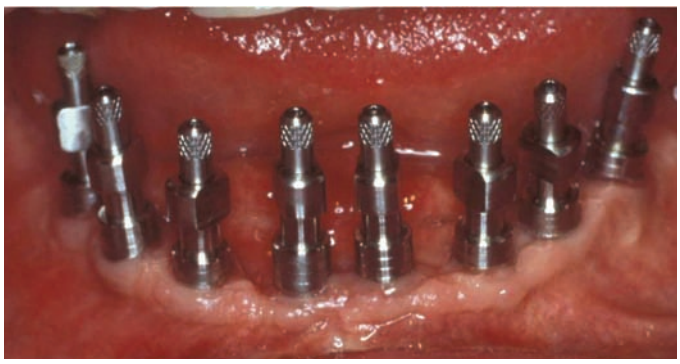

Figure 5: Pick-up impression copings

Figure 6: Master model showing gold UCLA abutments

Figure 7: Gold UCLA abutments in the mouth

Figure 8: Copings in the mouth

Figure 9: Pink porcelain framework with individual tooth preparations on master model

Figure 10: Mirror view

fused-to-metal bridge. It was the intention that the final restoration would have individual crowns cemented to a passive-fitting pink porcelain-fused-to-metal framework, cemented over eight custom-made UCLA abutments.

Implants

Eight implants were inserted into the lower jaw with a view to fabricating a fixed porcelain-fused-to-metal bridge as the final reconstruction (Figures 3 and 4). Three months after placement of the implants – and prior to uncovering – a closed mouth impression was taken to allow the fabrication of a gothic arch tracing with centre pin registration for determination of centric relation jaw relationship and vertical dimension. With these records a wax try-in was produced with teeth to assess the final position of the replacements and soft tissue defect. This information was used to construct a screw-retained acrylic provisional as described by Zinner (1994), designed to load the implants transitionally and also allow time for the patient to assess form, function, shape and aesthetics prior to the definitive restoration.

UCLA abutments

After six months of wearing the provisional bridge impressions were taken for construction of the lower final fixed restoration. This was done with traditional pick-up impression copings (Figure 5) rather than transfer impression copings for greater accuracy (Carr, 1991) and for

Figure 11: Fitting surface

Figure 12: Pink porcelain framework placed in the mouth over copings

Figure 13: Picking up the copings with Panavia – oxyguard evident

Figure 14: Pink porcelain framework with Panavia and oxyguard – mirror view

Figure 15: Individual crowns cemented on pink porcelain framework

Figure 16: Lingual view

the fabrication of a master model. It was expected that this master model processed from the pick-up impression would still be inaccurate because of the large span of the arch, and the inaccuracies in the impression techniques (Carr, 1991; Hsu, 1993) but this inaccuracy would be compensated for later on during the restoration. Eight custom-made gold UCLA abutments milled to a 4° taper were made (Figure 5-7) and placed onto the implants, the fit was verified in the mouth with the aid of an acrylic locating jig. On top of the abutments, copings were made in precious metal to be fitted over the top of the gold custom-made abutments. These were transferred to the mouth and verified for the fitting of the margins (Figure 8).

Technical aspects

Prior to the waxing and casting of the final framework, a spacer technique was applied to the precious metal copings ranging from 0.2mm thickness distally in the anterior region to 0.6mm disto-bucally in the most posterior areas, to accommodate casting inaccuracies and framework distortion due to multiple firings.

The wax try-in (verified at the start of prosthetic treatment) formed a matrix for the framework design. The original try-in was waxed to the master model and a silicone putty matrix formed to encompass the teeth and soft tissue replacement. Inlay wax was poured into the resulting space, which allowed the wax to be cut back

Figure 17: Fitting surface

Figure 18: Restoration cemented in mouth

Figure 19: Right lateral view

Figure 20: Left lateral view

accurately between 1.5 and 2.0mm for the placement of pink porcelain and the forming of the 12 individual tooth preparations for the acceptance of crowns at a later stage (Figures 9-11).

The pink porcelain framework was tried in the mouth on top of the precious metal copings and abutments (Figure 12). A passive fit was confirmed and jaw registration proceeded to confirm the original centric relation position on the semi-adjustable articulator. Verification at this stage is an important safeguard. When cementing the copings to the framework any discrepancies in fit will be highlighted and the framework may not seat onto the original model. In these instances an acrylic and stone model is cast and remounting in the articulator is necessary.

As described previously, the passive fit of the large framework on abutments also leads to uneven thickness of cement lutes, which, if the cement is of a temporary nature, will wash out, leading to the potential for overstressing of certain implants (Parel, 2000). Intentionally, this technique is to use a composite luting cement in order to pick the copings up from the abutments into the framework and have the composite as the major cement lute, so avoiding cement washout often seen when using softer cements. This was done intra-orally using 'Panavia' cement (Mortia) after the technician had sandblasted the internal aspects of the porcelain framework and copings for greater retention (Jorgennsen, 1955) (Figures 13 and 14). A perfectly passive framework would be achieved as the end result, whereby the final cementation process could be achieved with a soft cement, with the ideal cement thickness to prevent washout.

Individual crowns

Individual porcelain-fused-to-metal crowns were then fabricated according to the 'golden proportion' as described by Levin (1981). These were tried in place on the framework to finally determine aesthetics and occlusion prior to the crown being adhesively cemented to the previously silicoated metal fitting surface of the crown and metal tooth preparation by the dental technician (Figures 15-17). This technique allows for better aesthetic reproduction of detail as each crown can be built up over a period of time to create the illusion of a natural tooth (Goldstein, 1977). The patient can, if they so require, also floss between the crowns to give a psychological improvement in that their teeth feel more natural.

Maintenance

Maintenance also means that should a piece of porcelain on one crown fracture, the crown itself can be cut off,

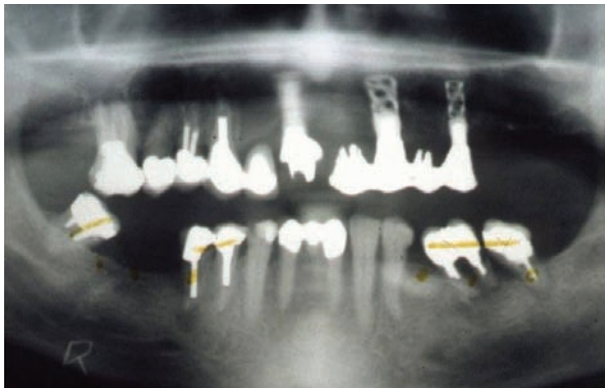

Figure 21: Preoperative OPG

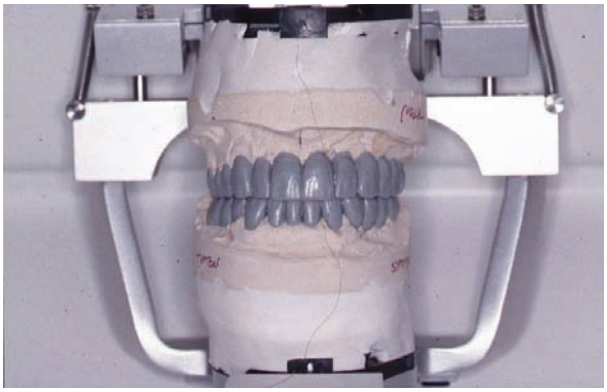

Figure 22: Diagnostic wax-up

Figure 23: Full arch bridge with individual cemented porcelain-fused-to-metal crowns cemented onto pink porcelain framework cemented with Panavia over gold copings

Figure 24: Left view

Figure 25: Right view showing screw block

Figure 26: Cemented in the mouth over the abutments with Temp Bond

impressions taken and a new crown fabricated by the technician and fitted at any stage. Thus the maintenance is similar to that of a full mouth reconstruction on individual teeth.

The custom-made abutments were tightened to 32Ncm using anti-rotation jigs and the bridge cemented passively in the mouth with Temp-Bond (Kerrs) (Figures 18-20).

Case study two (Figures 21-29)

This gentleman was referred from his practitioner in Bolton with failing restorative and implant work (Figure 21).

The same procedures as in case study one were performed, this time in the maxilla (Figures 22-27). The variable here was that two remaining teeth were also used as abutments and screw block joined the tooth-supported

Figure 27: UCLA abutments in the mouth

Figure 28: Gold copings picked up in the acrylic/gold framework with Panavia and oxyguard present

Figure 29: Acrylic/gold bridge cemented in the mouth over the UCLA abutments with Temp Bond

framework on one side to the implant-supported framework on the other side.

The guiding principles were the same however – that a purely passive fitting full arch restoration was achieved with maximum aesthetics and potential for long-term maintenance.

The same technique can be used with acrylic/metal bridges when wishing to improve the fit of large acrylic metal castings (Figure 28) .

Conclusion

The final results in both case studies illustrated in this article show aesthetic form and function with a truly passive fit and a long-term maintenance potential unlike any other form of full arch restoration, and is the treatment of choice for full arch restorations on implants (Figure 29).

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References

For a full list of references, please contact the editor at siobhan.lewney@fmc.co.uk. PD

CPD Questions on page 93

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