Dentistry Clinical

History repeating itself

Andrew Dawood, Susan Tanner and Tom Bereznicki discuss implant abutment selection for single unit or short-span bridgework

When we first restored dental implants years ago, crown and bridgework was nearly always screw-retained. As single tooth implants became commonplace, and CAD/CAM titanium abutments appeared, we moved toward cement-retained solutions for single teeth and short-span bridgework. However, we have begun to find ourselves increasingly dissatisfied with aspects of cement retention, and find that we enjoy using screw-retained structures more and more… again! Isn't it funny how history has a way of repeating itself?

Recent innovation in CAD/CAM technology now makes the use of screw-retained restorations even more attractive. This article gives a personal view of our abutment selection process.

Cement retention

In our practice, over the years, our standard approach for single unit and short span bridgework was to recommend the use of CAD/CAM milled titanium abutments to provide cement retention for 'conventional' crown and bridgework – either porcelain bonded to metal or all-ceramic restorations.

The principal advantage of cemented restorations is that the alignment of the screw-access for the implant abutment can be through any part of the abutment, as once the abutment has been screwed into place the cement-retained crown will cover the screw-access hole (Figures 1a and b). This is particularly important for anterior restorations, as it can be difficult or undesirable to position the implant with the screw-access hole palatal. Cement retention has been used more and more, as the laboratory and prosthodontic aspects of treatment are so similar to those used for the restoration of teeth.

However, when cementing the finished restoration, excess cement may be extruded into the tissues causing inflammation, soft tissue problems, and even severe bone loss (Figure 2). Using titanium abutments in the aesthetic zone often meant that the abutment needed to be significantly sub-gingival, making this problem that much more troublesome. The use of CAD/CAM Zirconium abutments means that the abutment/crown may be more superficial, making the subgingival extrusion of cement less likely, and reducing the potential for embarrassment that may result from recession later on.

On the other hand, if insufficient cement is used, retention may be unreliable. Retention may also be challenged if there is little interocclusal space available, and abutment height is reduced.

In the past, we tended to routinely use temporary adhesives, so that if restorations needed to be removed we could do so… but not infrequently we have found that these cements behave as if they are 'definitive'. If it should become necessary to remove a restoration, de-bonding the crown or bridge may be difficult, particularly if the abutments have long retentive surfaces, and may even result in porcelain fracture. So much for 'retrievability'.

And how temporary, is temporary? As years go by, our practices accumulate more and more patients with restorations cemented with temporary materials; this represents a considerable 'reservoir' of potential problems, just waiting to rear their heads.

If crown or bridgework is to be cemented to an abutment there must be adequate space for optimum porcelain aesthetics, as well as mechanical strength and retention for the

In the aesthetic zone

If screw-access is towards the buccal:

- Cement retained crown or bridgework is almost unavoidable without using a secondary framework
- Favour flat-fronted CAD/CAM zirconium abutment if high smileline, thin gum type. Crown margin just below or at gingival level labially
- Favour CAD/CAM titanium abutment if low smileline, or thick gum type. Crown margin just at or just below gingival level labially.

If screw-access is palatal:

- Screw retained crown or bridgework
- Favour screw-retained direct to fixture head, porcelain bonded to zirconium if high smile line
- If low smileline or thick gum type, favour porcelain bonded to alloy bridgework, screw-retained with intermediate titanium abutment.

Outside the aesthetic zone

If screw-access is buccal:

- Cement retained crown or bridgework
- Porcelain bonded to alloy bridgework – custom titanium abutments with margins just at gum line labially
- All ceramic individual crowns – custom titanium abutments. Crown margin just at gingival level.

If screw-access is occlusal/palatal:

- Screw-retained crown or bridgework
- Porcelain bonded to alloy bridgework – intermediate titanium abutment
- Porcelain bonded to zirconium for crown or bridgework – screw retained directly to fixture head.

Figures 1 a and b: The abutment screw emerges to the buccal, therefore there is no option but to cement an implant crown into place on these milled titanium Procera abutments. Note superficial margins on both teeth and implant abutments

entire assembly. There must be sufficient space for a robust abutment, a metal or ceramic coping, and an ideal thickness available for the aesthetic veneering material.

Screw retention

Of course, the main disadvantage of a screwed-on restoration is the need for a screw-access hole, particularly if the position of the access hole would appear to the facial aspect of a front tooth. Apart from this constraint, in so many respects screw retention has much more to offer. There is no adhesive to extrude into the tissues. Crown and bridgework can be tightened into position or removed by simply regaining access to the abutment screw. The forces generated by screwing down the restoration are easily sufficient to displace tissues and facilitate tissue moulding in pontic areas.

Screw retention can either be indirect at abutment level; in which case small prosthetic screws hold the restoration to the standard abutment (e.g. the Multiunit abutment available for Nobel Biocare implants) that is screwed down onto the fixture, or direct at fixture level; in which case larger abutment screws fixate the restoration directly to the implant. This is where the screw versus cement debate becomes a little more complex.

Bridgework screwed down onto a titanium abutment (Figures 3a and b) specifically designed for screw-retention, has the great advantage that a precisely fitting abutment made from a biocompatible implant material (titanium) lies between restoration and implant, providing an almost seamless interface where it is needed most. This is also the more comfortable option from the patient's perspective; working at abutment level makes all procedures such as impression-taking and try-in more 'superficial'. If the abutment can be placed at the time of surgery, and left in place subsequently, then so much the better, as this will encourage healing and bone maintenance.

Screwing down crown and bridgework directly to the fixture is more of a challenge to the tissues in this critical 'transitional' zone. If the implant has been correctly placed, any material placed at depth should ideally be an implant material. As yet, no suitable porcelain is available for direct application to titanium. Gold is not an implant material. So, this really means that zirconium is really the most suitable structural material for direct connection to the fixture head, if porcelain is to be applied directly to the structure.

Directly bonding veneering porcelain onto a zirconium superstructure (Figures 4a and b) has the advantage that there is no space taken up by a 'coping'. Furthermore, as there is no need to create parallel walls, the superstructure can be anatomically contoured for extra strength and to provide support for the veneering porcelain. This sort of 'integral abutment' is ideally designed and manufactured using CAD/CAM processes.

Of course, any restoration that splints implant units must fit 'perfectly' if unfavourable static loading of the implants, connecting screws, and the restoration itself is to be avoided.

Prosthodontic/abutment materials

Gold

Or perhaps we should now say dental 'gold' in view of escalating gold prices, and a move towards non-precious alternatives. This is most definitely not an implant material; furthermore a cast object can never have the crisply engineered surface required for perfect seating onto the implant head. Even if gold has been cast onto a prefabricated finding, the casting, porcelain-firing and subsequent polishing processes will adversely affect the

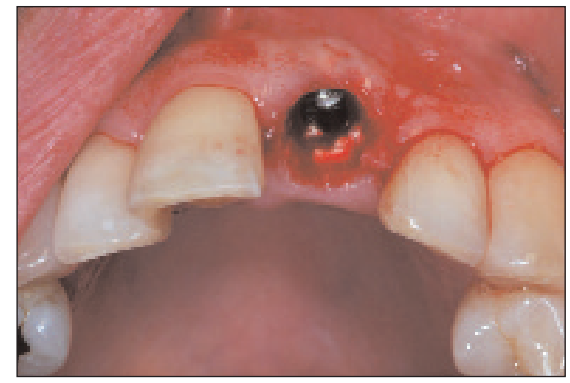
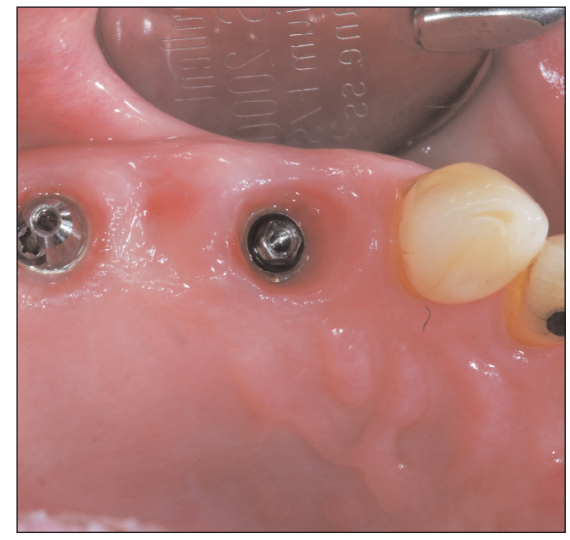


Figure 2: Cement extrusion into the tissues – far too much adhesive was used to secure the implant crown, causing inflammation and discomfort. If left, this would have undoubtedly caused bone loss



Figures 3 a and b: Screw retained porcelain bonded to metal bridgework has been secured to Multiunit abutments which have been secured to the fixture heads at the time of surgery. Note that the small screw-access holes are easily disguised




Figures 4 a-d: In all cases, the biocompatible material is in direct contact with the tissues. Porcelain with a matched coefficient of thermal expansion is directly bonded to a zirconium framework. 4a-b: 4-unit bridge based upon three fixtures. 4c-d: A single unit porcelain bonded to zirconium restoration on the premolar. Note the supragingival margin on the adjacent molar implant restoration, which is cement retained to a titanium abutment

fitting surface. We do use gold restorations that are screwed directly to the fixture head, but only occasionally; we tend to do so when there has been significant remodelling around the fixture, leaving the head more superficial than intended, and the bone more than 2.5mm away from the fixture head – the biological width – or when there is only a very limited amount of interocclusal space. The tissues around gold abutments never seem to appear as healthy as they do around more biocompatible materials. Gold abutments should never be used where the implants are short and deeply placed, as in Figure 5.

Figure 5: Even a small amount of bone loss is significant when short fixtures have been placed. These fixtures are deeply placed in a narrow ridge, so the tissues are very much in contact with the gold, causing inflammation and bone loss. Note also that there is a negative margin on the distal abutment, possibly a result of excessive post-casting finishing

Titanium

Titanium is renowned for its near ideal implant properties. It is a fantastic abutment material, either for CAD/CAM abutments, or for prefabricated abutments designed for screw retention. Unfortunately, titanium has resisted attempts to provide a direct porcelain bond with sufficient predictability to use routinely, so titanium has to be used as material for an intermediate abutment. We routinely use the Nobel Biocare Multiunit abutment, for the screw retention of porcelain bonded to metal crown and bridgework – most manufacturers offer a similar component. We also make most of our full-arch bridgework using CAD/CAM Procera titanium frameworks veneered with resin, which may be screw-retained to these abutments or directly to the fixtures.

Alumina

Alumina is a wonderfully biocompatible material, but lacks strength. We were quick on the uptake to use alumina abutments. Sadly, it did not take long to have a number of our patients return with a fracture of their thin, spindly, alumina abutment, broken off at the neck, and retained within the dental crown. This experience repeated on a few occasions and curbed our enthusiasm for ceramic abutments. We no longer use alumina as an abutment material.

Zirconium

Zirconium is also an implant material, and is indeed increasingly used as a dental or orthopaedic implant material. It is denser and considerably stronger than alumina. We have used it for a long time for bridge frameworks and abutments. I have not yet experienced a catastrophic failure of a zirconium abutment or framework. Zirconium is available in several shaded varieties, and is generally prepared using CAD/CAM processes. Zirconium is our abutment material of choice for all our anterior 'aesthetic' restorations. The great thing is, that porcelain with a matched coefficient of thermal expansion is available for direct application to a zirconium abutment or framework. This means that we can now combine screw retention, implant-grade biocompatibility, and CAD/CAM processing, with all-ceramic aesthetics, and a bespoke emergence profile. At present, zirconium components for direct screw retention are only available for Nobel Biocare fixtures, and only in a format that fits directly at fixture level. A note of caution, there is a tendency for 'chipping' of the veneering porcelain which seems to be more significant for opposing implant restorations. This may be overcome by the use of lithium disilicate 'pressed' ceramic materials – this is currently the focus of a lot of research activity in industry.

So which abutment should we use, and when? We always prefer bare titanium or zirconium against the gingivae. The abutment material should ideally extend supragingivally, as this will encourage gingival heath.

Do not use zirconium where there is evidence of bruxism, or where the restoration is opposed by another implant-supported porcelain restoration.

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Andrew and Susan lecture extensively in the UK and abroad on topics related to imaging, dental implants, and restorative dentistry.