Implant abutment selection for single unit or short-span bridgework

Andrew Dawood, Susan Tanner and Tom Bereznicki present a personal view of their abutment selection process.

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! History does have 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.

Education aims and objectives

The aim of this article is to explore the differences between cement-retained solutions and screw-retained structures, and when it is most appropriate to use one system or the other.

The reader will:

• Understand the authors’ implant abutment choices for single unit or short-span bridgework.
• Gain an overview of both cement and screw retention.
• Learn about the materials available for prosthodontics/abutments, as well as their advantages and disadvantages.

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Andrew and Susan run a long-established multi-disciplinary specialist referral practice. Their time is devoted entirely to implant surgery and prosthodontics, imaging, and surgical planning. Andrew and Susan lecture extensively in the UK and abroad on topics related to imaging, dental implants and restorative dentistry.

Tom Bereznicki graduated from Edinburgh University Dental School in 1976. Following various house surgeon’s appointments at both Guy’s and The Royal Dental Hospitals, he entered general practice and started his own private practice in Queen’s Gate, London, in 1982.

His area of special interest is the creation and duplication of the created emergence profile in conventional and implant-retained crown and bridgework.

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 1b). 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 prostodontic 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 use temporary adhesives routinely, so that if restorations needed to be removed we could do so. However, not infrequently we have found that these cements behave as if they are ‘definitive’. If it should become necessary to remove a restoration, debonding 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’.

How temporary is temporary really? 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 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 simply by 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 Multi-unit abutment available from Nobel Biocare implants), which is itself screwed down onto the fixture, or direct, at fixture level, in which case larger abutment screws fix the restoration directly to the implant. This is where the screw/cement debate becomes a little more complex.

Bridgework screwed down onto a titanium abutment (Figures 3a and 3b), specifically designed for screw retention, has the great advantage that a precisely fitting abutment made from a biocompatible implant material (titanium) lies between the restoration and the implant, providing an almost seamless interface where it is needed the 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 positioned, 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. This 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.

**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 a flat-fronted CAD/CAM zirconium abutment if of high smile line, thin gum type. Crown margin just below or at gingival level labially
- Favour a CAD/CAM titanium abutment if a low smile line 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 there is a low smile line 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 and custom titanium abutments with margins just at gum line labially
- All-ceramic individual crowns and 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 and an intermediate titanium abutment
- Porcelain bonded to zirconium for crown or bridgework. Screw-retained directly to fixture head.

**Golden rules**

Porcelain should be bonded to an intermediate titanium abutment. Screw retention can be used where there is no need for an access hole. Screwed-on bridgework is an ideal solution for the aesthetic zone. Screwed-on crowns are advantageous in the transitional zone.
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.

So, what are the materials available to us?

**Prosthodontic/abutment materials**

**Gold**

Perhaps we should now call it dental ‘gold’ in view of escalating gold prices and a move toward 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 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 appear to be as healthy as they do around more bio-compatible materials. Gold abutments should never be used where the implants are short and deeply placed, as in Figure 5.

**Alumina**

Alumina is a wonderfully bio-compatible material but it 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, 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 directly bonded to a zirconium 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, however – 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.

**Which abutment should we use, and when?**

A restorative algorithm for implant crowns and short-span bridgework is as follows:

- We always prefer bare titanium or zirconium against the gingivae. The abutment material should ideally extend supragingivally, as this will encourage gingival health.
- Do not use zirconium where there is evidence of bruxism, or where the restoration is opposed by another implant-supported porcelain restoration.