Challenging aspects of implant restoration

Brenda Baker and ***David Reaney*** explain various methods to restore function and aesthetics to patients in need of implant restoration

Implant dentistry has revolutionised the way we restore function and aesthetics to patients who, historically, would have needed removable prosthetics or less mechanically favorable fixed prosthetics.

However, it is not always smooth sailing and we need to be aware of some of the possible pitfalls and issues.

Aims and objectives

This article aims to explain the various methods to restore function and aesthetics to patients in need of implant restoration.
Readers will:
- Recognise the pitfalls and issues to restoring the function and aesthetics
- Be able to monitor peri-implant tissues
- Understand the maintenance protocols after restoration has taken place.

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Try-in and torquing of implants

There is confusion between the torque load delivered to the implant complex, the initial force transformation and stress developed within the system during the implant complex assembly, and how the clamping forces at the interfaces and the preload stress impact the implant prior to external loading.

The application of any external load to the implant complex must be preceded by the assembly of the abutment onto the implant, achieved by tightening the abutment screw to create a stable screw joint and, thus, form the implant complex. It is the first step in preparing the assembled implant complex to transfer loads.

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Accuracy, with respect to the applied load, is critical in the determination of load transfer to and through the complex to the bone. The dynamic nature of the implant complex assembly generated by a certain magnitude of torque loading is essential for understanding the response of any implant system to external loading. The contact forces, including the preload, are the first response to the torque experienced by the implant complex.

The insertion torque should not exceed 30 Ncm, especially for immediate load implants, as higher insertion torques above 50 Ncm can generate high compressive stresses to the peri-implant tissues, causing blood supply deficiency and bone necrosis during the osseointegration phase, as well as early implant failure (usually within the first month after placement) (Trisi et al, 2009).

A high insertion torque may occur during implant placement in high-density bone tissue. Under high stresses, significant changes impair the formation of new blood vessels, causing hypoxia in the peri-implant tissues, thus inhibiting bone formation and favouring the formation of cartilage and connective tissue.

Common complications (Goodacre et al, 2003)

Screw loosening

There are two main reasons why screw loosening occurs:

Incorrect torque

Torque drivers should always be used to tighten screws.

The correct pre-load must be applied to the screw. The material of the screw must be stretched to 80% of its elastic limit, which means that the screw will return to its original length as the torque is released and the two components are clamped together.

If the screw is tightened by hand, adequate pre-load will not be achieved, which means that the screw will not be stretched to its full potential and repeated screw loosening will occur.

If the screw is over-tightened and exceeds the elastic limit, it will become plastic and not return to its original length. There will also be no tension placed into the system. Thus, loosening of the screw will occur and may cause eventual fracture.

The design of the screw head has an impact on the ability to apply the preload. Slotted screws do not allow enough preload to be applied.

However, square and hexagonal screws

Figure 1: Anterior tooth aesthetics are critical. Colour data with shade tabs against various teeth will help guide the laboratory

Figure 2: Minimal space is evident anteriorly for aesthetic functional reconstruction

Figure 3: The irregularity of the occlusal plane is clearly illustrated when the patient's mouth is partially open

allow the preload to be transmitted through the screw and either can be used.

A screw can loosen where the abutment underlying the crown becomes loose yet the crown remains cemented. Always replace abutment screws that have loosened repeatedly or are damaged.

The crown may not detach from the abutment easily. If the crown will not separate, it may be possible to cut a hole in the crown to expose the screw access hole underneath. The access hole may not be in the centre of the abutment and can be difficult to locate.

Considerable cutting of the crown can damage the underlying abutment and possibly lead to eventual replacement of the entire assembly. It is also possible to cut through the interproximal contacts and unscrew the whole assembly. Then, the abutment can be relocated onto the implant and the screw torqued down. A new impression can be fabricated to construct a new restoration.

Mismatch between the diameter of the implant and the width of the crown that the final prosthesis replaces

There is always a small mismatch in fit between the top of the implant and the undersurface of the abutment due to the tolerance during manufacturing.

Forces are applied that cause a small amount of movement between the component parts during function.

If applied forces fall outside the diameter of the implant, the movement between the component parts is magnified and the screw is more likely to become loose.

The diameter of the implant should match the diameter of the tooth that is being replaced as closely as possible. When considering multi-unit cases, the correct number of implants should be chosen to allow even distribution of the forces. Components should be chosen from the same manufacturer, or the use of customised abutments specifically tailored for each clinical scenario may prove to be even more accurate.

Screw fracture

Kim and colleagues found that screw fracture occurs as a result of overloading an implant by occlusal forces (2005). The abutment screws become loose and eventually fracture. Incorrect preload may also create ultimate screw fracture. Over-tightening of the screw may eventually cause fracture and occlusal overload caused by excessive cantilever design should be avoided. The forces applied to the prosthesis should be controlled, and it is important to avoid damaging the internal thread of the implant.

The worst case scenario is that the implant would have to be removed surgically, the site be allowed to heal and then a new implant placed and restored once osseointegration has occurred.

The design of the superstructure should be carefully planned as this could cause fracture of the screw. If the screw cannot be removed, it may have to be drilled out in order to salvage the implant. Then, a cemented post and abutment can be made with an impression of the internal surface of the implant and a new superstructure fabricated.

Fracture of the superstructure

This can occur in either porcelain or resin, as found by Molin and Karlsson (2008) and Larsson and colleagues (2006).

If the occlusion has not been designed properly or the interface between the veneering material and the underlying metal framework is placed under stress, then material fracture can occur. The framework must be made rigid enough to support the veneering material.

Extensive cantilevering can increase the risk of fractures, as can parafunction. The occlusion should be checked in lateral excursions to ensure that there are no interferences.

If a crown needs to be removed, then it is possible to either unscrew the component – if it is screw-retained – or ease it off if it is cement-retained after having used a temporary cement.

If acrylic resin is too thin, it too will fracture when loaded, and the alignment of the screw access hole, when using a screw-retained restoration, should be in the central fossa of the restoration to allow adequate thickness of porcelain or acrylic.

Inflammation and peri-implantitis

Cochran reported that during maintenance, gingival inflammation can be detected. It may either be mucositis, which is reversible without evidence of bone loss or peri-implantitis (2002).

Most frequently, mucositis is caused by abutment loosening. The loosening of the abutment enables bacterial infiltration. Lindhe and Meyle found that if the mucositis caused by abutment loosening goes undetected, it can result in peri-implantitis (2008). Mucositis lesions can show apical progression after three months of plaque build-up around implants.

In order to detect abutment loosening, look for abutment separation on the radiograph – seen as a dark line between the components and prosthesis mobility. Abutment loosening can result in uncomfortable pressure on the prosthesis if gingival tissue has overgrown into the opened junction. The excess soft tissue must be removed before the abutment or prosthesis can be tightened back into place.

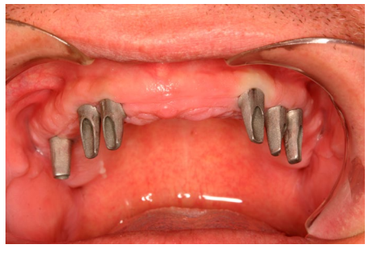
Treatment of peri-implantitis involves inflammation control and modifying the exposed implant surface.

Occlusal evaluation

The occlusal status of the implant and its prosthesis must be assessed routinely at every maintenance appointment. Occlusal overload can cause a variety of problems, including loosening of abutment screws, implant and prosthetic failure (Zarb and Schmitt, 1990).

Occlusal contact patterns should be assessed, as well as the mobility of the implant and opposing dentition. Successful implants should not be clearly mobile. A failing implant is not mobile until all or most of the bone has been lost.

Figure 4: These implants show excellent tissue health around the abutments



Abnormal occlusal loading will negatively affect the various parts of the implant-supported prosthesis. Hence, premature contacts or interferences should be identified and corrected to prevent occlusal overload. There should be light centric contact with no contacts in lateral excursions (Engleman, 1996).

Lundgren and Laurell believe that shim stock should be able to be held only with hard clenched teeth (1994). Possible bruxism and parafunctional activities must be evaluated as excessive concentrated forces can result in rapid and significant peri-implant bone loss.

If a failed implant is connected to a multi-unit prosthesis, it may mask evidence of mobility.

Maintenance protocols (Lang, Wilson and Corbet, 2000)

These should be customised for the individual patient. There is insufficient data on exact recall intervals, methods of plaque and calculus removal and appropriate antimicrobials for maintenance around implants.

Before implant placement, the patient's ability for home care and motivation must be assessed and the patient must understand their role in caring for the implant. The patient's motivation and skill in undertaking oral hygiene measures may influence prosthetic design.

Importantly, if the patient is unable to achieve adequate oral hygiene, then this should be a possible contraindication to implant placement. It is essential to monitor peri-implant tissues at regular intervals so that should disease be noted early in treatment if possible.

The maintenance appointment should include evaluation of:

- Presence of plaque and calculus and oral hygiene
- Clinical appearance of peri-implant tissue and deposit removal from implant/prosthesis surface
- Occlusal status and stability of prostheses and implants
- Probing depths and presence of exudates or bleeding on probing
- Patient comfort and function
- Possible need for antimicrobials
- Re-evaluation of present maintenance intervals that may be altered depending on the clinical situation
- Mobility.

Any movement would indicate possible lack of osseointegration of the fixture, possible failure of the cement bond between the superstructure and the retainer, or screw failure by fracture or loosening. If an abutment is loose, then the microgap widens, which can result in the formation of a fistula.

By using the recommended torque settings, biologic considerations of the peri-implant areas, and adhering to certain biomechanical principles governing abutment and restoration shapes and sizes, we can avoid much heartache through careful planning so that we have content patients with favorable lifelong outcomes. **IDT**

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