

Prosthodontic complications in dental implant therapy

Edmond Ho-Nang Pow *, BDS, MDS (Prosthetic Dent), PhD, FRACDS, FCDSHK (Prosthodontics), FHKAM (Dental Surgery)
 Katherine Chiu-Man Leung *, BDS, MDS (Prosthetic Dent), PhD, FRACDS,
 FCDSHK (Prosthodontics), FHKAM (Dental Surgery)

ABSTRACT Implant therapy is popular in dental practice. However, prosthetic complications in implant-supported prostheses are common. Although most of the problems can be prevented by careful case selection and treatment planning, failures do occur and their management can sometimes be very demanding. This article discusses the common prosthodontic problems encountered during and after implant therapy. Special emphasis is placed on how to avoid and solve the late mechanical complications of implant-supported prostheses.

Key words: Dental implants; Dental prosthesis, implant-supported; Osseointegration

Introduction

Implant therapy is becoming popular in dental practice, and is now regarded as a predictable treatment option for replacing missing teeth (Figure 1) ¹. Long-term follow-up studies have revealed that it is very successful. Meta-analyses ^{2,3} indicate impressive results. Thus, the 5-year survival for an implant replacing a single missing tooth is 95.6%, while for implants replacing multiple teeth using a bridge it is 97.7%. In edentulous patients rehabilitated with fixed implant prostheses, the 5-year survival rate in the maxilla is 87.7% while in the mandible it is 96.7%. In edentulous patients rehabilitated with removable prostheses, the 5-year survival rate in the maxilla is 76.6% while in the mandible it is 95.7% ^{2,3}.



Figure 1 Implant-supported crown to replace 22

Prosthodontic complications

Although implant survival rates across-the-board are high, prosthetic complications in implant-supported prostheses are not uncommon ⁴. They can be classified

Table Cumulative 5-year occurrence of technical complications in implant-supported fixed partial dentures (FPD) and single crowns (SC) ^{5,6}

| | Veneer fracture | Screw loosening | Screw fracture | Framework fracture | Implant fracture |
|-----|-----------------|-----------------|----------------|--------------------|------------------|
| FPD | 13.2% | 1.5% | 5.8% | 0.8% | 0.4% |
| SC | 4.5% | 12.7% | 0.3% | 3.0% | 0.1% |

* Oral Rehabilitation, Faculty of Dentistry, The University of Hong Kong, Hong Kong

Correspondence to:
 Dr. Edmond Ho-Nang Pow
 Oral Rehabilitation, Faculty of Dentistry, The University of Hong Kong, 34 Hospital Road, Hong Kong
 Tel : (852) 2859 0309
 Fax : (852) 2858 6114
 E-mail: ehnpow@hkusua.hku.hk

as: veneer fracture, screw loosening, screw fracture, framework fracture, implant fracture, and problems related to overdentures.

Two systematic reviews ^{5,6}, based on the data from over 40 clinical studies, have estimated the 5-year cumulative



Figure 2 Fractured acrylic veneer

incidence of technical complications in implant-supported fixed partial dentures and single crowns (Table). However, there are no such systematic reviews on implant-supported overdentures. Goodacre *et al.*⁷ reported that the mean incidence of overdenture retention loss requiring adjustment was 30%; for overdenture relines it was 19%; for overdenture clip/attachment fracture it was 17%, and for overdenture fracture it was 12%. Technical complications do not necessarily lead to implant loss but maintenance and repair can be a burden for both the patient and the dentist and influence their level of satisfaction. Complications can also lead to additional costs and time investment during the follow-up years.

Veneer fracture

Mechanical failures are not uncommon and of these, veneer fracture is the most frequent (Figure 2). They are often due to insufficient support from the underlying framework. A full contour wax-up of the final prosthesis followed by the cut-back technique can greatly minimize the problem. Veneer failure can also be caused by technical errors, such as: incompatibilities between an alloy and ceramic, poor alloy surface preparation or surface contamination, and improper ceramic buildup or firing techniques. In addition, the design of the framework also plays an important role. It should be rigid enough to resist significant deformation under occlusal loads (Figure 3). Retentive features such as beads or pins can be incorporated to enhance bonding between the veneer material and the framework. In cases of foreseeable heavy occlusal load, a metal occlusal surface is preferred. Acrylic/composite veneer fractures can be repaired intraorally under proper moisture control.



Figure 3 Weak framework leading to cracking of acrylic resin

Porcelain fractures, however, usually need to be repaired in the laboratory to achieve better results.

Screw loosening

Screw joint stability in implant prostheses is determined by a number of factors such as adequate preload, the precision of the fit between the mating implant components and the antirotational characteristics of the implant-to-abutment interface⁸. Preload is the clamping force on a screwed joint produced by tension in the screw as a result of its being tightened. Screw loosening occurs when the clamping force is overcome by forces acting to separate the fastened components. Higher preload values can be achieved using newly designed screws with enhanced surfaces (compared to earlier gold or titanium alloy designs)⁹. To achieve optimum preload, a mechanical torque device should be used instead of tightening the screw manually.

Regarding connections between the implant and abutment, those having an external (or sometimes internal) antirotation feature between the implant body and connecting component (abutment) can undergo relative rotation around the joint due to machining tolerances. This can lead to micro-movement during functional loading and subsequent joint failure. It has been shown that some implant systems using external hex connections had rotational movement in excess of 4 degrees¹⁰. On the other hand, the Morse taper design connection provides a mechanical friction grip which is significantly more resistant to rotation. This design can also distribute forces to the implant more evenly.

Screw loosening or fracture can also be due to

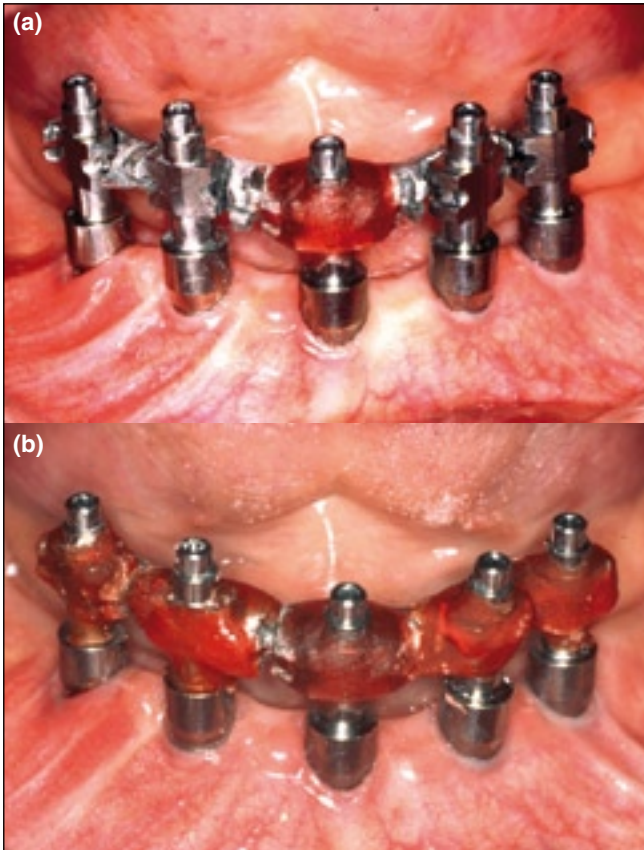


Figure 4 (a) Cast cobalt-chromium bar fixed on one impression coping. (b) All impression copings are linked with cobalt-chromium bar by autopolymerizing acrylic resin

framework misfits. Attempts have been made to minimize errors during impression taking. They include: splinting the impression copings with impression plaster, and using autopolymerizing resin possibly in combination with dental floss^{11,12}. Another alternative is first to fabricate a cast cobalt-chromium bar in the laboratory, and then connect it with the impression copings at chairside, using autopolymerizing resin (Figure 4). However, in the literature there is conflicting evidence about these approaches. In some studies, splinting improved the accuracy of the working cast but in others there was no advantage compared to non-splinted techniques^{13,14}. To minimize casting discrepancy and misfits, cementation of prostheses can be considered instead of screw retaining¹⁵. Other techniques such as double casting¹⁶, computer-aided design/computer-aided manufacturing (CAD/CAM) or welding are also available to fabricate passively fitting frameworks.

Heavy or unfavorable occlusal loading also contributes to failure of implant components. Prostheses with long



Figure 5 Fractured prosthetic screw

cantilevers should be avoided. Parafunctional habits such as bruxism should be diagnosed and a hard acrylic protective night guard can be prescribed after implant therapy.

Screw fracture

Implant-supported prostheses can be either screw- or cement-retained. Screw-retained ones are popular because they are easily retrieved for maintenance. In the traditional implant prosthesis, the prosthetic screw was intentionally designed as the weakest link within the system. If there was any mechanical stress challenging the prosthesis, the screw took up the stress without endangering the bone-implant interface.

If a fractured gold screw is encountered, it can often be removed by counterclockwise rotation with a dental explorer or probe. On the other hand, an abutment screw fracture is more difficult to manage. If the remaining abutment screw fragment is above the implant head, that fragment can often be gripped by an artery forceps and rotated out of the fixture (Figure 5). If the abutment screw has fractured at or below the implant head, it can sometimes be rotated out with a probe as for a gold screw. A small round drill can be used as a screwdriver to engage the head of the fragment (Figure 6). Some clinicians suggest using the smallest possible drill to cut a small groove in the screw fragment and then rotate the fragment out of the fixture by a screw driver of the same size, but it is very difficult to achieve at the chairside. On the other hand, retrieval kits for different implant systems are also available. When using the latter, damage to the internal threads of the implant should be avoided lest the

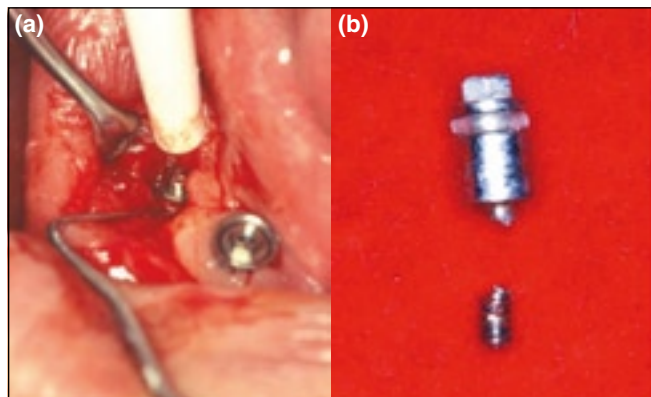


Figure 6 (a) Retrieval of fractured abutment screw by open flap surgery. (b) Fractured abutment screw retrieved



Figure 7 Fractured implant

implant cannot be used again¹⁷.

Framework fracture

Properly designed frameworks should not fracture. Common parts to fracture are the solder joints and just distal to the distal-most fixture. Because of the cantilever, this region is subjected to a higher force, and an adequate cross-sectional dimension is needed to resist fracture. Improperly soldered joints are also subject to fracture. Fractured solder joints may be reindexed intraorally and then soldered. Framework fractures caused by a minimal cross-sectional dimension in the metal may require redesigning and remaking of the frameworks.

Implant fracture

Implant fractures are rare. In fixed partial dentures, they are usually associated with long distal cantilevers. During retrieval of the prosthesis, the coronal part of the fractured implant usually comes out in one piece with the abutment (Figure 7). Because the apical fragment is

often well osseointegrated, a rotary trephine instrument must be used to remove it. If necessary the same site can be reused (following adequate healing) to install another implant.

Technical problems related to overdentures

Overdenture retention loss requiring adjustment is the most frequent post-insertion problem. It partly reflects the tendency of attachments to wear over a period of time, due to cyclic occlusal loading. On the other hand, denture-bearing areas which are not close to the implant region resorb over years and relining of the denture may be required to improve denture stability. Bar-clip, ball-stud and magnet attachments are common retention systems. However it is still unclear as to which type is most suited to a given application. In terms of frequency of aftercare and total costs, an 8-year randomized clinical trial on mandibular implant-retained overdentures showed that a bar on two implants was preferable to a triple bar on four implants or ball attachments on two implants¹⁸. Notably, the stability or success of the implant-retained overdenture should not rely solely on the attachments. In such matters, the quality of the denture (fit, extension, vertical dimension, jaw relationship and tooth setting) should not be overlooked.

Conclusions

Most implant complications can be prevented by careful case selection and treatment planning. New implant connection designs, ceramic materials and CAD/CAM technology facilitate the fabrication of prostheses with much enhanced longevity. However, no matter how sophisticated the implant technology, failures do occur. Dentists should always be prepared for failures, and inform patients about this possibility well before treatment is commenced¹⁹.

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