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CASE REPORT

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Exotic encounters with dental implants: managing complications with unidentified systems

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ABSTRACT

As the application of dental implants increases worldwide, so is the number of technical and biological complications that general dental practitioners will be called to manage, while maintaining implant patients. In addition, the greater patient mobility encountered today combined with a growing trend of 'dental implant tourism' will very often result in situations where the dentist is requested to deal with complications in implants placed elsewhere and which sometimes might be of an 'exotic' system one cannot directly recognize. Such a situation can pose significant challenges to even experienced clinicians. The challenges are not only in the scientific field, but often include professional and ethical implications. This case report will discuss strategies for the management of implant complications in cases of unidentified implant systems. Critical factors in such situations would be the clinician's experience and special training, the correct radiographic technique, as well as access to the appropriate tools and devices.

Keywords: Dental implants, technical biological complications, clones, prosthetic reconstructions.

Abbreviations and acronyms: ARTG = Australian Register of Therapeutic Goods; FDP = fixed dental prosthesis; FPD = fixed partial denture; PFM = porcelain fused to metal.

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INTRODUCTION

Replacement of missing teeth with dental implants is one of the most rapidly increasing treatment modalities for edentulism. The advancement in our understanding of tissue healing, as well as continuous improvement in technology has extended the indication of dental implants to a wide portion of the population, ensuring long-term successful and highly predictable treatment outcomes. Despite the achievements of the last decades, treatments with dental implants are not free of complications, the majority of which can occur many years after successful installation/restoration. Such complications have in many cases significant consequences for the patient. In addition, the management of such complications would claim significant chairside time, costs and effort.[1]

Typically, we would classify long-term implant complications to *biological* and *technical*, although in reality there exists a complex interrelation between biology and technical components, to the extent that often a biological problem can manifest itself as a technical failure or vice versa.[2] Biological complications mainly include plaque-induced *peri-implant mucositis* and *peri-implantitis*. As these are relatively new pathological entities, there still exists a degree of controversy as to their aetiopathogenesis and prevalence. However, a recent consensus paper estimated on the basis of published research that peri-implant mucositis can affect as much as 50% of the implants placed, while peri-implantitis between 12% and 43%.[3] However, a recent survey of Australian specialists showed that the majority of periodontists reported peri-implantitis to affect no more than 25% of their implant patients in maintenance.[4]

Technical complications on the other hand cover a wide diversity of problems, spreading from chipping of the porcelain in porcelain fused to metal (PFM) implant crowns, to fractures of metal or acrylic framework, fractures or loosening of abutment screws, loss of retention, fracture of implant fixtures and more. A recent systematic review concluded that as many as 40% of patients with implant supported fixed partial dentures (FPDs) will be affected by some sort of complication in the first five years of function,[5] the management of which will require chairside time and specific interventions.

Therefore, it is inevitable that dentists will sooner or later be confronted with some sort of complication of implant treatments while maintaining their patients. A large percentage of implant patients today will receive implants and consequent maintenance through the general dental practitioner.[6–8] Consequently, modern dental curricula are being adjusted in Australia and worldwide to ensure that dental graduates are not only prepared to maintain implant patients, but also to early detect complications and act accordingly to prevent further problems.[9,10]

In addition, today we experience a greater mobility of patients and a growing trend of 'dental implant tourism'.[11] This will very often result in situations where the dentist is requested to deal with complications on implants placed elsewhere and which sometimes might be of an 'exotic' system one cannot directly recognize. Such a situation can pose significant challenges to even experienced clinicians and this article will attempt to discuss strategies for the successful management of such patients. Critical factors here would be the clinician's experience and special training, as well as access to the appropriate tools and devices.

A case study

Let's start with an example: a 55-year-old male patient requested an emergency appointment. He mentions that six months ago he received an implant supported FPD in the lower jaw during a trip abroad, with which he is in general satisfied. Unfortunately, he recently realized that the right side feels slightly mobile (Fig. 1).

Upon examination, it becomes apparent that the abutment screw of the distal implant on the right side has fallen off (Fig. 2). In addition, there is a whole 'wall' of calculus underneath the hybrid denture (Fig. 3a), as access to the peri-implant area for oral hygiene is completely blocked by the reconstruction. This has resulted in an advanced mucositis, with severe bleeding at the lightest touch of the area underneath the denture (Fig. 3b).

In such cases, we simply do not have the option of referring the patient back to where the restoration was made. Without doubt, we want to help the patient return to a healthy condition and maintain it. However, there is a series of challenges that we have to respond to.

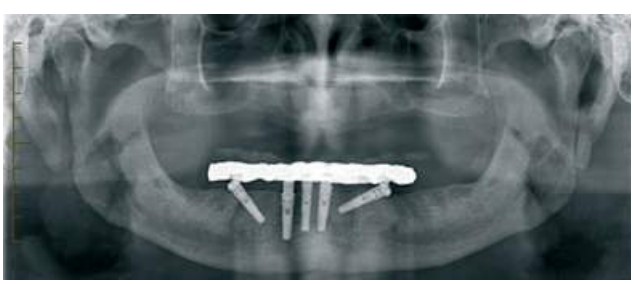

Fig. 1 OPG radiograph of the hybrid screw-retained denture in the lower jaw.

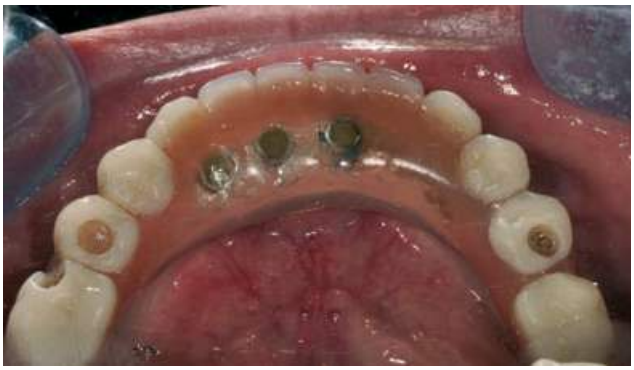

Fig. 2 Occlusal view of the screw-retained reconstruction, where the loss of the access hole filling of the right distal implant is visible.

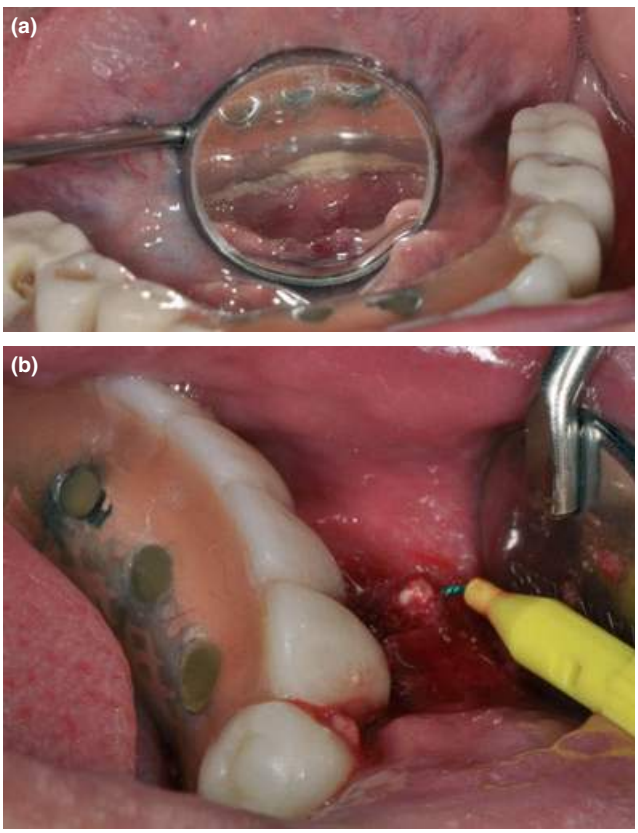

Fig. 3 (a) A thick layer of calculus is visible at the lingual side of the denture, between the metal framework and the alveolar process. (b) Severe bleeding provoked at the slightest attempt to access the area around the implants with an interdental brush.

1. Can we identify the implant system?

The prerequisite for every treatment is knowledge of the respective implant system and access to the appropriate tools. Even in the case of biological complications, where the treatment is not system-specific, removal of the reconstruction is a necessary first step in order to

have direct access to the inflamed area. With the increasing number of implant systems available – many of which are very similar – identifying the implant system can be a difficult challenge to even very experienced clinicians. The radiographic image is in most cases the only available hint as patients rarely have a card with information of the treatment or a copy of their dental records.

Certain websites can be helpful in this task. Sites such as *what implant is that*,[12] *Osseosource*[13] and *Whichimplant*[14] are equipped with a search engine that allows identification of implants through its radiographic characteristics. In addition, the site *Whichimplant* has a very good database of implant sizes and dimensions which could further help differentiate between original implants and 'clones'. Such sites can help an experienced clinician, but in most cases contact with the doctor who placed the reconstruction if possible, appears to be the safest way. And even if the implant system is finally identified, the quest is still only at the beginning.

2. Is this an implant system I can work with?

This can be broken down to many more questions. Do I have access to the tools needed to unscrew abutments and remove components? Is this system available in Australia so that I can easily order a new screw? Very often, especially in treatments done abroad, implant systems will be used that are not available or represented in Australia. You might be still able to order tools and components through the internet, but this might raise some important legal implications: certain implant parts and components are sold as medical devices and as such they require a specific licensing procedure through Australia's Therapeutic Goods Administration. Unless a specific exemption has been granted, it is a criminal offence under the *Therapeutic Goods Act 1989* to import into, supply in or export from Australia, a medical device that has not been entered onto the Australian Register of Therapeutic Goods (ARTG).[15] If the specific system is not available in Australia, it might be that it is also not certified as a medical device under the country's law and the use of any of its components in patients might lead to legal complications, especially if something goes wrong.

Often, we will be informed by the patient or the overseas dentist who restored the implants that the system used is 'compatible' with company 'X', with X implying a major company that is also represented in Australia. However, using components of company X on the 'compatible' system is not covered by any warranty and there is little to ensure that we are not running risks for further problems in the future. Very often, 'compatible' components have visible morphological differences with the originals (Fig. 4a,b and 5a,b), which might significantly affect their mechanical properties. Just like in every other market, the market of 'compatibles' or 'clones' includes some components made under high quality standards and others that are of very low quality and there is very little other than trial and error to help the clinician differentiate one from the other. Errors in this area can be very costly for both dentist and the patient.

3. Why did the complication occur?

A critical issue is to identify the possible reasons for the complication. Implant complications, especially the technical ones do not occur 'randomly'. In most cases

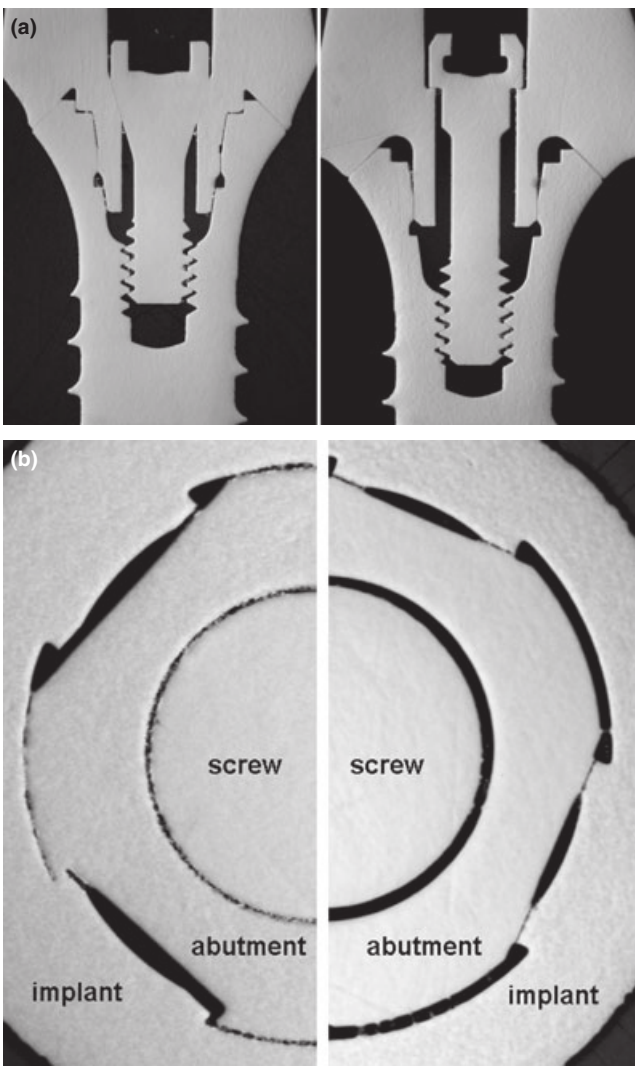

Fig. 4 (a) Photograph of a vertical slice of an implant-abutment junction. Morphological differences are obvious between the original implant/abutment (left) and a 'compatible' abutment or 'clone' in the right. (Image courtesy Straumann AG, Switzerland.) (b) Photograph of a horizontal slice of an implant-abutment junction. Morphological differences and wider gaps are obvious between the original implant/abutment/screw (left) and a 'compatible' abutment/screw or 'clone' in the right. (Image courtesy Straumann AG, Switzerland.)

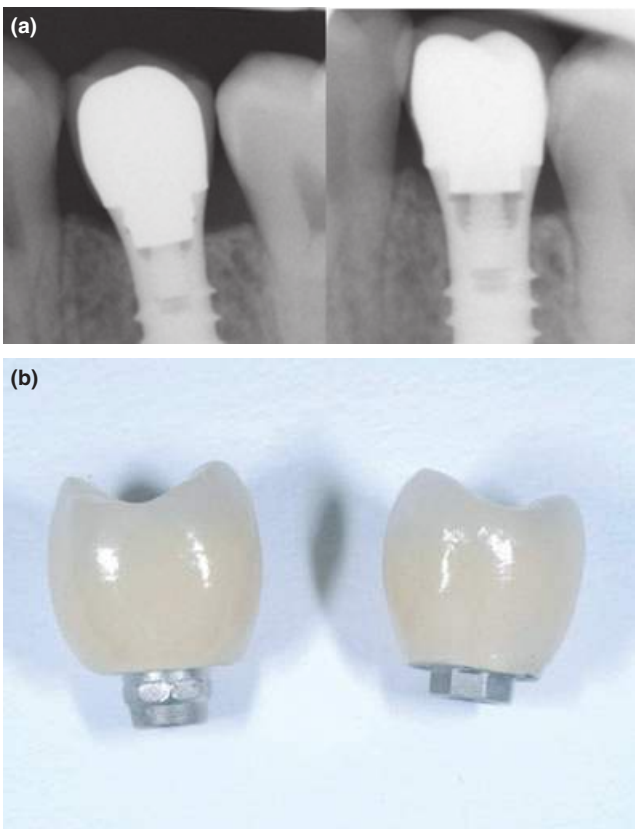

Fig. 5 (a) and (b) Radiographs of Straumann implants restored with original (left) and compatible (right) prosthetic abutments. Observe the difference of the length of the abutment in the conical connection in both cases.

there is some hidden underlying problem, which unless we can identify, we run the risk of having the complication repeated in the future.[16] In this particular case, a loosening of the screw might be attributed to several factors:

- Was the screw not tightened to the correct torque value?
- Was there a defect in the threads or the head of the screw?
- Was there any incompatibility between the implant and the screw threads?

If the underlying reason was any of the above, then replacing the missing screw with a new one and proper torque tightening will most likely solve the problem. But what if there was any tension in the metal framework due to incorrect fitness of the denture? In that case replacing the screw will only mask the problem for a while, until another loosening or fracture occurs, most likely to the same place.

When a bridge is placed on natural teeth, even if the metal framework fits with some tension, the strain could slowly cause a drift of the teeth (like an orthodontic movement) and bring them in a more favourable position to neutralize the tension from the framework. Natural teeth can adjust to strain and pressure, which is the principle that all orthodontic manipulations are based on. However, in the ancylotic implant this will not happen. Any tension imposed by an ill-fitting framework will be carried on to the implant-abutment junction and the implant, and will most likely result in a complication in the form of screw loosening or a fracture in due time. Even with careful impression procedures, dimensional changes between impression and cast model can lead to significant three-dimentional distortion, which can cause 'misfit' of the reconstruction and result in tension concentrating in specific parts of the implant prosthesis.[17] If not corrected, misfits of the framework under the cyclic loading of a functioning reconstruction will eventually result in fatigue related complications.[18] A carefully taken set of radiographs and the clinician's tactile perception while tightening the screws might be the only way to identify such 'ill fitting' reconstructions.

Occlusion or the presence of parafunctions might also be an important factor, as any premature/lateral/unbalanced contacts could place more strain or apply bending forces in specific parts of the restoration. The design of occlusion has been found to affect the tension distribution through the framework of the fixed dental prosthesis (FDP).[19] Patients with dental implants have reduced perception due to the absence of the periodontium and are often unable to maintain a precise occlusion.[20] Careful inspection with functional examination and articulation paper might offer some hints of damaging occlusal interferences.

Although careful clinical and radiographic examination might help to identify the problem, removal of the reconstruction will most likely be required for this examination to be complete. A digital radiograph with parallel cone technique is also a necessity. By manipulating the angle of the cone, as well as the brightness, contrast and depth of exposure on the screen, one can better identify the relationship between the metal components, implants, screws and abutments.

4. How to conduct a radiographic examination on an implant?

It is of utmost importance to secure that the direction of the cone is absolutely parallel to the implant threads. Only in this way one can evaluate the relation between all parts of the implant and the prosthetic reconstruction. In cases where multiple implants are placed (often with slightly different angles), there might be a need to take an individual radiograph for each of the placed implants, in order to examine all parts correctly. Implant threads will appear sharp if the radiograph is taken with optimal parallelism and unsharp if the angle of the beam is wider or more narrow in the axial direction (Fig. 6a,b,c).

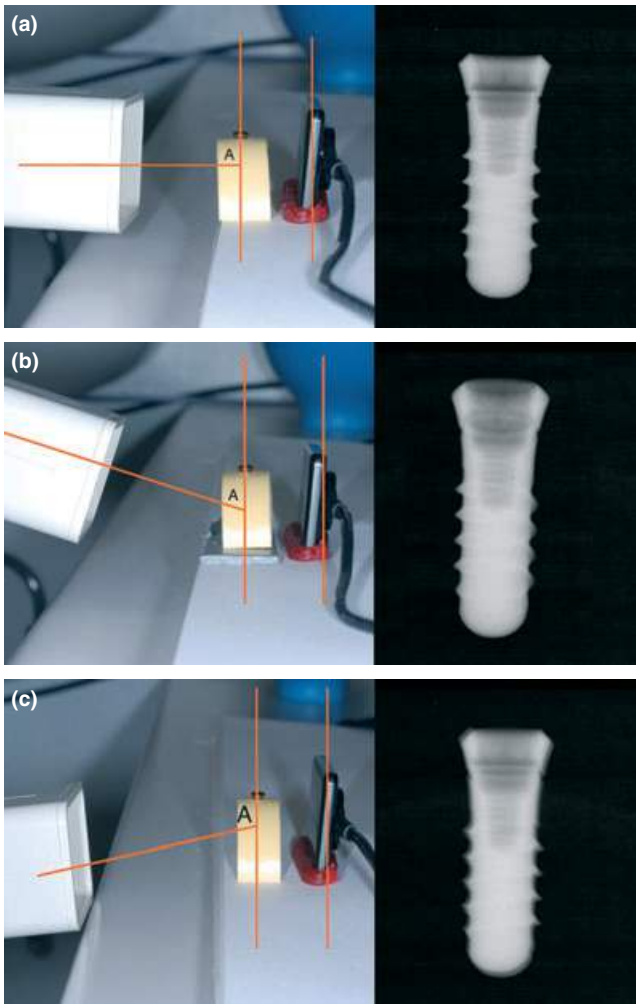

Fig. 6 (a) Radiograph taken with optimal parallelism. Observe the sharpness of the threads in both sides of the implant. (b) Radiograph taken with a narrow axial angle (A). Observe the threads are depicted with sharpness only in the left side of the implant. (c) Radiograph taken with a wide axial angle (A). Observe the threads are depicted with sharpness only in the right side of the implant.

For example, with the implant fixture in Fig. 6 (Straumann), if the threads are sharp only on the left side – the radiograph is taken with a narrow axial angle (Fig. 6b). To correct the image one will need to take the radiograph widening the angle. If the threads are sharp only on the right side – the radiograph is taken with a wide axial angle (Fig. 6c). To correct the image one will need to close up the angle of the beam. This applies to implants placed both in the maxilla or mandible (Fig. 7).

A clinical example: a patient is referred because of a 'loose' bridge. The radiograph sent with the referral letter is taken with a too wide axial angle and shows no gap between implants and the abutments (Fig. 8a).

The first radiograph taken in our clinic (Fig. 8b) reveals a gap in the connection of the right implant but not of the left implant. This would imply a misfit of the framework. But, in this radiograph, only the right

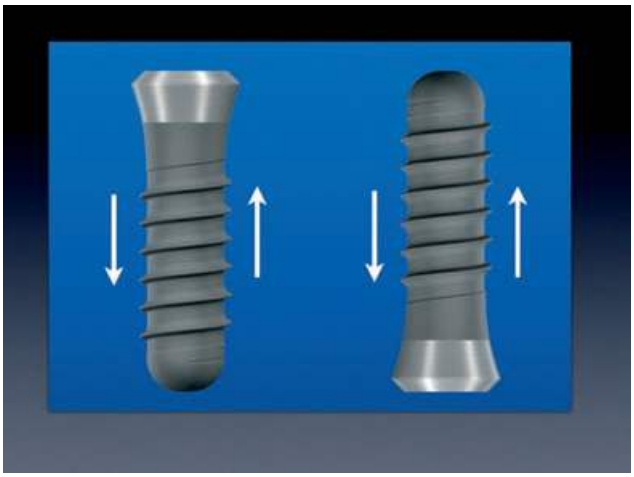

Fig. 7 The sharpness of the threads as depicted in the radiograph depends on the parallelism of the beam and not on the location of the implant in the maxilla or mandible.

implant is taken in an absolutely parallel direction. An indication of parallelism is that the implant threads appear 'sharp' on both sides of the fixture. Looking carefully at the left implant fixture, one can see that the threads are sharp only on the right side, suggesting that the radiograph is taken with a wide axial angle with regards to the left implant.

The radiograph is now being repeated (Fig. 8c) with a wider angle and the left implant is now correctly depicted. The threads are sharp on both sides of the implant. Observe that now a gap is visible on the left implant. When seen together with the first radiograph (Fig. 8b), this indicates that the problem is not a misfit but rather the bridge being loose on both implants. Notice that the right implant in the second radiograph does not show any visible gap and that the threads are only sharp on the left side this time, suggesting that the radiograph is taken with a too narrow axial angle.

Conclusively, the complete extent of the problem cannot be evaluated in this case, unless we take one radiograph for each of the implants with absolute parallelism. Radiographs that are not taken carefully often conceal more than they reveal.

Course of actions

To return to the patient case used previously as an example, the implant system used was not available in Australia. We could use a compatible screw from company 'X', without the security that the problem will not reoccur. The most critical issue was that of access to oral hygiene (Fig. 9). The patient already suffered from an extensive mucositis, which would most certainly turn into a peri-implantitis and could threaten the survival of the implants in the long term. The denture had to be unscrewed, calculus had to be removed, implant surfaces

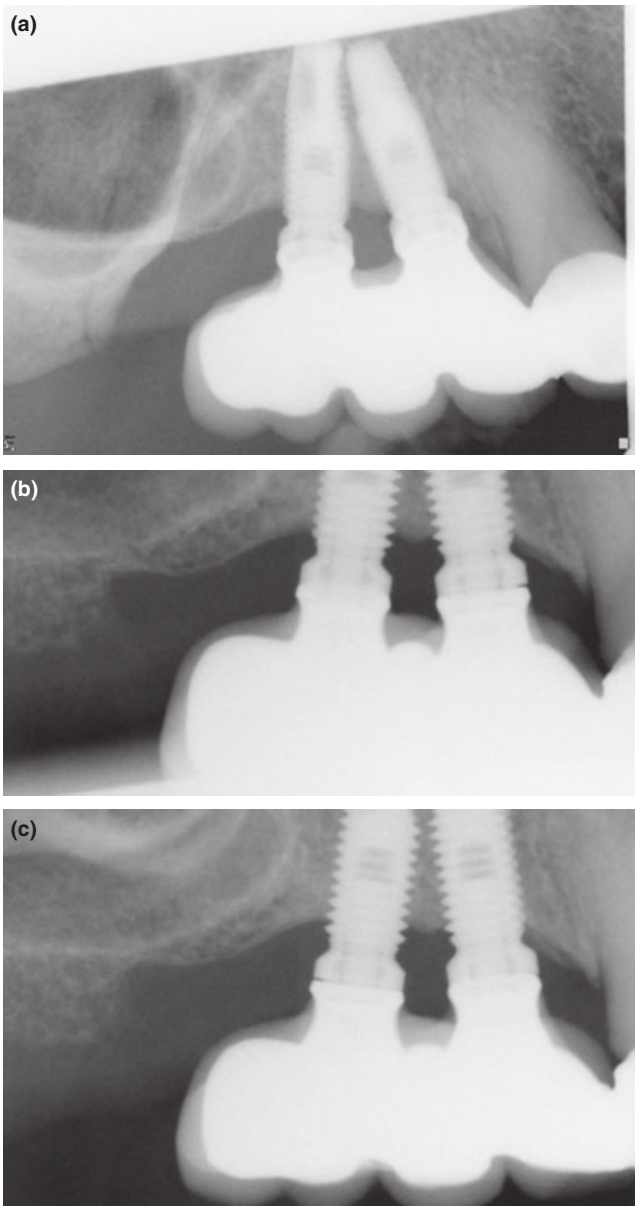

Fig. 8 (a) The radiograph shows no gap between the implant and the prosthetic reconstruction. However, when observing the sharpness of the threads one can suspect the radiograph is taken with a too wide axial angle. (b) The radiograph reveals a gap in the connection of the right implant but not of the implant left. Again, when observing the sharpness of the threads it is evident that only the right implant is taken in an absolutely parallel direction. (c) The third radiograph taken with a wider axial angle now reveals a gap on the left implant. The threads are sharp on both sides of the left implant, but not the right this time.

polished and the acrylic/metal framework trimmed in such a way that oral hygiene will be possible around the implants. Such intervention, although necessary, is by no means guaranteed to solve all of the problems, or at least to not create new ones, especially those of a technical nature.

Removing the screws with a 'compatible' screwdriver, replacing the missing screw with a 'compatible' screw and trimming, thus weakening the prosthesis framework at key points, might predispose to further complications in the future. The decision on how to proceed should be carefully considered and the patient must be informed of the compromise and risks undertaken at any stage. Balancing the benefits from any possible intervention with the risks of future problems is not very easy. Patient informed consent is very important in such cases. Refusal to undertake further action could also be justified on the basis that proceeding with an intervention might mean inheriting 'sins' of the past from a treatment that was done in a non-optimal way.

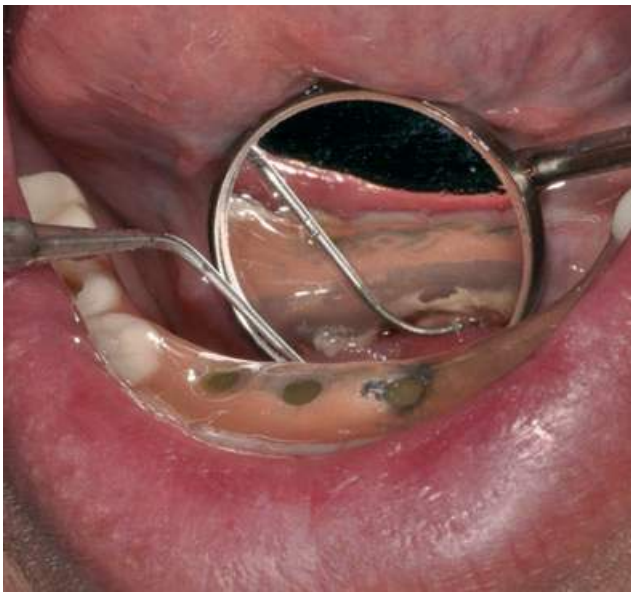

Fig. 9 Any attempt to clean the implants and effectively remove calculus is impossible without removal of the reconstruction.

Quick Guide

What to do if you restore implants

- Ensure optimal oral hygiene is practised.
- Design implant prosthesis so as to allow access for oral hygiene.
- Design the occlusion free of damaging interferences, while guiding occlusal forces apically.
- Ensure tension-free (passive) fitness of the bridge framework.
- Follow all manufacturer's instructions and scientific guidelines and document every step.
- Use an implant system you trust which is supported by good scientific evidence.
- Avoid using 'compatible' prosthetic components, copies or components of questionable origin, even if they appear to be identical to the ones of the original system.
- Document your baseline: give a plastic implant ID-card to your patients with all related information and a baseline radiograph.

What to do if an exotic encounter comes your way

- Can you identify the implant system?
- Do you have access to original components and devices?
- Can you identify the underlying reason that led to the actual complication?
- Can you correct it?
- Can you prevent recurrence of the complication?

If the answer to any of the above is negative, consider carefully before you proceed with any intervention. In many cases the risks one undertakes outweigh the benefits. A referral to a specialist clinic is in most cases justified and might be a far more beneficial option in the long term.

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