Implant Complications and Failures: The Fixed Prosthesis

D. TINSLEY, C.J. WATSON AND A.J. PRESTON

Abstract: **The implant-retained fixed prosthesis has been advocated as an effective restoration offering significant benefits over conventional prosthetics. The success of treatment depends on careful pre-surgical planning and prosthesis design. This paper outlines some common complications encountered during the planning, fabrication and maintenance of both large and small fixed prostheses and suggests how these complications can be minimized.**

***Dent Update* 2002; 29: 456–460**

Clinical Relevance: **The pitfalls of implant treatment are rarely discussed. Design and position of the implant, prosthesis design and inadequacies of the soft and hard tissue can all create complications. This paper highlights complications which the practitioner should be aware of and avoid.**

Where patients have lost a number of teeth an implant-retained prosthesis may be the restoration of choice. Whether this restoration is removable by the patient or fixed is dependent on a number of factors. For instance, patients often undertake implant treatment in an attempt to alleviate the necessity to wear a conventional removable prosthesis. They may wish to avoid preparation of their natural teeth to support conventional crown and bridgework and, understandably, may request an appliance that is fixed, feels natural and more fully restores oral function and self-esteem. This becomes a major factor in determining the type of restoration.

Advantages of fixed prostheses include enhanced masticatory efficiency, increased confidence in function and a reduced incidence of food trapping under the appliance. In addition, fixed prostheses are generally more comfortable and less bulky in design. It is also well documented that the maintenance commitment is less for the fixed option than for removable implant-retained overdentures.[1–3]

However, the use of the fixed prosthesis is not without its complications. More implants are generally required to support a fixed prosthesis than for the removable option, which makes the surgery more time-consuming and expensive and necessitates careful planning and interdisciplinary teamwork and co-operation. From a restorative point of view, these cases can be complex and mistakes can be costly – in terms of both implant failure and expense of remakes.

The purpose of this paper is to discuss a selection of complications that may be encountered during the restorative phase of the construction of fixed implant-retained prostheses.

***D.Tinsley**, BDS, MDSc, MFDS RCS, Lecturer in Restorative Dentistry, **C.J.Watson**, BDS, FDS RCS, PhD, Senior Lecturer/Honorary Consultant in Restorative Dentistry, and **A.J. Preston**, BDS, PhD, FDS RCS, Lecturer/Honorary Specialist Registrar in Restorative Dentistry, Leeds Dental Institute.*

IMPLANT POSITIONING

Correct positioning of the implant is crucial to success: a fixed prosthesis has no flange that can cover and mask the malpositioning of the implants, and presurgical treatment planning is vital. A diagnostic wax-up followed by construction of a surgical stent should reduce the incidence and degree of positional complications. Other surgical techniques, such as bone augmentation and ridge expansion, may also be indicated to ensure that the implants can be placed in the optimal position. Figure 1 demonstrates how aesthetics

***Figure 1.** An attempt has been made to restore an atrophic ridge without augmentation. In this case the long crown length and compromised emergence profile has led to an aesthetically poor result: crowns with a long clinical height and poor emergence profile. In addition, the patient's ability to clean beneath the bulky crowns and pontics was significantly impaired.*

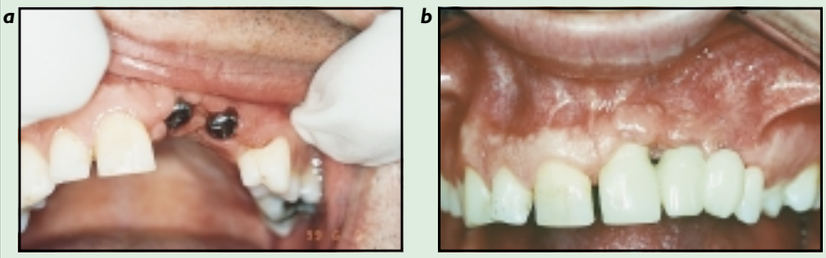

Figure 2. (a) *Poorly positioned implants – implant placement does not exactly replicate original root position.* ***(b)*** *Aesthetically compromised restoration of implants shown in (a).*

in the front of the mouth can be compromised by poor positioning of implants.

Implants placed in the aesthetic zone must be inserted within the alveolar bone in a position similar to that of the natural roots they replace. Failure to achieve this compromises aesthetics, emergence profiles and patient hygiene (Figure 2). The case in Figure 2 was compromised from the beginning, as there was a significant labial bone deficiency. Although a socket expansion technique was used, the central implant was placed 2 mm distal to its ideal position, and the distal implant between where the lateral incisor and canine natural roots would have been. This resulted in inability to produce an ideal crown morphology in the final restoration. The central and lateral incisor restorations had poor emergence profiles and an inadequate regeneration of the interdental papilla. The pre-operative surgical planning in this case should have considered bone grafting procedures in order to produce adequate bone volume.[4]

Placing implants too close together creates problems both during the restorative phase (Figure 3) and for patient maintenance and plaque control in the long term. It may also result in abutment seating problems as abutments tend to be wider than the implant itself.

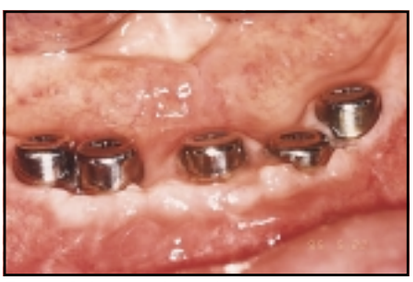

Figure 3. *Lower right implants positioned too closely together.*

The height of the implant can have a significant effect on the aesthetic result. Figure 4 shows an example of suboptimal aesthetics caused by placing the implants at different levels. The implants were evidently placed at the time of extraction of the remaining lower natural teeth and subsequent bone resorption has exposed the neck of the implants, resulting in crowns of non-uniform length.

Placing implants as near parallel as possible considerably simplifies bridge construction. In the situation shown in Figure 5, the central implant had to be left 'sleeping' owing to the mesial angulation of the distal implant. However, in many similar cases it would be feasible to use abutment designs, which could be customized either at the chairside or within the laboratory, to overcome the problem of lack of parallelism.

RESTORATIVE PROBLEMS

Design of the Fixed Prosthesis

The final fixed prosthesis should restore function and aesthetics but limit the occlusal loads transferred to the supporting implants to within physiological tolerances. When designing this type of prosthesis the following points should be considered:

- Excessive cantilevers, bulky crowns and designs that interfere with effective hygiene measures should be avoided.
- If possible, bridges should be made retrievable so that repair and additions can be completed with reasonable ease.
- The fixed prosthesis should not be too wide in a labiolingual direction. Ideally, the bulk of the framework should be similar in thickness to the width of the implants, so that no undercuts are created that may interfere with cleaning.
- To achieve good oral hygiene there must be a space beneath the superstructure large enough to allow cleaning aids such as 'Super Floss' and bottlebrushes to be used. Figure 6 shows the result of a poorly designed fixed prosthesis, which inhibited cleaning and necessitated regular removal for maintenance.
- If the cleansing space is too large, however, particularly in the anterior region of the upper arch, aesthetic problems may present (Figure 7). Phonetics might be affected, with patients complaining of whistling

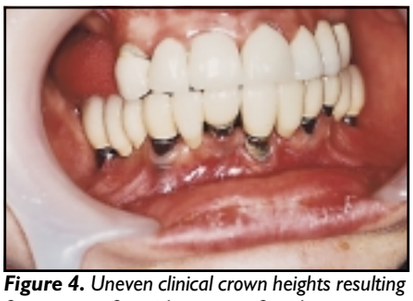

Figure 4. *Uneven clinical crown heights resulting from non-uniform placement of implants.*

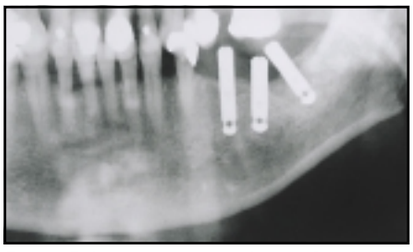

Figure 5. *Inappropriate angulation of implants.*

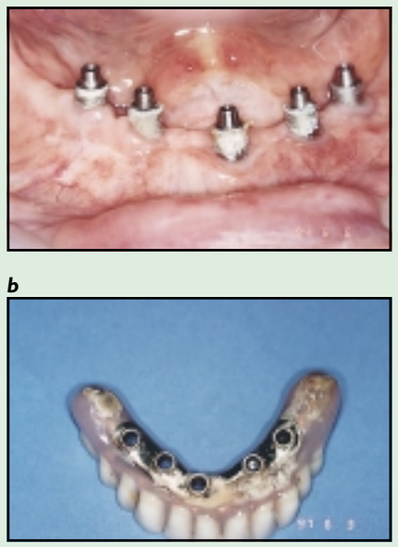

Figure 6. (a) *Implants covered with calculus, which was discovered after removal of the fixed prosthesis.* ***(b)*** *Under-surface view of rather bulky fixed prosthesis with adherent debris.*

during speech and difficulty in pronouncing certain words. Patients can also experience an embarrassing escape of saliva through the gaps while speaking.

The rigid connection of teeth to implants is a relative contraindication and area of debate. For example, in Figure 8 a large upper 14-unit bridge has been cast in one piece. Natural teeth and implants have been used as abutments and have been rigidly connected. However, the bridge debonded from the natural teeth and the abutments became carious (Figure 8c). The fact that this was restored as one unit, joining implants and natural teeth, has made maintenance and remedial work difficult and costly. The bridge required sectioning to gain access to the implants and the natural teeth retainers. Some implants and natural teeth were lost and the patient had to revert to an overdenture. The functional life of this expensive full upper arch fixed restoration was less than 5 years. If the connection of natural teeth to implants is unavoidable, then a movable joint should be incorporated into the design of the bridge to protect against the retainer debonding from the natural tooth;[5,6] alternatively, the natural tooth could be protected with a gold coping and the bridge cemented with a temporary luting agent.[7]

It is important therefore that the bridge design should account for future ease of retrievability and maintenance. This would be aided where possible by breaking long-span bridgework up into smaller units that the clinician can remove if necessary. Despite these concerns, however, there is emerging evidence that the connection of implants to natural teeth may have value in some patients,[8] especially in short spans.[9]

Try-in of the Superstructure

For the construction of the superstructure, an accurate impression is required. The use of well fitting impression posts that reinsert into the impression positively and only in one position is essential. Some manufacturers advocate the use of an open tray, together with impression plaster or similar material, to link the impression copings rigidly. The casts can then be poured and the superstructure constructed.

Figure 7. *In the maxillary fixed prosthesis a gap or 'black triangle' with associated shadowing can be seen. This is due to placement of bulky, long clinical crowns with poor emergence profiles. The spacing at the gingival margins also had a deleterious effect on the patient's speech.*

The superstructure should be tried in the mouth before positioning the teeth. Passive fit of the superstructure can be difficult to assess (Figure 9).[10–12] Jemt[13] has described a method to judge the level of accuracy of fit of a superstructure. He states that the framework should not tilt or tip when

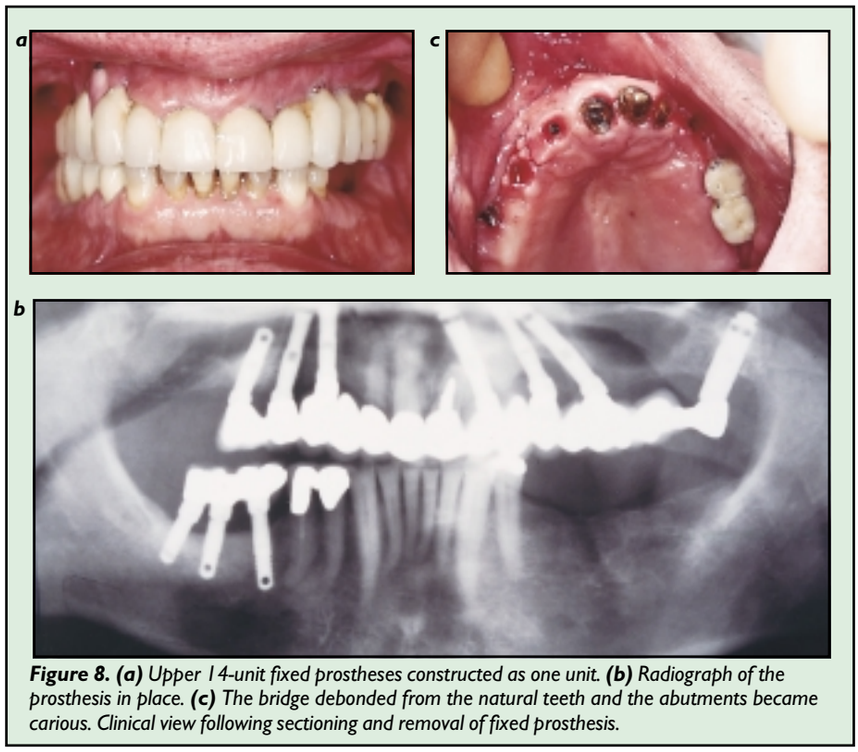

Figure 8. (a) *Upper 14-unit fixed prostheses constructed as one unit.* ***(b)*** *Radiograph of the prosthesis in place.* ***(c)*** *The bridge debonded from the natural teeth and the abutments became carious. Clinical view following sectioning and removal of fixed prosthesis.*

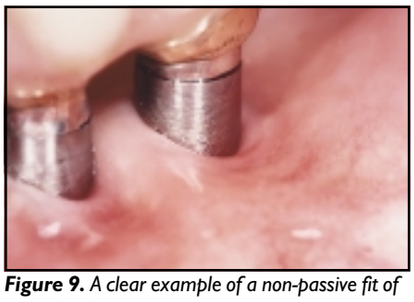

Figure 9. *A clear example of a non-passive fit of superstructure.*

either of the distal screws are inserted and tightened. In our experience, patients should not experience pain or tension when all the bridge screws are secured.

It is important that the seating of transmucosal abutments are confirmed radiographically before fabricating the superstructure. In the case shown in Figure 10, the transmucosal abutment was not seated on the lower right distal implant. This error necessitated an expensive remake of the fixed prosthesis. It can be seen, therefore, that even a relatively minor, undiscovered discrepancy in transmucosal abutment seating could result in a major corrective procedure.

Significant problems can arise when a superstructure links individual prepared abutments. If the implant alignment does not allow retrievability and if the implants do not have an anti-rotational device, the abutments must be screwed down before placing the overlying bridge. It is during the application of the final preload to the abutment screws that the abutments can turn slightly, resulting in the loss of fit of the bridge. To overcome this problem, the abutment must be first secured in the mouth, then an impression taken of the abutments in this position. The abutments are then temporized and the final bridge constructed on a cast poured from this new impression.

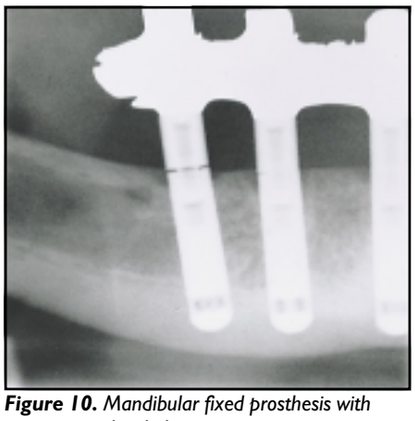

Figure 10. *Mandibular fixed prosthesis with non-seating distal abutment.*

Owing to the necessity to place implants in the anterior region of the mouth to avoid anatomical structures and to use the maximum height of bone available, it is often necessary to cantilever the bridge. The cantilever must not be too long because this can result in unnecessary application of torque to the implants, leading to eventual failure or to fracture of the cantilever itself[14] (Figure 11). The cantilever must also be clear of the tissues, otherwise proliferation and ulceration can result, especially if the patient fails to attend for regular reviews. This situation is illustrated in Figure 12, where a mandibular fixed bridge prosthesis was removed for the first time 5 years after placement. Poor hygiene and plaque build-up, combined with some soft-tissue proliferation and alveolar bone changes under the distal cantilever, resulted in a painful deep ulcerated lesion. This rapidly resolved once the bulk of the cantilever had been reduced to allow more effective hygiene.

Maintenance

If the implant angulation and position is such that the emerging screw heads do not compromise the aesthetics, then the bridge can be designed to be retrievable by the dentist. Figure 13 shows a patient who developed hyperplasia around titanium abutments. The removal of the superstructure enabled access to the abutments for cleaning and debridement. The fact that the prosthesis was removable aided maintenance, simplified remakes and repairs, and enabled professional cleaning and hygiene to be carried out on a regular basis.

Long-term complications and maintenance problems can result from the high occlusal forces that are generated during vigorous chewing (Figure 14). Another consequence of increased occlusal loading is enhanced wear of the prosthesis, especially if acrylic

Figure 11. *Poor design of the cantilever can lead to fracture of the bridge.*

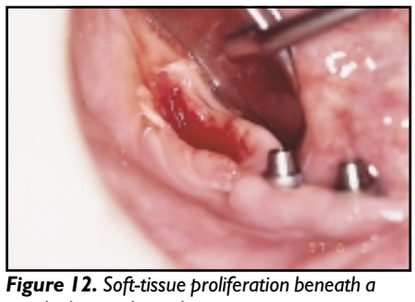

Figure 12. *Soft-tissue proliferation beneath a poorly designed cantilever.*

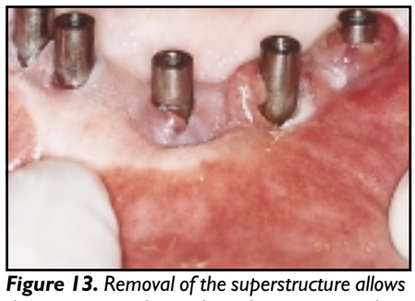

Figure 13. *Removal of the superstructure allows direct access to the implant abutments to aid cleaning.*

Figure 14. *The acrylic, together with the teeth, have fractured from the underlying superstructure of an upper fixed prosthesis in a bruxist.*

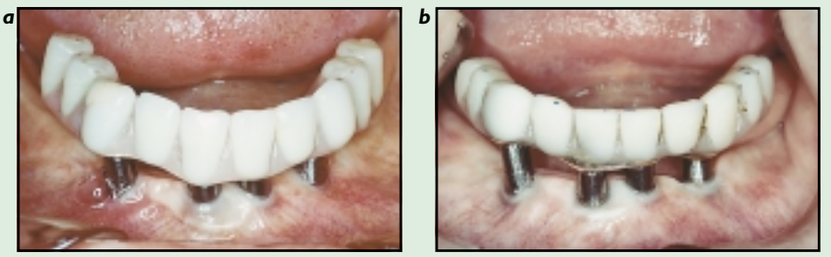

Figure 15. (a) *Fixed prosthesis at insertion.* ***(b)*** *Occlusal wear of acrylic teeth on the fixed prosthesis, which developed over a 2-year period.*

teeth (as opposed to porcelain teeth) have been used (Figure 15). This can be reduced by the use of reinforced acrylic teeth. This phenomenon can also apply to the opposing denture (Figure 16).

The higher occlusal forces generated by the patient can cause increased resorption of the opposing ridge, resulting in instability of the denture. Corrective relines or repairs can become time-consuming and expensive to both dentist and patient.[3] Patients should be made aware of this possibility at the commencement of treatment.

SUMMARY

The implant-retained fixed prosthesis can provide a useful treatment option for the partially dentate and edentulous patient for whom a removable denture is undesirable, although it may also be expensive.

Careful planning of implant position and subsequent bridge design is critical for optimal results: technical and clinical errors can be extremely costly to rectify.

The need for ongoing maintenance in the implant-retained fixed prosthesis is less than that for implant-retained overdentures.

The increased occlusal forces generated after the restoration of the implants can lead to problems with an opposing prosthesis.

REFERENCES

1. Watson CJ, Ogden AR, Tinsley D, Russell JL, Davison EM. A 3- to 6-year study of overdentures supported by hydroxylapatite-coated endosseous dental implants. *Int J Prosthodont* 1998; **11:** 610–619.
2. Watson RM, Davis DM. Follow up and maintenance of implant supported prostheses: a comparison of 20 complete mandibular overdentures and 20 complete mandibular fixed cantilever prostheses. *Br Dent J* 1996; **181:** 321–327.
3. Tinsley D, Watson CJ, Russell JL. A comparison of hydroxylapatite coated implant retained fixed and removable mandibular prostheses over 4 to 6 years. *Clin Oral Implants Res* 2001; **12:** 159–166.
4. Sennerby L, Roos J. Surgical determinants of clinical success of osseointegrated oral implants: a review of the literature. *Int J Prosthodont* 1998; **11:** 408–420.
5. Lill W, Matejka M, Rambousek K, Watzek G. The ability of currently available stress-breaking elements for osseointegrated implants to imitate natural tooth mobility. *Int J Oral Maxillofac Implant* 1988; **3:** 281–286.
6. Sullivan DY. Prosthetic considerations for the utilization of osseointegrated fixtures in the partially edentulous arch. *Int J Oral Maxillofac Implant* 1986; **1:** 39–45.
7. Laufer BZ, Gross M. Splinting osseointegrated implants and natural teeth in rehabilitation of partially edentulous patients. Part II: principles and applications. *J Oral Rehabil* 1998; **25:** 69–80.
8. Hosny M, Duyck J, Van Steenberghe D, Naert I. Within subject comparison between connected and nonconnected tooth-to-implant fixed partial prostheses: up to 14-year follow-up study. *Int J Prosthodont* 2000; **13:** 340–346.
9. Olsson M, Gunne J, Astrand P, Borg K. Bridges supported by free-standing implants versus bridges supported by tooth and implant. A five-year prospective study. *Clin Oral Implant Res* 1995; **6:** 114–121.
10. Jemt T, Book K. Prosthesis misfit and marginal bone loss in edentulous implant patients. *Int J Oral Maxillofac Implant* 1996; **11:** 620–625.
11. Jemt T, Back T, Petersson A. Precision of CNC-milled titanium frameworks for implant treatment in the edentulous jaw. *Int J Prosthodont* 1999; **12:** 209–215.
12. Wee AG, Aquilino SA, Schneider RL. Strategies to achieve fit in implant prosthodontics: a review of the literature. *Int J Prosthodont* 1999; **12:** 167–178.
13. Jemt T. Failures and complications in 391 consecutively inserted fixed prostheses supported by Brånemark implants in edentulous jaws: a study of treatment from the time of prosthesis placement to the first annual checkup. *Int J Oral Maxillofac Implant* 1991; **6:** 270–276.
14. Shackleton JL, Carr L, Slabbert JC, Becker PJ. Survival of fixed implant-supported prostheses related to cantilever lengths. *J Prosthet Dent* 1994; **71:** 23–26.

Figure 16. *A fractured cobalt chrome complete denture which was opposed by an implant-retained fixed prosthesis.*

LETTERS

Dental Update would like to devote more space to airing the views and experiences of its readers. If you have a comment or opinion on an article *Dental Update* has published or an interesting case to share with other readers, please send your letter (double-spaced, signed and with an indication that it is for publication, together with any photographs) to:

The Editor, *Dental Update*
George Warman Publications (UK) Ltd,
Unit 2, Riverview Business Park, Walnut Tree Close, Guildford, Surrey GU1 4UX