Comparative Observation of Immediate and Late Placement of Dental Implants With Immediate Loading: A 14-Year Follow-Up Case Report

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INTRODUCTION

Conventional treatment protocols in implant therapy follow a process of healing for 3 months, after tooth extraction, prior to implant placement, and a second healing phase of 3 to 6 months, after implant placement, prior to placement of an implant restoration. This conventional approach was first developed as it was thought that any forces placed onto the implant prior to bone healing would be detrimental to the osseointegration process. Immediate implant placement and immediate loading options have considerably shortened the overall treatment times and inconvenience to patients compared with conventional implant placement and loading protocols.[1,2]

Few studies on immediate placement and loading of implants in the premolar area have been published and have demonstrated adequate short-term outcomes with survival rates ranging between 82.4% and 100%.[3–7] A randomized controlled trial on immediately placed and restored maxillary anterior implants concluded that there were no significant differences in crestal bone levels compared with late implant placement, and also suggested that immediate loading of implants may provide support for peri-implant soft tissue with improvement in the mid-facial margin position.[8]

However, it has been shown that placement of a dental implant into a fresh extraction socket does not limit or prevent dimensional ridge alterations following tooth extraction,[9,10] which predispose these implants to esthetic and biological complications. This has been confirmed by a systematic review, which reported slightly increased risk of esthetic complications with immediate implant placement.[2] Furthermore, long-term follow-up data of over 10 years on immediately placed implants into fresh extraction sockets has not been reported in the literature.

This clinical case report describes the replacement of missing adjacent maxillary premolars with immediate and late implant placement, simultaneous bone grafting, and immediate loading. Comparative observations from the 14-year follow-up of the peri-implant tissue health and radiographic appearance are presented. Furthermore, the restorative management of a technical complication after 14 years of function is discussed.

A description of the case

Diagnosis and Treatment Planning

A 63-year-old female patient presented in 2002 with a missing right maxillary second premolar. Her chief complaint was "I want to get my bridge finalized." Past medical history was noncontributory. A thorough clinical and radiographical examination revealed no pathology, except for a radiolucency in the furcation area of the right maxillary first premolar (Figure 1). Her interim 3-unit fixed partial denture (right first premolar to first molar) was placed after root canal re-treatment of her right maxillary first premolar by her former dentist. The definitive restoration could not be completed since the patient had been experiencing continued discomfort with her first premolar for a few years.

After prosthodontic, periodontic, and endodontic consultations regarding the right first maxillary premolar, its extraction was recommended due to the poor crown-root ratio, the radiolucency in the furcation area and the prolonged discomfort after root canal re-treatment. The patient did not want to get her healthy canine involved with a 4-unit fixed partial denture option, thus the treatment option with implants was considered. However, the patient insisted on having a fixed interim tooth replacement throughout the treatment. Assessment of the local alveolar bone anatomy was performed with cone beam computerized tomography (CBCT), which demonstrated sufficient bone for implant placement. However, a labial deficiency was identified, which required bone grafting for contour augmentation to achieve a natural soft tissue profile. Occlusal surfaces for parafunction/bruxism were carefully evaluated. The placement of 2 implants immediately after removal of the right maxillary first premolar, simultaneous bone grafting, and immediate loading was planned.

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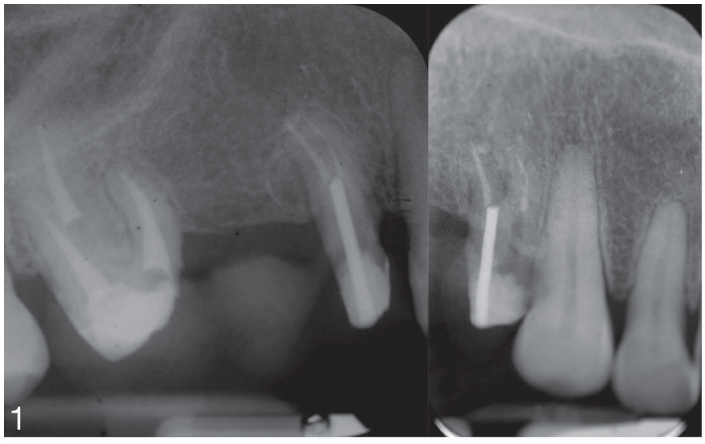
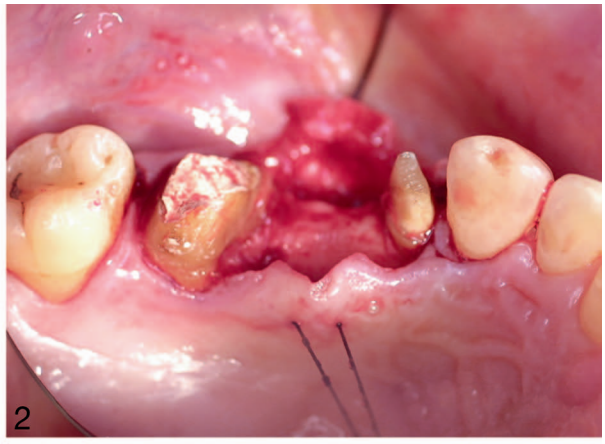
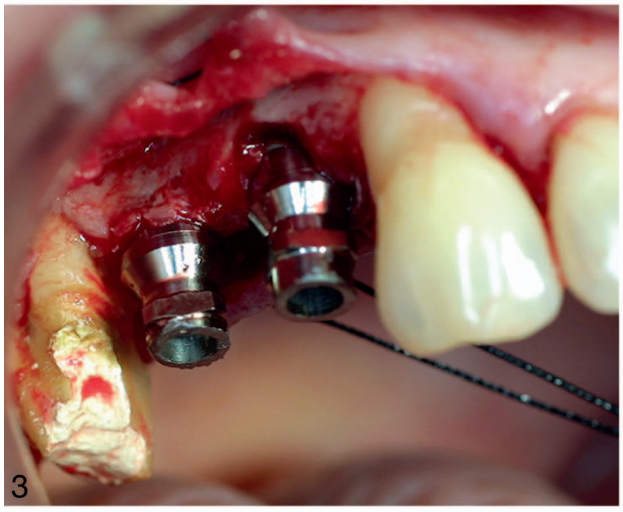
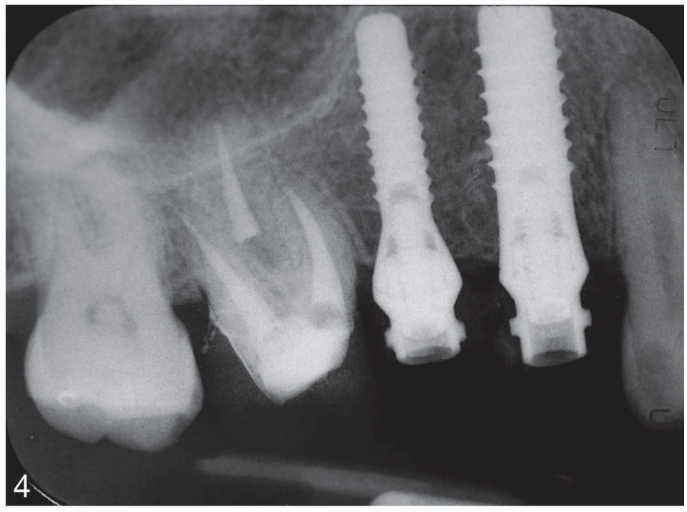
https://doi.org/10.1563/aaid-joi-D-18-00290









Figures 1–5. Figure 1. Preoperative radiograph: Note the radiolucency in the furcation area of maxillary right premolars. **Figure 2.** Evaluation of surgical area after elevation of a full-thickness mucoperiosteal flap. **Figure 3.** Extraction and implant placement. Note the small dehiscence on the buccal aspect of area of maxillary right first premolar. **Figure 4.** Periapical radiograph immediately after implant placement confirms proper implant placement. **Figure 5.** Laboratory fabricated splinted interim restorations 5 months after implant placement.

Consent of the Patient

The patient was informed about advantages and disadvantages of immediate implant placement/restoration including the potential greater risk of failure and the possibility of not being able to perform immediate placement right after the extraction of the first premolar. Other treatment options, including no treatment, were discussed thoroughly and the patient agreed to the treatment plan.

Treatment Rendered

A full-thickness mucoperiosteal flap was elevated (Figure 2), and the right maxillary first premolar was carefully extracted using fine elevator and forceps with care taken to maintain the integrity of the surrounding alveolar bone. The implant sites were then prepared to receive tissue level implants with a sandblasted and acid-etched surface, with a diameter of 4.8 mm and length of 12 mm in the first premolar site, and a diameter of 3.3 mm and length of 12 mm in the second premolar site (Straumann USA, Andover, Mass). Both implants exhibited good primary stability. A small cresto-buccal bone dehiscence of 2 mm $\times$ 2 mm at the first premolar implant (Figure 3) was grafted with autogenous bone collected when preparing the implant sites and covered with a slow-resorbing deproteinized bovine bone mineral xenograft (Bio-Oss, Geistlich, Wolhusen, Switzerland). The graft was covered with a non-crosslinked porcine-derived resorbable collagen membrane (Bio-Gide, Geistlich, Wolhusen, Switzerland) following the principles of guided bone regeneration.[11] Immediately after implant placement, implant-supported, splinted, and screw-retained polymethyl methacrylate (PMMA) interim restorations were fabricated at the chairside using nonengaging titanium copings (Straumann USA) (Figure 4).

After 5 months, the first interim restorations were substituted with laboratory fabricated splinted interim restorations to achieve the best gingival contours for an esthetic result (Figure 5). After 8 months of healing, definitive synOcta abutments (Straumann USA) were inserted and tightened to 35 N-cm, and the splinted porcelain-fused-to-metal (PFM) crowns were cemented with Temp-Bond (Kerr, Orange, Calif) (Figure 6a and b).

Maintenance

Maintenance and evaluation of the implants were performed at yearly follow-up examinations during which radiographic marginal bone levels, bleeding on probing, plaque accumulation, soft tissue condition, occlusal contacts in centric and eccentric positions, esthetic outcome, and patient satisfaction were assessed.

Minimal radiographic changes in bone levels were observed over the 14-year period, and are within the norm for postsurgical peri-implant bone level changes described by Albrektsson et al[12] of less than 0.2 mm annually following the first year of service (Figure 7).

Management of Restorative Complication

The patient presented in 2016 for the 14-year follow-up. It was noted that the palatal cusps of the 2 premolar restorations had been subject to porcelain fracture, which necessitated replacement of the implant restorations (Figure 8). Photographs demonstrate maintenance of adequate mucosal architecture and tissue contours around the restorations. However, it was evident that some labial bone flattening and slight midfacial recession (0.5–1 mm) were present, and more pronounced in the second premolar, which was the healed site with the late implant placement (Figure 9).

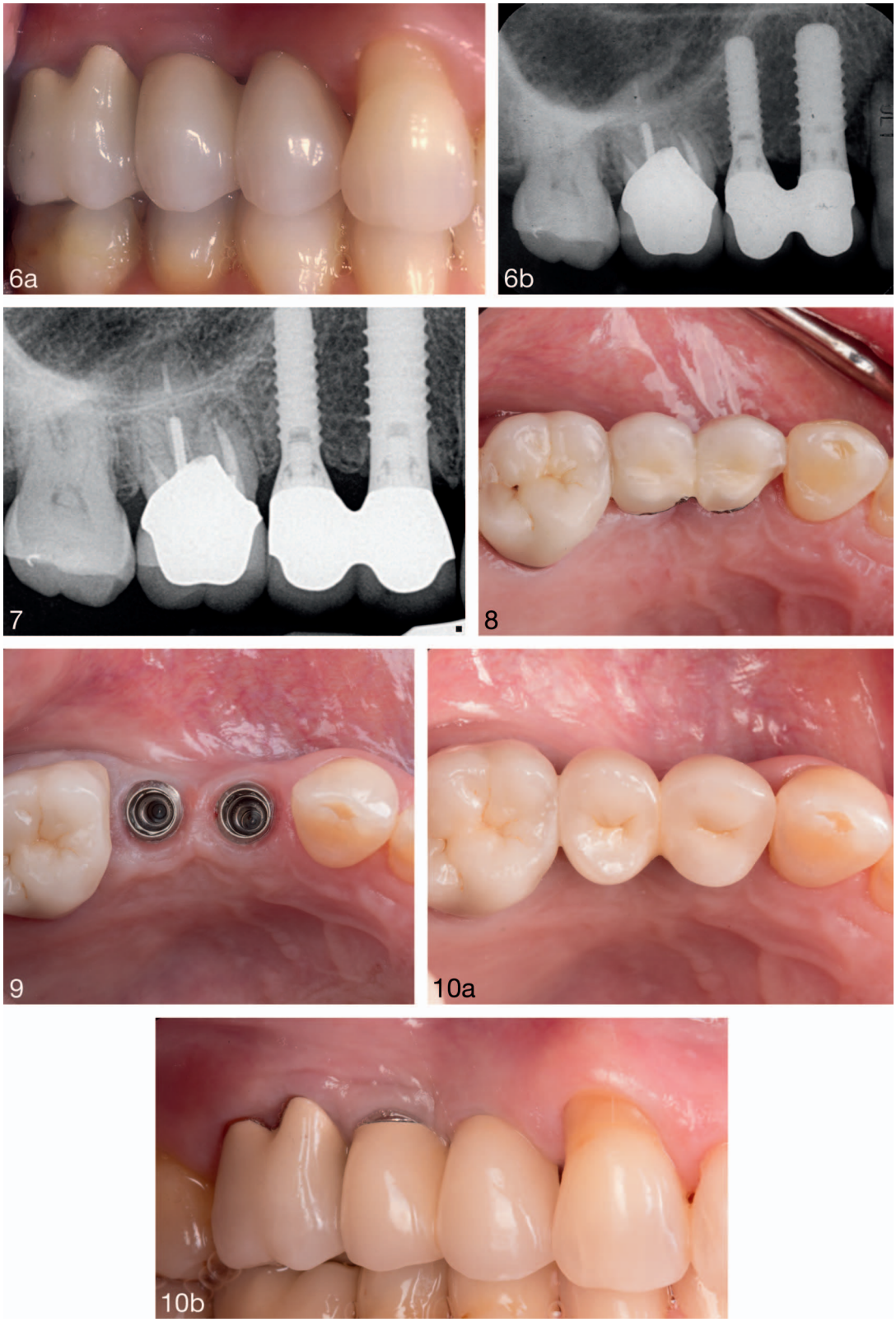
To facilitate replacement of the restorations the existing crowns and abutments were removed and an implant level impression was taken. Following the try-in visit, new Straumann SynOcta abutments were inserted. The abutment screws were tightened to 35 N-cm, and the new splinted PFM crowns were cemented with Temp-Bond (Figure 10a and b). Splinted crowns were chosen by following the company's guidelines for restoration of diameter reduced titanium implants in posterior locations.

Discussion

Immediate implant placement and immediate loading was chosen for this patient. This option provided a shortened overall treatment time, the requirement of only one surgical procedure, and was in line with the patient's desire of not having to wear a removable interim prosthesis. However, this option did have a greater risk of failure and the involvement of a surgical procedure compared with a fixed partial denture. Inadequate bone at the site, the presence of an infection of the tooth, and severe parafunctional habits might be contraindications for such a treatment plan.

Dimensional changes in the alveolar ridge following tooth removal are well documented and may compromise implant esthetic outcomes.[13,14] Research into the effects of the timing of implant placement on the esthetic outcome is ongoing; however, it is generally accepted that immediate implant placement does not prevent these dimensional changes and esthetic problems are common.[2] In this case report, after 14 years, slight-moderate midfacial recession, flattening of the ridge, and loss of buccal tissue volume was evident, and was more pronounced at the second premolar, which was the implant placed into a healed alveolar ridge. This may be attributed to the more favorable bony architecture for simultaneous bone grafting in the extraction site with a slow-resorbing deproteinized bovine bone mineral xenograft as described by Buser in 2008.[15,16] However, this does demonstrate the need for careful execution and planning as such flattening of the bone in esthetically critical areas may lead to esthetic complications and a suboptimal long-term result.

Splinting adjacent implant restorations was required in this clinical situation to conform to the manufacturer's recommended guidelines for use of narrow diameter implants made from commercially pure titanium in posterior regions. A narrow diameter commercially pure titanium implant was used in the second premolar site to maximize the volume of surrounding native bone and minimize the need for bone augmentation. Due to compromised mechanical properties of commercially pure titanium used at the time, splinting of this specific implant type was recommended by the manufacturer. This has the disadvantages of difficulty in providing passivity of fit of the restoration and can complicate oral hygiene measures for the



Figures 6–10. Figure 6. (a) A clinical photograph of the splinted final porcelain-fused-to-metal restorations 8 months after implant placement demonstrating optimal maintenance of per-implant soft tissues. (b) Peri-apical radiograph with the final restorations shows the stable bone levels. **Figure 7.** Radiograph taken at the 14-year follow-up demonstrates minimum bone resorption at the implant sites. **Figure 8.** Fractured restorations at the palatal cusps. **Figure 9.** Labial soft tissue flattening visible following removal of restorations for impression procedures. **Figure 10.** A clinical photograph of new splinted final porcelain-fused-to-metal restorations (a: occlusal and b: buccal view), more labial soft tissue flattening at the maxillary first right premolar was observed.

patient as well as professional maintenance and repair should complications arise.[17] Stronger implants have since been developed and successfully implemented into clinical practice with improved biological and mechanical performance, such as those made from a titanium-zirconium alloy.[18] The use of newer titanium-zirconium alloy implants could have allowed for individual nonsplinted restorations to have been fabricated.

The immediate implant placement and restoration described in this report, resulted in a successful outcome based on the patient's specific esthetic and functional expectations in addition to the crestal bone levels and peri-implant tissue health that have been maintained around the implants.

Conclusion

This clinical case report demonstrates long-term 14-year follow-up on immediate and late implant placement with immediate loading in the maxillary premolar region with 2 splinted implants. Slight midfacial recession and alveolar bone flattening was visible after 14 years. It was more evident in the healed site with the late implant placement than the immediate placement. This suggests that careful patient and site selection for immediate implant placement and restoration is essential to ensure such long-term mucosal changes lead to satisfactory esthetic outcomes. Further, it is always important to complete a thorough informed consent and select a treatment option that meets the demands of the patient, when appropriate, to most often achieve successful clinical outcomes and high patient satisfaction.

Abbreviations

CBCT: cone beam computerized tomography
PFM: porcelain-fused-to-metal
PMMA: polymethyl methacrylate

Note

Authors have no conflicts of interest to disclose.

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