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CASE REPORT

Immediate implant placement following minimally invasive extraction: A case report with a 6-year follow-up

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Abstract Single tooth replacement with a dental implant has become an increasingly favored treatment option in the anterior maxilla; however, bone resorption following maxillary anterior tooth extraction is very common and often compromises gingival tissue for the implant restoration. Achieving predictable peri-implant esthetics requires a proper understanding and preservation of the osseous and gingival tissue surrounding the failing tooth. Therefore, the key to maintaining the interproximal papillae is to preserve the osseous support with minimally invasive extraction. An immediate implant insertion after tooth extraction may maintain the crest bone and the interdental papillae, thus achieving peri-implant esthetics. This article describes the detailed treatment planning and meticulous techniques in immediate implant placement that reduce treatment time and maintain functional as well as esthetic results through a 6-year follow-up.

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Introduction

Alveolar ridge resorption has been an unavoidable phenomenon following tooth extraction. When a tooth is extracted,

predictable bone loss is accelerated in the first 6 months with as much as 40% of the alveolar height and 60% of the alveolar width loss, which continues at a rate of 0.25%–0.5% per year [1]. Guided bone regeneration techniques and the use of bone substitutes have been shown to enhance socket healing as well as modify the resorption process. Maintaining the existing gingival architecture of a failing tooth is essential in achieving an optimally esthetic result. Recently, many studies have also reported that immediate implant following

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minimally invasive extraction is contributive to preserving the crest bone and the interdental papillae, thus improving peri-implant esthetics [2,3].

Immediate implant placement has many advantages, such as preservation of crest bone, reduction in the number and complexity of surgical procedures, reduction of the edentulous period, and increased patient acceptance; however, this technique-sensitive procedure has some contraindications, such as the presence of uncontrolled infection and insufficient bone for initial implant stability. This article describes a flapless immediate implant placement in the esthetic zone with a predictable 6-year follow-up. The approach uses the osteoconductive potential of demineralized freeze-dried bone alloplast (DFDBA) to assist in bridging the osteogenic "jumping distance" [4] and eliminates the need for a barrier membrane. This approach also permits good osseointegration and preservation of the hard and soft tissue architectures with a predictable outcome.

Case presentation

A 58-year-old female patient presented with a dislodged crown and vertical root fracture of the right maxillary lateral incisor (tooth No. 12) and was advised that the tooth should be extracted. The patient was informed that her restorative options included a removable partial denture, a fixed bridge, or a fixed implant restoration. To avoid preparation of the adjacent teeth, the patient selected the implant-supported restoration. According to the patient's statement, her medical history showed that she exhibited mild hypertension but had no other cases of systemic disease. Radiographic and clinical evaluations neither demonstrated any obvious periapical pathology nor signs or symptoms of active infection (Fig. 1). Periodontal evaluation revealed a thick and flat periodontal type. A high smile line was also observed during the patient's laugh. Diagnostic probing to the osseous crest of the hopeless tooth at the interproximal aspects were 7.5 mm mesially and 6.5 mm distally. The patient was informed that the existing bony destruction might result in open interproximal embrasures (i.e. "black triangles"). Potential risks and benefits of treatment options were discussed with the patient, and an immediate implant with the flapless technique was selected.

Minimally invasive extraction is the first and one of the most critical steps of immediate implant placement. A sulcular incision with transeptal fiberotomy was performed

using the Periostome (Nobel Biocare, Yorba Linda, CA, USA) to separate the tooth from the periodontal tissue. Caution must be exercised to not luxate the tooth buccal palatally. Superfluous force in such an unfavorable direction may damage the buccal plate. The tooth was atraumatically removed without flap reflection, which preserved the gingival and osseous architectures. A periodontal probe was used following tooth extraction to verify the integrity of the bony plate, and the socket was thoroughly debrided to eliminate the infectious material. In the anterior maxilla, it is crucial to avoid placing the implant directly into the extraction socket. The axis of the implant should be even with the incisal edges of the adjacent teeth or slightly palatal to this reference. Implant placement in this way could greatly reduce the risk of buccal plate perforation and implant failure. Standard drilling procedures were performed according to the manufacturer's instructions. A MIS tapered implant (4.2 mm × 13 mm; MIS, Shlomi, Israel) with a platform switching design was installed into the prepared site using a flapless approach.

The bone-to-implant gap was about 3 mm. Primary implant stability was achieved by engaging the palatal wall and the bone approximately 3.5 mm beyond the apex of the extraction socket (Fig. 2). The implant platform was placed 3 mm apical to the facial free gingival margin to achieve the appropriate emergence profile. A minimal distance of 1.5 mm between the implant and adjacent teeth was recommended to minimize marginal bone loss because of encroachment. The bony gap between the implant and extraction socket was filled with DFDBA. Next, a healing abutment, measuring 4.2 mm in diameter with 4 mm in height, was tightened onto the implant. Interproximal papillae adjacent to the implant were adapted with interrupted sutures under minimal tension. The provisional partial denture was adjusted to not contact the healing abutment. One week postoperation, the sutures were removed.

After the 6-month healing phase, a final implant impression was made with a polyether impression material (Impregum; 3M ESPE, St Paul, MN, USA) using an open tray technique. A definitive metal-ceramic crown was fabricated. Following occlusal adjustment, the metal-ceramic crown was cemented with temporary cement (TempBond; Kerr/Sybron, Orange, CA, USA).

The 6-year follow-up showed that the gingival architecture maintained the form as the tooth No. 12 implant-supported prosthesis was just delivered (Fig. 3). Radiographic examination (Fig. 1) revealed that marginal bone loss was

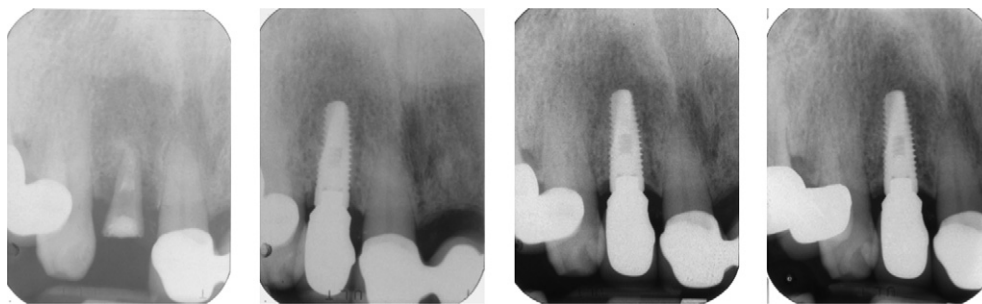


Figure 1. Preoperative radiograph of the No. 12 failing tooth (left). Periapical radiographies of the tooth No. 12 implant 1 year (middle left), 2 years (middle right), and 6 years (right) following implant surgery.



Figure 2. Postoperative radiograph of the tooth No. 12 implant.

within the Albrektsson criteria [5]. With the 6-year follow-up, it was concluded that the treatment was satisfactory for the patient's functional and esthetic expectations.

Discussion

Immediate implant placement in the esthetic zone has demonstrated predictable long-term results [6]. Nevertheless, precise diagnosis and treatment planning are the key



Figure 3. Six-year follow-up photograph. Note the interdental papillae were stable between the tooth No. 12 implant and its adjacent teeth.

factors in achieving good outcomes after placing and restoring implants placed immediately after tooth extraction. Because immediate implant placement is a sensitive technique, some specific circumstances must be fully considered before the technique is performed. For example, the presence of active, acute infection around the failing tooth; severe lack of hard/soft tissue, such as insufficient bone (3 mm–5 mm) beyond the tooth socket apex for initial implant stability; and conditions that may severely compromise the results in the esthetic zone are usually considered as contraindications of placing immediate implants.

Clinicians are usually concerned with the problems related to the inserted implant and extraction socket. The morphology of the alveolus appears to have an impact on immediate implant placement. To date, there is no evidence to establish the superiority of any graft materials or their necessity with respect to immediate implant placement [7]. Knox et al. [4] have described the concept of an osteogenic "jumping distance," and attribute a significant biologic relevance to the distance between an implant and the surrounding alveolar wall. Specifically, bony gap distances greater than 0.5 mm may not allow for predictable bone deposition on the implant surface without simultaneous use of a regenerative procedure. Wilson et al. [8] compared wound healing following immediate implant placement after extraction to that observed following implant placement into a healed extraction site in a human volunteer. They concluded that bone grafts and membranes are not required if the peri-implant bone defect does not exceed 1.5 mm. Paolantonio et al. [9] indicated that the clinical outcome and the degree of osseointegration did not differ for implants when placed in mature bone or an extraction socket with a bone-to-implant gap of 2 mm or less. Kan and Rungcharassaeng [3] have claimed that the necessity of bone grafts depends on thickness of the labial plate rather than the size of the gap. Although a thick labial plate is generally resistant to resorption, which makes grafting unnecessary, bone grafting is frequently used to prevent collapse and minimize resorption of the thin labial plate, regardless of the gap size.

Extraction sites in the esthetic zone present a great restorative challenge. Collapse of the hard tissue after a tooth extraction is frequently associated with significant resorption, remodeling, and deformity. Ridge preservation achieved using DFDBA with or without a barrier membrane has been previously reported [10]. Becker [2] deemed that placement of bovine bone, allografts, or other substitutes with or without barrier membranes may support or improve soft tissue contours; however, these materials cannot be depended on to enhance osseointegration. In this case presentation, guided bone regeneration was achieved around the immediate implant when DFDBA was used. Periodontal sounding measurements revealed that there was minimal loss of ridge height or width. Soft tissue dimensions were also preserved. The alloplast was a suitable material when used as a gap-filling graft in sockets around immediately placed implants.

There is increasing evidence that supports the concept of platform switching. This concept refers to the connection of restorative components with smaller diameters to implant platforms with larger diameters. The

positive effects of platform switching were discovered by coincidence when an implant manufacturer introduced wide-diameter implants. In a recent prospective clinical trial, Huerzeler et al. [11] found that platform-switched abutments caused significantly less crestal bone resorption. A biomechanical analysis by Maeda et al. [12] also demonstrated a shift of the stress concentration area away from the cervical bone/implant interface. The reduced crestal bone loss has a positive effect on the peri-implant soft tissue and, ultimately, the esthetic outcome. Esthetic predictability makes platform switching a preferred concept for immediate implant placement protocols. In the case presented here, the platform switching design of the implant restoration might be a contributory factor to the esthetic outcome.

Following the least traumatic extraction of the failing tooth and immediate implant placement, DFDBA was used to minimize resorption of the thin labial bone plate in this case presented. The clinical outcome displayed small black triangles of the prosthesis, but the patient was satisfied with the treatment. Moreover, the peri-implant mucosa of the patient was a thick biotype that implied less gingival recession in comparison to a thin biotype.

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