Using immediate implant placement to address aesthetic and biomechanical challenges: A clinical presentation

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Immediate implant loading has become an attractive option for meeting some of the aesthetic and biomechanical challenges associated with replacing single teeth with implants, particularly in the aesthetic zone. This article reviews some of the literature relating to immediately loading single-implant sites. A case is presented in which implants were placed and immediately non-occlusally loaded to treat a young man who had suffered a traumatic injury to his maxillary central incisors.

Key Words: immediate occlusal loading, immediate non-occlusal loading, single-tooth restoration, BellaTek™ Encode® Impression System

Introduction

The loss of a single tooth has been documented to be the most common indication for implant treatment.[1] In the aesthetic zone, implant-supported single-tooth replacement is one of the most challenging situations confronting the clinician, especially when a two-stage protocol is being employed. In the wake of tooth loss, both hard- and soft-tissue resorption is the inevitable consequence. The volumes of both the hard and soft tissues must be evaluated carefully, and in cases of severe resorption, augmentation may be required. With every exposure of the alveolar bone, the biologic width also must be reestablished. In contrast, placing and immediately loading an implant with a provisional restoration may forestall some of these negative consequences and increase the potential for achieving an optimal emergence profile.

From the patient's perspective, the loss of a single tooth often is traumatic, and phonetics may be compromised during the traditional two-stage placement healing period.

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The ability to reduce the number of surgeries and total treatment time also appeals to many people.

For all of these reasons, accelerated implant-loading procedures have become an attractive treatment option. As this has occurred, clinicians have used a variety of terms to refer to the different possible approaches. For the purposes of this article, immediate occlusal loading (IOL) refers to the placement (within 24 hours of implant placement) of a provisional restoration that is in contact with the opposing dentition in centric occlusion. Immediate non-occlusal loading (INOL) refers to instances in which the immediate restoration is not in contact with the opposing dentition in centric occlusion. When a provisional restoration is placed more than 24 hours after implant placement but less than three months post-surgically, such restorations may be referred to as early (as opposed to immediate) loading.

Scientific evidence of the predictability of both early[2] and immediate loading procedures has steadily accumulated. Ericsson and colleagues[3] performed a prospective clinical and radiographic study comparing immediately loaded single-tooth implants to single-tooth implants restored according to a traditional two-stage protocol. The immediate-loading group consisted of 14 patients, and the

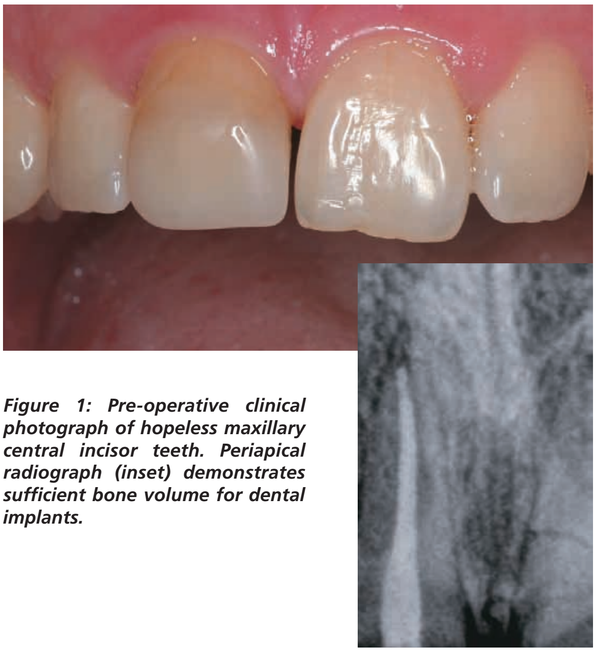

Figure 1: Pre-operative clinical photograph of hopeless maxillary central incisor teeth. Periapical radiograph (inset) demonstrates sufficient bone volume for dental implants.

Figure 2: Teeth Nos. 8 and 9 (11 and 21) were carefully extracted. The right central incisor demonstrated root resorption, and the left central incisor was fractured.

Figure 3: The sockets were debrided with hand instruments. An implant depth gauge was used to ensure the buccal plates were intact.

two-stage control group included eight patients. All patients had single-tooth losses anterior to the molars, were non-smokers, and had sufficient bone to accommodate a 3.75mm diameter implant of at least 13mm in length. Two of the 14 implants in the immediately loaded group were lost after five months in function. The remaining 12 implants were stable. No implant losses were recorded in the two-stage control group. Analysis of radiographs from both groups showed a mean change of bone support of about 0.1mm at the 12-month follow-up.

In another prospective clinical study conducted by Hui and co-workers,[4] 24 patients were followed. Single-tooth implant placement was done according to an immediate provisional protocol in 24 patients, including 13 who had immediate implant placement after tooth extraction. All implants were placed in the aesthetic zone using a surgical protocol aimed at enhancing primary implant stability and achieving a minimal insertion torque of at least 40Ncm. Within the follow-up period of between one and 15 months, all implants in the 24 patients were stable. No crestal bone loss of greater than one thread was detected. The aesthetic results were considered satisfactory by all patients.

Calandriello et al[5] reported on a prospective multicenter study including 44 patients treated with 50 wide-platform implants and provided with provisional crowns in centric occlusion at the time of surgery. During follow-up periods ranging from six months to one year, no implants were lost. Marginal bone levels were found in accordance with normal biologic width requirements. Resonance frequency analysis (RFA) showed high and consistent implant stability.

Rocci and co-workers[6] evaluated 97 implants, including 27 placed at single-tooth sites in flapless surgeries and immediately loaded. Nine implants placed in eight patients failed during the first eight weeks of loading. Five of the eight patients with failed implants lost single-tooth implants, including two that had been inserted in fresh extraction sites. Three patients lost four implants in partial restorations. The marginal bone resorption was 1.0mm on average during the first year of loading, 0.4mm during the second year, and 0.1mm during the third year.

Lorenzoni et al[7] evaluated clinical outcomes of immediately loaded implants 12 months after placement in the maxillary incisal region. The implants were inserted with torque values of up to 45Ncm and immediately

Author	Type of Study	No. Patients	No. Implants Loaded	Follow-Up Years	Lost Implants	Survival Rate %
Ericsson et al[3]	Prosp	14	14	1	2	86%
Hui[4]	Prosp	24	24	1-15 months	0	100%
Calandriello et al[5]	Prosp	44	50	6-12 months	0	100%
Rocci et al[6]	Retro	27	27	3	5	81.5%
Lorenzoni et al[7]	Retro	12	12	1	0	100%
Degidi et al[8]	Retro	111	111	5	5	95.5%
Östman et al[9]	Prosp	14	14	1	0	100%
Total		**246**	**252**	-	-	

Table 1. Published articles on immediate loading of single-tooth maxillary and mandibular restorations.

restored with unsplinted acrylic resin provisional crowns. Patients were provided with occlusal splints. No implant failed up to 12 months after insertion. Mean coronal bone-level changes at 6 and 12 months were 0.45 and 0.75mm. Bone resorption after 6 and 12 months was less than that evaluated for implants placed in a standard two-stage procedure.

Degidi and co-workers[8] evaluated 111 single implants that were immediately non-functionally loaded. All implants were placed with a minimum insertion torque of 25Ncm. After five years of follow-up, the overall survival rate was 95.5%. The authors found a significant difference between healed and immediate post-extraction sites (100% and 92.5%, respectively) and type of bone (100% for Type I, versus 95.5% for Type IV).

In a prospective, single-center study,[9] the present author and co-workers enrolled 35 patients requiring implant treatment. Surgical implant-placement requirements consisted of a final torque of at least 25Ncm prior to final seating and an implant-stability quotient above 55. A total of 102 implants (66 maxillary and 36 mandibular) were placed, mostly in posterior regions (65%) and soft bone (69%). A total of 44 prosthetic constructions were evaluated, consisting of 14 single-tooth restorations (7 maxillary and 7 mandibular), 26 fixed partial dentures, and four complete fixed restorations. All provisional constructions were delivered within one hour, and the final constructions were placed after four months. Implants were monitored for clinical and radiographic outcomes at 3-, 6-, and 12-month follow-up examinations. Only one implant failed, and it was not one of those supporting a single-tooth restoration.

Table 1 summarizes these findings regarding immediately loaded single-tooth restorations.

Although the above-referenced papers include a limited number of samples, experimental studies and histological analysis of clinically retrieved implants have shown similar and sometimes better bone-implant contact (BIC) for immediately loaded implants, compared to delayed cases. Piattelli et al[10] compared histologically non-submerged unloaded implants with early-loaded titanium-screw implants in monkeys. They found a tight contact of new bone to the implant surfaces in all samples examined. Moreover, around the necks of the early-loaded screws, a pattern of lamellar cortical bone was noted, thicker than in the unloaded implants. In a pilot study,[11] the bone reactions to early loaded titanium plasma-sprayed implants were analyzed in a monkey model. Twenty implants were immediately loaded, and four implants functioned as controls. The result showed a BIC of 67.2% of the maxillary implant surfaces (10 implants) and 80.7% BIC of mandibular implant surfaces (10 implants). No differences were found in the percentage of bone-implant contact in the control implants. However, the loaded implants had a more compact appearance compared to the controls.

Testori et al[11] found a higher BIC for immediately loaded OSSEOTITE® Implants (BIOMET 3i; Palm Beach Gardens, FL, USA) (64.2%), compared to submerged implants (38.9 %). Rocci et al[12] retrieved nine oxidized titanium implants after five to nine months in function. Two implants had been loaded the same day, whereas seven implants were loaded after two months of healing. Morphometric measurements of the two immediately loaded implants

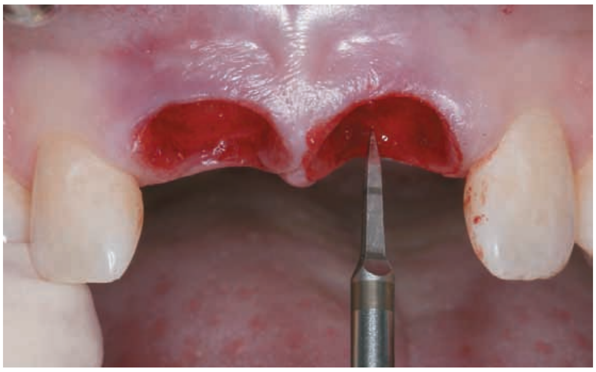

Figure 4: An ACT® Pointed Starter Drill was used to properly orient the osteotomies within the extraction sockets.

Figure 5: A 2mm diameter twist drill was advanced to the desired depth for preparation of the osteotomy. The bone quality was determined to be Type IV (soft).

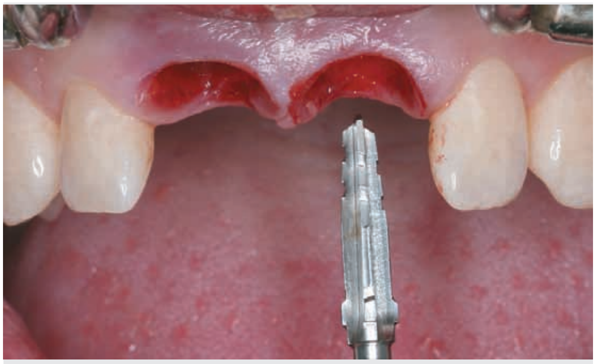

Figure 6: Following the manufacturer's guidelines for placement of Tapered Implants, 3.25mm and 4.0mm diameter x 15mm length Quad Shaping Drills were advanced into the osteotomies to full depth.

showed a mean BIC value of 92.9%. The corresponding value for the six early loaded implants was 81.4%. Frost[13] has postulated that both overly modest and excessive loading can result in negative tissue reactions.

Clinical Presentation

The following clinical presentation illustrates the immediate placement and provisionalization of implants in the anterior maxilla, using an INOL protocol.

The patient was a 22-year-old male who presented with hopeless maxillary central incisors due to trauma. Clinical and radiographic examination revealed root resorption of tooth No. 8 (11) and a root fracture of tooth No. 9 (21) (Fig. 1 and inset of PA). Sufficient bone volume was present for a fixed implant-supported prosthesis. Since the patient desired a fixed solution for these two teeth, the treatment plan included extractions and simultaneous implant placement with immediate provisionalization.

Following administration of local anesthesia by infiltration, teeth Nos. 8 and 9 (11 and 21) were extracted (Fig. 2), and the sockets were carefully debrided. Examination of the socket walls revealed intact facial bone in both sites (Fig. 3). Preparation of the osteotomies began with an ACT® Pointed Starter Drill (Fig. 4). A 2mm diameter twist drill was then advanced into the osteotomies (Fig. 5). The bone quality was determined to be Type IV (soft bone). Next, 3.25mm and 4.0mm diameter x 15mm length Quad Shaping Drills (QSD) were used to full depth (Fig. 6). Following the manufacturer's guidelines for placement of NanoTite™ Tapered Implants (BIOMET 3i) in soft bone, the 4.0mm diameter QSD was the last drill used, thus undersizing the osteotomies by one drill diameter. A Depth/Direction Indicator (NTDI) was placed into the prepared osteotomies to confirm the accuracy of the preparations and to visualize where the implant-abutment junction should be positioned. Two 5mm diameter x 15mm length implants were placed (Fig. 7) with the handpiece. No irrigation was used; rather the patient's own blood was allowed to wick onto the surface of the implants (Fig. 8). The insertion torque of the implants reached the limit preset on the drilling unit (50Ncm). An Osstell SmartPeg (Osstell Mentor Device, Integration Diagnostics, Gothenberg, Sweden) was placed into the internal interface of each implant (Fig. 9), and ISQ readings greater than 70 were recorded.

Figure 10 shows the seating surfaces of the implants and the depth of the soft tissue present around the implants. Two PreFormance® Posts (BIOMET 3i) of 5mm diameter x 4mm trans-tissue height were selected to gain as much soft-tissue support as possible. The posts were placed into the implants and secured with abutment screws tightened

Figure 7: Two 5mm diameter x 15mm length NanoTite™ Tapered PREVAIL® Implants (BIOMET 3i) were placed with the handpiece, then hand tightened with a High Torque Driver. The final torque measured 70Ncm.

Figure 8: No irrigation was used during implant placement. The patient's own blood was allowed to wick onto the surface of the implants.

Figure 9: An Osstell SmartPeg was placed into the internal interface of each implant, and ISQ readings greater than 70 were recorded.

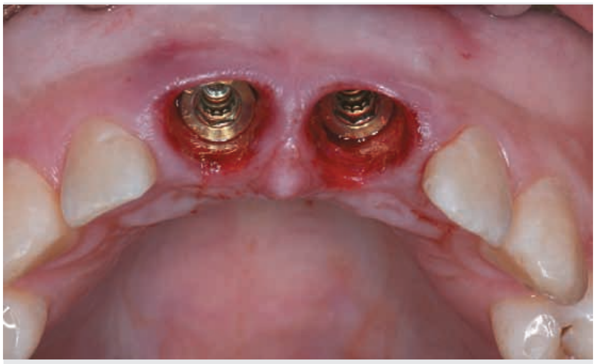

Figure 10: Occlusal view of the restorative seating surfaces of the implants and the depth of the soft tissue present around the implants.

Figure 11: PreFormance® Posts were selected for fabrication of the provisional restorations. The posts were secured with abutment screws tightened to 20Ncm.

Figure 12: The PreFormance Posts were trimmed and modified for occlusal clearance.

to 20Ncm (Fig. 11). The PreFormance® Posts were prepared and modified for occlusal clearance (Fig. 12). An alginate impression was made prior to tooth extraction for fabrication of the provisional prosthesis. Splinted provisional crowns were made with ProTemp™ 4 Garant (3M ESPE, St. Paul, Minnesota, USA) (Fig. 13). The material was allowed to set per the manufacturer's instructions. The restoration was then removed, trimmed, and polished. It

Figure 13: A splinted provisional restoration was fabricated chairside. Once the material set, the restoration was removed, trimmed, and polished.

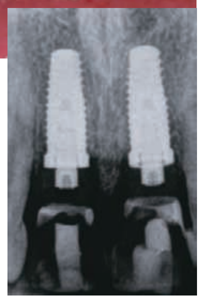

Figure 14: The splinted restoration was tried in intraorally over the posts and then cemented with provisional cement. A periapical radiograph was taken (inset).

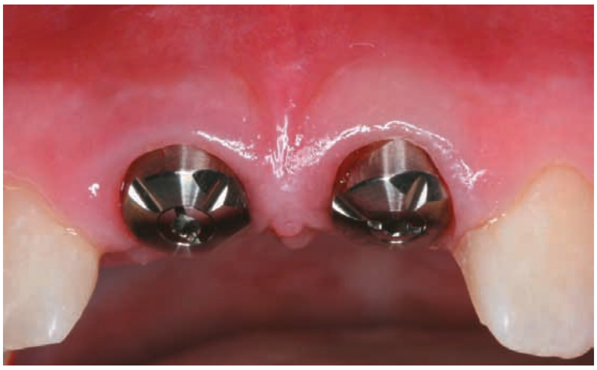

Figure 15: Four months later, the provisional restoration and the PreFormance® Posts were removed, and BellaTek™ Encode® Healing Abutments were placed. An impression was made with a closed stock tray.

was tried in intraorally over the posts and then cemented with ProTemp 3 Garant (3M ESPE) (Fig. 14). The occlusion was adjusted following the protocol for non-occlusal loading. A periapical radiograph was taken (inset), and the patient was released with instructions to avoid hard foods and use proper oral hygiene.

Healing was uneventful. At the four-month evaluation, healthy soft tissue was noted around the provisional restorations. The crowns and PreFormance® Posts were removed, and BellaTek™ Encode® Healing Abutments (BIOMET 3i) were placed (Fig. 15). An impression was made with a closed stock tray filled with heavy body polyvinylsiloxane impression material (AFFINIS microSystem™, Coltène Whaledent, Switzerland). The impression material was allowed to set, then removed. The impression was inspected for accuracy and to ensure that the codes on the occlusal surfaces of the abutments were accurately captured in the impression. The posts and provisional restorations were replaced, and the patient released.

In the laboratory, the impression was poured in die stone for fabrication of a master cast. The cast and BellaTek Encode Work Order were then sent to a BellaTek Production Center for fabrication of BellaTek Zirconia Abutments. The abutments were returned to the commercial laboratory for fabrication of two Denzir® zirconia crowns (Fig. 16).

The patient returned to the dental clinic. The provisional restoration and abutments were removed, and the definitive BellaTek Zirconia Abutments were placed. Gold-Tite® Abutment Screws (BIOMET 3i) were placed into the abutments and tightened to 20Ncm (Figs. 17 and 18). The screw-access openings were blocked out, and the crowns

Figure 16: In the laboratory, two zirconia crowns were fabricated for the BellaTek™ Zirconia Abutments.

Figure 17: The definitive BellaTek™ Zirconia Abutments were placed and secured with Gold-Tite® Abutment Screws tightened to 20Ncm.

Figure 18: Occlusal view of the BellaTek™ Zirconia Abutments in place. The screw-access openings were blocked out, before cementation of the restorations.

were cemented with RelyX™ Luting Cement (ESPE, 3M, St. Paul, Minnesota, USA) (Figs. 19 and 20). A periapical radiograph was taken to ensure that all the excess cement was removed from the subgingival margins (Inset), and the patient was released with oral hygiene instructions.

Clinical Relevance

A number of studies have evaluated immediately loaded single-tooth sites located throughout the mouth. When primary stability has been achieved, good to excellent short-to medium-term results have been reported. Furthermore, immediate loading protocols allow treatment to be accomplished in less time, provide patients with immediate functional, aesthetic, and psychological benefits, and help to better maintain the soft- and hard-tissue architecture in the wake of implant placement. Additional long-term data evaluating the benefits and risks of immediate loading are needed, as well as guidelines for choosing occlusal loading versus non-occlusal loading.

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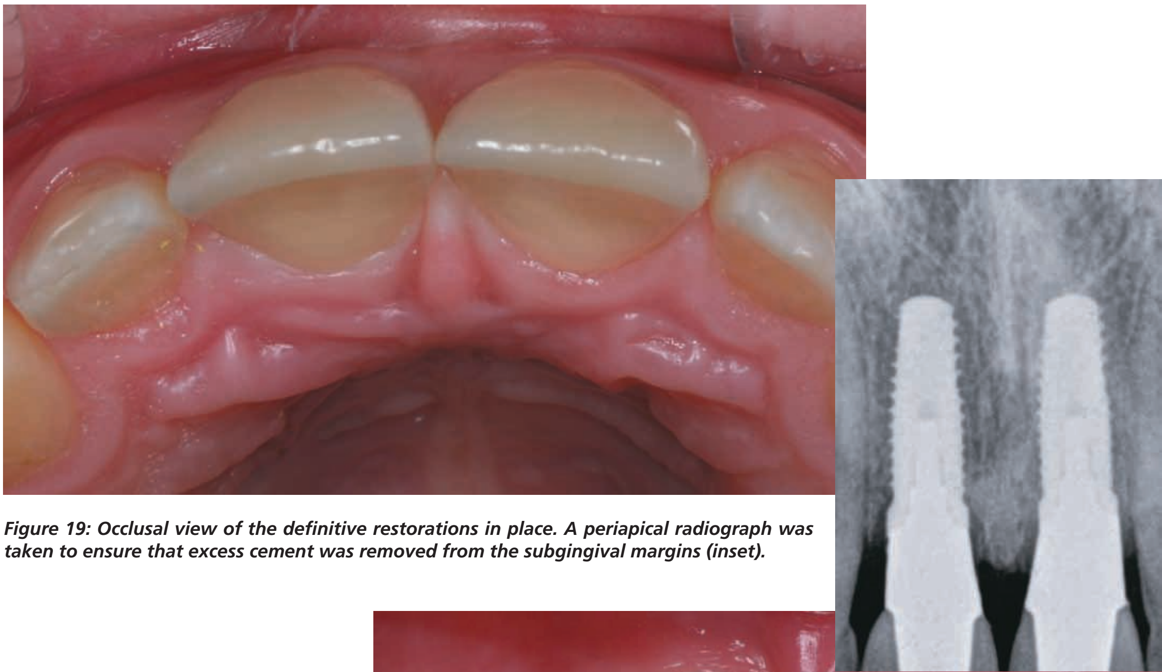

Figure 19: Occlusal view of the definitive restorations in place. A periapical radiograph was taken to ensure that excess cement was removed from the subgingival margins (inset).

Figure 20: Facial view of the definitive zirconia restorations supported by BellaTek™ Zirconia Abutments.

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