Marginal bone change of Immediate Versus Delayed Restoration Procedures on Immediate Implants in Single Tooth Replacement

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ABSTRACT

Purpose: The primary aim of this study was to evaluate and compare the overall clinical outcomes of immediate and delayed restoration procedures for implants placed in fresh extraction sockets by means of a flapless technique and rhBMP-2 bone graft.

Materials and Methods:

A total 30 dental implants were evaluated in 30 patients (14 male and 16 female) with an average age of 46.2 years. All patients underwent tooth extraction and clinical measurements at baseline; the amount of available alveolar bone and the presence of an intact buccal bone wall were evaluated. Implants with an insertion torque of at least 45 N cm were included in the immediate restoration group and were temporarily restored immediately after implant placement; on the other hand, implants with an insertion torque lower than 45 N cm were included in the delayed restoration group and were restored 4months after implant placement Patient data were evaluated to acquire implant survival rates and the marginal bone change. Panoramic X-rays were analyzed for marginal bone loss.

Results: Any implant among30 INNO® dental implants of both 15 immediate restoration group and 15 delayed restoration group was not lost, resulting in a survival rate of 100 %. In marginal bone change, immediate loading (0.18 ± 0.01 mm) was not a factor of bone loss, compared with delayed loading (0.26 ± 0.19 mm).

Conclusions: Immediate restoration of implants installed in fresh extraction sockets was at least as effective and safe as delayed restoration.

Key Words: alveolar bone resorption, immediate implants, immediately restored implant, soft tissue recession

INTRODUCTION

The use of dental implants to replace one or more missing teeth in the anterior maxilla has become an increasingly common practice. The conventional protocol, which involves the placement of implants in healed ridge sites, is widely accepted as a highly predictable treatment.[1,2]Nevertheless, over the years, implant dentistry has tried to further simplify clinical procedures and to shorten the overall treatment time; as a result, the placement of implants into fresh extraction sockets has become a promising area of research. Immediate implant placement reduces surgery and treatment time, morbidity, and, importantly, costs for the patient.[3,4]

The placement of implants into fresh extraction sockets provides several clinical advantages and has been proven to be a reliable procedure despite the surgical challenges it can pose.[3,5] Surgical difficulties that even an experienced clinician might face include obtaining adequate three-dimensional implant positioning, ensuring primary implant stability, and managing the bone wall remodeling phase subsequent to tooth extraction.[6]Several key factors are important for ensuring positive clinical outcomes: namely, surgery should be performed without flap elevation to reduce deleterious facial boneremodeling[7–9]; the buccal bone plate should be left essentially intact; and the implant should be placed toward the palatal aspect of the socket.[10]

It has been clearly shown that bone remodeling inevitably occurs after tooth extraction and simultaneous implant placement. Augmentation procedures have been

Table 1. patient characteristics

	Immediate restoration	Delayed restoration
Sample size (*n)*	15	15
Age (years)	43 ± 17.5	51 ± 19.5
Time of clinical treatment (days)	120 ± 15	203 ± 17
Gender ratio (M/F)	7/8	7/8
Buccal plate thickness (mm)	0.7 ± 0.2	0.7 ± 0.2

developed for treatment of the peri-implant bone defects that can be observed after the placement of implants into fresh extraction sockets. These procedures may reduce the dimensional changes that spontaneously occur after tooth extraction.[11] Single maxillary implants may also be immediately restored with predictable clinical success and high survival rates.[12,13] Several authors have suggested that adequate primary implant stability and avoidance of occlusal or eccentric contact during the healing phase could be considered prerequisites for success in this regard. A review of the outcomes of different loading protocols showed no differences in terms of survival rates between immediately and conventionally loaded implants placed in fresh extraction sockets.[14]However, there has previously been a lack of information pertaining to reducing soft tissue remodeling and achieving good aesthetics around these implants. Therefore, an aesthetically satisfying result may not be easily achieved following immediate placement and restoration of a dental implant in the anterior maxilla. Furthermore, factors such as the remodeling of bone walls after tooth extraction and the differences in healing of buccal tissue following immediate versus delayed restoration of immediate implants require full consideration and investigation.

The primary aim of the present study was to evaluate and compare the overall clinical outcomes of immediate and conventional restoration procedures for implants placed in fresh extraction sockets. The present study tested the null hypothesis that there are no differences in clinical outcome between the two procedures against the alternative hypothesis that there is a difference. The short-term implant survival rate was also evaluated.

MATERIALS AND METHODS

Between January 2011 and August 2013,30 patients (14 male and 16 female) with an average age of 46.2 years were included in this study at Christmas Implant Clinic, Koyang, Korea. 30 implants with sandblasted, acid etched surface (INNO® implant, Cowellmedi, Pusan, Korea) made from commercially pure titanium (grade IV), and were placed in the fresh extraction socket. (Table 1) These implants had the diameters of 3.5, 4.0, 4.5, 5.0 and 6.0 mm. The lengths varied between 8 and 14 mm.

Patients were included in the study according to the following criteria: (1) were at least 18 years of age, (2) had a failing anterior /bicuspid tooth in the maxillary/mandibular area requiring extraction and immediate dental implant placement with either immediate or delayed restoration, and (3)were willing to have their progress followed for at least 1 years, and (4) physically and mentally able to tolerate conventional surgical and restorative procedures. The exclusion criteria were the following: (1) active infection in the sites selected for implant placement; (2) systemic diseases, such as diabetes without control; (3) pregnancy; and (4) severe bruxism.

Surgery

All patients underwent tooth extraction and clinical measurements at baseline; the amount of available alveolar bone and the presence of an intact buccal bone wall were evaluated. Implants with an insertion torque of at least 45 N cm were included in the immediate

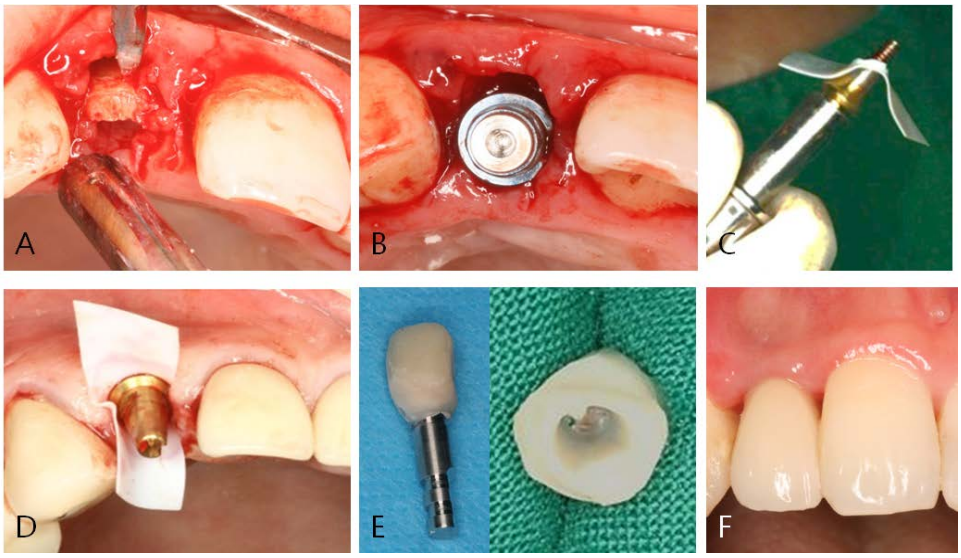

Figure 1 Immediate restoration. A: Atraumatic tooth extraction with root section B: Implant placement positioned to palatal side C: Teflon coverage sheet with abutment for prevention the contact of resin and cement with tissue D: Abutment connection with the placed implants E: Marginal adjustment with abutment replica F: restoration

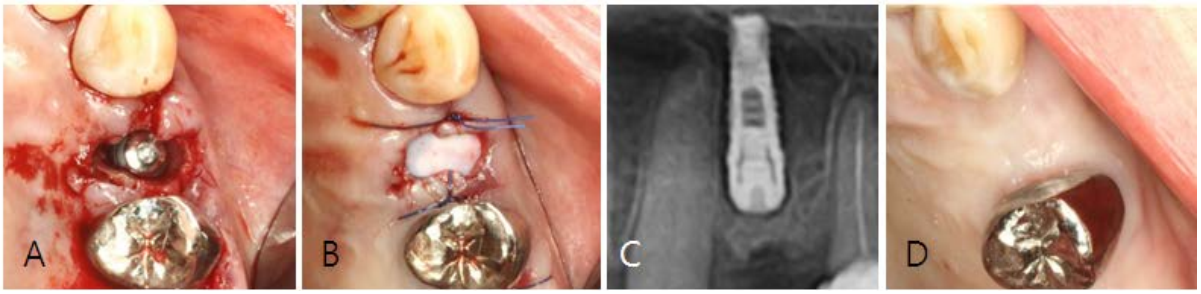

Figure 2 Late restoration. A: Implant placement positioned to palatal side B: Open membrane technique with rhBMP-2 bone grafting and Teflon coverage C: post-operative X-ray D: Healed socket on 4 months after implant placement

restoration group and were temporarily restored immediately after implant placement (Figure 1); on the other hand, implants with an insertion torque lower than 45 Ncm were included in the delayed restoration group and were restored 4months after implant placement (Figure 2).

All patients received prophylactic antibiotic therapy (2 g amoxicillin, or 600 mg clindamycin if allergic to penicillins) 1 hour before the extraction procedure and continued to take the antibiotic (1 g amoxicillin or300 mg clindamycin) postoperatively three times a day for 4 days. All patients rinsed for 1 minute with 0.2% chlorhexidine mouthwash prior to the surgery (and twice a day for the following 3 weeks) and were treated under local anesthesia using lidocaine with adrenaline1:100,000). A flapless approach was chosen, and tooth extractions were carried out with or without elevators as necessary to minimize the trauma; great care was taken to maintain the integrity of the buccal bone wall. After extraction, the socket was carefully curetted, and subsequently, the implant bed was prepared according to the standard procedure (with standard drills, following the palatal bony wall as a guide and making maximum use of the bone apical to the removed tooth). A periodontal probe was used to verify the integrity of the bone walls and to measure the periimplant bone defect after implant osteotomy preparation. The INNO® implants were placed with the implant platform at the marginal level of the palatal/lingual bone wall (Figures 1 and 2). All the implants were evaluated for their final insertion torque; 45 N cm was the cutoff value determining whether the implant would be allocated to the immediate restoration or delayed restoration group. The peri-implant bone defect−between the implant surface and bone wall was augmented with synthetic bone and rhBMP-2 (CowellBMP, Cowellmedi, Pusan, Korea). Subsequently, a Teflon sheet was used to stabilize the graft in only late restoration group, and a interrupted suture was used to stabilize the blood clot. Patients were instructed to continue with prophylactic antibiotic therapy, and 600 mg ibuprofen

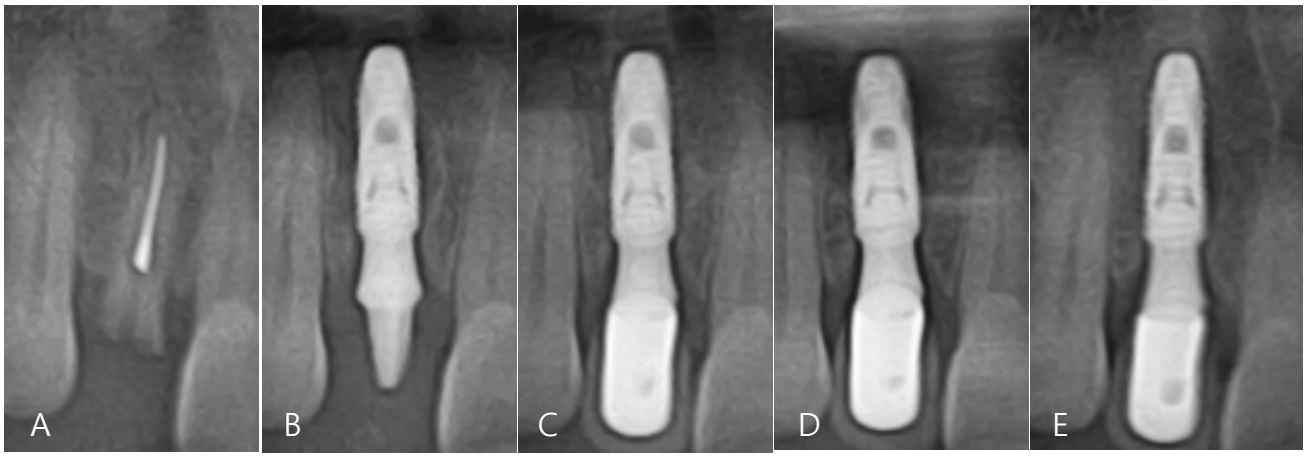

Figure 3 Radiological evaluation A: Before implant surgery, B: At the implant placement and immediate loading, C: Final restoration after 3 month healing period, D: At 6 months follow-up vist, E: at 1 year follow-up vist

tablets were prescribed as anti-inflammatories to be taken three times a day as long as required. Sutures were removed after 10 days and oral hygiene instructions were given.

The prosthetic procedures were similar for the immediate and delayed restoration groups; All implants were restorated using a fixed temporary crown immediately after abutment connection. The temporary crown was made chairside with self curing resin around the abutments(Figure 1). The provisional crown were cemented temporarily at the same day of the surgery using Temp Bond®-cement material (Kerr Co., Karlsruhe, Germany). The temporary restorations had occlusal contacts in the maximal intercuspidation (ICP).

The patients were advised to use soft/liquid diet for the first 6 to 8 weeks of healing in order to reduce excessive loading at the bone-to-implant interface. A postoperative antibiotic administration was given to all patients during 1 week.

Panoramic X-rays (Vatec, Anseong, Korea) were made at the appointment of before surgery, after surgery and 3, 6, and 12 months after loading (Figure 3).

Image analysis

Panoramic X-rays were analyzed with Easydent viewer version 4.5 software (Vatec, Anseong, Korea). Two reference points were marked on the top of implant surface and the first contact point with bone at the mesial and distal side of implant. The measurement between two points was calculated to a average value. The differences between the values of each visit X-rays were used to establish marginal bone loss. The vertical bone increase of the bone graft in extraction socket is measured to 0 mm change value

Statistical analysis

The data were processed using the SPSS version 17.0statistical package (SPSS Inc., Chicago, IL, USA) for Microsoft Windows. The Student t-test was used for the comparative analysis.

The criteria for success were the following: (1) no clinically detectable mobility; (2) no peri-implant radiolucency; (3) no complaint of pain at the implant site; (4) no recurrent or persistent peri-implant infection; (5) no neuropathy or paresthesia; and (6) no marginal bone loss more than 2 mm after 1 year of functional loading and less than 0.2 mm/year in the follow-up visits according to the criteria of success presented previously.

RESULTS

Any implant among 30 INNO® dental implants of both 15 immediate restoration group and 15 delayed restoration group was not lost, resulting in a survival rate of 100 %. In marginal bone change, immediate loading (0.18 ± 0.01 mm) was not a factor of bone loss, compared with delayed loading (0.26 ± 0.19mm).

DISCUSSION

The present cohort study described and compared the clinical and radiographic outcomes after 2 years of function of immediate versus delayed restorations of single dental implants installed in fresh extraction sockets. Implant survival and marginal bone loss were evaluated. The preliminary findings of this comparative study are very promising, as no implant was lost during the 1year of the survey. Moreover, the 1-year data revealed no biological or technical complications; the overall success

rate of 100% for implants placed immediately in the fresh extraction socket. The two groups presented same successful tissue integration over the study period, showing that immediate restorations of implants installed in fresh extraction sockets were at least as effective and safe as delayed restorations.

The latest review paper has calculated the survival rate of dental implants placed flaplessly to be from96.9% to 97.86% for the first year of loading irrespective of immediate or delayed restoration,[24,25] and a 2-yearsurvival rate of 98.4% (97.3% to 99%) has been reported for immediate implants.[6]

A few key factors should be considered in this respect: First, implants were installed in fresh extraction sockets on the basis of strict clinical criteria, such as intactness of the buccal bone plate, absence of acute infection, and adequate soft and hard tissue dimensions; second, the prosthetic treatment, that is, immediate or delayed restoration, was selected based on the insertion torque value (cutoff value 45 N cm), which meant that patients were not allocated to the immediate or delayed restoration groups on the basis of a randomized process but on the basis of strict clinical criteria; third, a contour augmentation was performed at all implant sites with the aim of reducing ridge changes after tooth extraction. Therefore, it should be taken into consideration that the current treatment protocol eliminated many high-risk scenarios that are capable of jeopardizing the clinical outcomes regarding either the survival rate or the aesthetic results.

Bone loss after immediate prosthetic restoration seemed to follow a slow, gradual progression; however, results showed that the two groups (immediate and delayed restoration) seemed to attain similar final levels of mean marginal bone loss, which were 0.18 ± 0.01 mm and 0.26 ± 0.19 mm, respectively, for immediate and delayed restorations.

A recent review paper has described results for immediate implant placement with either immediate or conventional loading6: for immediate restoration, 1-year studies showed a bone loss from less than 1 mm to a maximum of 2 ± 1.4 mm in the first year, while longer-term studies demonstrated a stabilization of the bone level after the first year of functioning[23,25]; for delayed restoration, among the studies that measured the bone level at the time of implant placement, a bone loss from 0.05 mm to 1.4 mm over 12–21 months wasreported.[6,25]

CONCLUSION

The final outcomes of immediate and delayed prosthetic rehabilitation for a single implant installed in a fresh extraction socket were very similar, although the two restorative procedures may be employed only following precise clinical indications.

No significant differences were recorded between the two procedures with regard to bone resorption. Immediate restoration of implants installed in fresh extraction sockets was at least as effective and safe as delayed restoration.

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