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This study evaluated the clinical outcomes of immediately loaded maxillary anterior single implants placed in fresh extraction sockets. A patient cohort that was treated 1.5 years earlier was recalled, and 18 patients (6 men, 12 women) with 21 implants were included. Clinical photographs and periapical radiographs were taken at follow-up and baseline to determine the bone loss and change in esthetics. No marginal bone loss was detected at follow-up (mean bone level ± standard deviation = 0.32 ± 0.82 mm). Immediate implant placement and loading resulted in predictable clinical and esthetic outcomes, with soft and hard tissue levels remaining stable over time. (Int J Periodontics Restorative Dent 2015;35:715–723. doi: 10.11607/prd.2494)

The initial treatment protocol for dental implants prescribed a healing period of 6 to 8 months from tooth extraction to implant placement.¹ This would allow proper bone healing, thereby eliminating infection and improving primary stability at the time of implant placement. However, the need to decrease treatment time led to the introduction of immediate implant placement, whereby the implant is immediately inserted into the extraction socket.² Apart from the decreased treatment time, this also reduces the number of surgical interventions and may improve the esthetic outcome.³ Because no flap is raised, the risk of bone resorption or soft tissue retraction is reduced. After tooth extraction, there is a 50% reduction in bone width and a 2.4- to 4.5-mm decrease in bone height during the first year.⁴ In some cases, this bone resorption is so extensive that it prevents delayed implant placement.⁵

On the other hand, immediate placement also raised some concerns regarding the risk of infection, unpredictable soft and hard tissue response, and the difficulty of achieving primary stability.⁶ Immediate implant placement increases the risk for implant failure in periodontitis-susceptible patients, and patients with a thin biotype demonstrate mucosal recession over time.⁷

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In their review, Lang et al calculated the annual failure rate for immediate implants to be 0.82%, translating to a 2-year survival rate of 98.4%. Survival rates of 95% and more have been reported in the esthetic zone as well as in the posterior region. Even in combination with immediate loading, immediately placed single implants demonstrate a predictable outcome, with survival rates of 95% to 100%.

Placing dental implants in the anterior maxilla is always a challenge because of the high esthetic demands. Particularly in this region, immediate placement is of interest not only because it reduces the treatment time but also because it minimizes surgical intervention and may improve the soft tissue outcome. Immediate flapless implant placement with delayed restoration demonstrated minimal bone changes and stable soft tissues over a 5-year period. The use of an immediate provisional restoration may even help to further maintain the soft tissue contours and improve the final esthetic outcome.

It has been proven that this methodology functions with high implant survival and minimum marginal bone level alteration. It must be noted, however, that the peri-implant biotype is an important factor in many of these studies, which select only patients with thick biotypes. This is based on the fact that thicker biotypes result in greater peri-implant mucosal dimensions, and ridge alterations are larger in thin biotypes. Therefore, it has been recommended that, for a predictable outcome, immediate insertion/loading in fresh extraction sockets should be avoided as much as possible in patients with thin biotype.

Although it can be said that this protocol has proven to be a predictable concept, most clinical evidence has originated from the white population, and the anatomic differences with other races have not been taken into consideration. For instance, the shape of the anterior maxillary teeth is more slender in Asian subjects than in white subjects. Funtato et al reported that most of the Asian population possessed thin and scalloped biotypes, whereas Gobbato et al reported that most of the white population possessed thick and flat biotypes. Hence, it was of great importance to obtain information on clinical outcomes with regard to the immediate loading of implants placed in fresh extraction sockets in an Asian population, and therefore, a retrospective study was conducted at a private practice of one of the authors in Japan.

### Method and materials

#### Patient selection

The patients were selected from a private practice in Japan, where they were treated by one experienced surgeon (K.T.). All single implants that were immediately placed after tooth extraction in 2011 were included. The implants had to be positioned in the anterior maxilla and had to be functioning for at least 1 year at the time of recall. Smokers were excluded from the study. All participating patients had to sign an informed consent form.

#### Surgical procedure

Before surgery, patients were examined, and clinical pictures and periapical radiographs were taken. Surgery started with extraction of the tooth using periotomes, to minimize the trauma to the surrounding tissues. After extraction, a 0.05% chlorhexidine (ConCool, Weltec) impregnated gauze was inserted in the extraction socket for 10 minutes to disinfect the wound. Implant preparation was done without flap elevation. Special attention was paid to correct three-dimensional positioning of the implant, whereby the implant (Osseospeed, Dentsply Implants) is situated more to the palatal side and kept away from the buccal bone. In apicocoronal dimension, the implant was submerged about 4 mm under the midfacial gingiva level. If primary stability (35 Ncm) was achieved, an impression was made for the provisional crown.

In cases where the jumping space between the implant and the buccal bone was 2 mm or more, a beta-tricalcium phosphate graft (OSferion, Olympus Terumo) was placed. The healing abutment was connected to the implant and the wound was closed using a horizontal mattress suture (CV5, Gore-Tex).

#### Provisional restoration

One day after the implant insertion, the patient returned for placement of the provisional crown. The healing abutment was removed and replaced by a standard abutment (Direct Abutment, Dentsply...
Implants) and a cementable acrylic crown (Temp Bond, Kerr) that was made in the dental laboratory. The crown was placed slightly out of occlusal contact.

**Final restoration**

An open-tray impression was made 12 weeks after surgery, with a two-body vinyl polysiloxane impression material (Imprint II, 3M ESPE). Two weeks later, the final cementable abutment and crown were placed. Eleven abutments were milled in titanium, six in zirconia, and four in a conventionally cast noble alloy. A periapical radiograph and clinical pictures were taken. The zirconia abutments were restored with a lithium-disilicate crown (e.max, Ivoclar Vivadent) and the other abutments were restored with a nonprecious porcelain-fused-to-metal crown.

**Evaluation procedure**

Clinical examination and data evaluation were performed by an independent examiner (VV), who was not involved in the patients’ treatment.

The pink esthetic score (PES) by Furhauser et al.\(^2\) and the white esthetic score (WES) by Belser et al.\(^2\) were used to evaluate the esthetic outcome, and were determined based on clinical pictures taken at the time of crown placement and at the 1.5-year follow-up. Of a total of 14, the PES was considered (almost) perfect if the sum was 12 or more, satisfactory between 8 and 12, and an esthetic failure if less than 8.

On the other hand, of a total score of 10, the WES was considered (almost) perfect if the sum was 9 or more, satisfactory between 6 and 9, and a failure if less than 6.

Probing depth was measured at the 1.5-year follow-up with a standardized periodontal probe at four sites around the implant.

Fig 1 Clinical photographs and radiographs at the time of the patient’s first visit with a fractured maxillary left central incisor (a and b), taken at baseline (c and d) and follow-up (e and f). Soft and hard tissue changes are minimal.
The higher the total score, the worse the satisfaction level was, with a maximum possible score of 216. To facilitate interpretation of the results, the score of 216 was set equal to 0% satisfaction, and a score of 0 meant 100% satisfaction.

Periapical digital radiographs were taken using the paralleling technique with the help of a dental radiograph holder (Honshin, Japan) at baseline and at the 1.5-year follow-up. These radiographs were imported into a computer to measure the bone level (ImageJ). The known thread pitch and implant length were used to calibrate the radiographs before measuring. The apical point of the diagonal bevel of the implant shoulder was used as a reference point. Bone level was measured from the reference point to the most apical bone-to-implant contact. Bone level apical from the reference point was negative, whereas bone level coronal from the reference point was registered as a positive value. Both mesial and distal bone levels were measured at baseline and at the 1.5-year follow-up. The difference between the mean bone level at both time points was calculated and resulted in the mean bone loss.

**Statistics**

SPSS version 20 software (IBM) was used for statistical analysis. The Mann-Whitney U test was used for comparison of bone loss. PES and WES were compared using the Wilcoxon paired sample test.

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**Fig 2** Clinical photographs and radiographs at the time of the patient's first visit with an endodontically compromised maxillary left central incisor (a and b), taken at baseline (c and d) and follow-up (e and f). Soft and hard tissue changes are minimal.
Results

A total of 18 patients (6 men, 12 women), mean age 48 years (standard deviation [SD]: 11; range: 32 to 77 years), were treated with 21 single implants. Three patients received two single implants. In 18 cases, the tooth had to be extracted because of a fracture; 1 tooth was removed because of periodontitis; and 2 teeth were extracted because of persisting periapical infections. Some of the cases are presented in Figs 1 to 3.

Based on the diagnosis at the time of examination, clinical photographs, and the method introduced by De Rouck et al, it was determined that all patients possessed a thin gingival biotype.

The implants had a length of 11 mm (n = 8) or 13 mm (n = 13) and a diameter of 4 mm (n = 20) or 5 mm (n = 1). Implant positions are depicted in Fig 4. In five cases, an additional bone graft was placed into the residual space.

Bone remodeling resulted in a mean bone level of 0.32 mm (SD: 0.82; range: –0.89 to 2.47 mm). The mean bone level after 1.5 years was positioned 0.56 mm (SD, 1.28; range –1.00 to 4.00 mm) coronal to the implant shoulder. There was no significant difference in bone loss whether or not a bone graft was used (P = .934). The mean probing depth was 2.88 mm (SD: 0.45; range: 2.25 to 4.00 mm).

Of a total score of 14, the PES at baseline and at the 1.5-year follow-up were 10.52 (SD: 2.04; range: 4 to 13) and 10.24 (SD: 2.39; range: 4 to 14), respectively. There was no statistically significant difference over time (P = .279). Of a total score of 10, the WES at baseline and at 1.5-year follow-up were 8.05 (SD: 1.94; range: 5 to 10) and 8.29 (SD: 1.62; range: 5 to 10), respectively. This difference was not statistically significant (P = .059). The esthetic outcomes are depicted in Tables 1 and 2. The mean OHIP-J score was 96.7% (SD: 2.16; range: 92.6 to 100).
The results of the marginal bone alteration showed that the bone-implant contact moved to a more coronal level over time in most cases. This phenomenon is probably caused by a continuing mineralization and densification of the bone. Another reason could be that the immediate implant procedure
may have contributed in preserving the bone level, though no definitive conclusion can be drawn because the current study is not a comparative one. This is in accordance with another study that reported better crestal bone loss preservation for immediate implants compared with delayed implants.24 Using the same implant system as in our study, Berberi et al25 also concluded that immediate implantation reduced marginal bone loss. It must be stated however, that the quality of the radiographs could have some influence on the outcomes, and custom radiograph holders are the best solution to compare the radiographs at different time points. This study was a retrospective analysis extracted from daily clinical practice, so the radiographs were not taken with these holders for various reasons, including economy. Therefore, the radiographs were calibrated by computer software to compensate for the shortcomings.

Correct positioning of the implant is crucial for soft and hard tissue outcome. A more facial position of the implant, close to the buccal cortical bone, will increase the risk for mucosal recession.26 Furthermore, a deeper placement of the implant, preferably 2 mm subcrestally, will result in less bone resorption and a higher bone-to-implant contact.27 Because the anterior incisors are not round but oval, one can expect a residual gap between the implant and buccal bony wall, the so-called jumping space. In this study, beta tricalcium phosphate was used as graft material, which has been shown to demonstrate similar long-term results as non-grafted immediate implant sites.28 It can be said that the effect of bone grafting was minimal for the mesiodistal aspect of the marginal bone levels. Moreover, the grafting procedure had no influence on the esthetic outcomes (PES and WES). However, this topic is of interest and should be investigated in future studies.

When implants are placed in extraction sockets, the primary stability needed for immediate loading is sometimes difficult to achieve and therefore may put the implant at risk. In a recent review, Lang et al8 found no significant effect of immediate loading on the survival of immediate implants. However, when making a distinction between

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PES = pink esthetic score; WES = white esthetic score.
the anterior and posterior jaw, Atieh et al.\(^2\) found that immediate loading increases the risk for implant failure of immediate implants in the esthetic region, but not in the posterior jaw. In the anterior maxilla, lateral forces and smaller-diameter implants may negatively affect the implant survival of immediately loaded implants. In the present study, all implants reached at least 35 Ncm at insertion, and care was taken to avoid occlusal contact during masticatory movements to avoid overload of the implant.

A surgical intervention, such as tooth extraction and implant placement, will cause dimensional changes of the surrounding soft tissue. Mucosal recession often occurs and ranges between 0.30 and 0.55 mm during the first year.\(^3\) In some cases, this may negatively affect the esthetic outcome. In the present study of 21 cases, two could be considered esthetic failures and five were (almost) perfect. The majority (n = 14) demonstrated minor shortcomings and were therefore categorized as satisfactory. These figures correspond well with the results of Cosyn et al.,\(^1\) who, in a study of 24 cases, described 5 as failures, 14 as satisfactory, and 5 as perfect. From the raw data of the PES and WES, it can be said that the esthetic scores were maintained before and after the intervention, but did not lead to a significant esthetic improvement for patients whose situations were compromised from the beginning.

There was no significant difference in the esthetic score between baseline and follow-up, indicating a stable level of the mucosa. Most alterations take place during the first 3 months after implant placement and are followed by a stabilization of the mucosa.

Although only a quarter of the cases could be considered (almost) perfect, the patient satisfaction was very high, with a mean score of 96.7 out of 100. It can be said that in addition to the esthetic result, the patients value the functional aspect of the therapy very highly.

The results of this current retrospective study suggested that the thin biotype did not affect the clinical outcomes. Longer observation periods are necessary to draw definitive conclusions; however, with proper selection of cases (free of periodontal diseases, heavy smokers, parafunctional patients, etc) and implant positioning, the clinical results are expected to be comparable with those seen in the existing literature.

**Conclusions**

Immediate implant placement in combination with immediate loading resulted in predictable clinical outcomes with stable soft and hard tissue levels in a group of Japanese patients known to possess thin biotypes compared with those seen in the white population.

**Acknowledgments**

The authors reported no conflicts of interest related to this study.

**References**


