



Original Article

Esthetic results of immediate implant placement in extraction sockets with intact versus deficient walls

Kang-Shuo Hu ^a, Hua Li ^b, Yu-Kang Tu ^b, Shih-Jung Lin ^{a,c*}

^a Department of Periodontology, Shin Kong Wu Ho-Su Memorial Hospital, Taipei, Taiwan

^b Institute of Epidemiology and Preventive Medicine, College of Public Health, National Taiwan University, Taipei, Taiwan

^c College of Dentistry, National Taiwan University, Taipei, Taiwan

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Introduction

Immediate implant placement has become a common treatment option in dental treatment. It reduces time and number of treatment appointments, and the result is stable, with survival rates as high as 93.9%–100%.^{1–4} Some studies have demonstrated comparable survival rates when implants are placed immediately following tooth extraction or in healed alveolar ridges.^{5–10}

The challenge in immediate implant treatment is that the implant is placed in a socket with a deficient wall (deficient socket), which have a dehiscence-type or fenestration defect resulting from tooth fracture, endodontic lesion, or periodontal destruction. Only a few papers have discussed esthetic results of immediate implant placement in deficient sockets. Furthermore, it is more difficult to place the implant into deficient sockets with labial bone destruction. The immediate implant placement is esthetically challenging especially in buccal bone destruction cases.¹¹ The most common esthetic complication is gingival recession, especially in cases with thin periodontal biotype.

Belser presented the pink esthetic score (PES) to evaluate implant esthetics.¹² The PES evaluates the soft tissue condition and comprises the following five variables: mesial papilla, distal papilla, curvature of the facial mucosa, level of the facial mucosa, and the root convexity, soft tissue color and texture at the facial aspect of the implant site. A score of 2, 1, or 0 is assigned to each PES parameter.

The present study compared the survival, esthetic results, and complications of immediate implant placement in intact sockets with that in deficient sockets, including fenestration and dehiscence defects.

Materials and methods

Patients and implants

Fifty patients with unrestorable teeth (incisor, canine, or premolar) were treated with an immediate implant placement between March 1996 and September 2017. Cases with adjacent implants were excluded. Patients were deemed unsuitable for implant placement if they presented with one or more of the following: smoking more than 10 cigarettes per day, diabetes, immune diseases, radiation to the head and neck area in the preceding 12 months, and poor oral hygiene.

Implant surgery was performed by two periodontists. All implants were categorized into the deficient socket group

* Corresponding author. Department of Periodontology, Shin Kong Wu Ho-Su Memorial Hospital, B1F., No. 95, Wen Chang Road, Shih Lin District, Taipei, 11101, Taiwan. Fax: +886 2 28389321.
E-mail address: louissj.lin@msa.hinet.net (S.-J. Lin).

(dehiscence or fenestration bony defect after tooth extraction; n = 25) or the intact socket group (no bone destruction after tooth extraction; n = 25). Implant location, numbers, and defect types are listed in Table 1. The most common implants were Straumann implants with SLA surface (Straumann, Basal, Switzerland), including bone level or tissue level implants; four were Ankylos implants (Dentsply, Mannheim, Germany); and one was an Astra Tech implant (Astra Tech, Molndal, Sweden).

Records were obtained, including clinical measurements, photos, and radiographs.

Implant placement

After local anesthetic administration and flap elevation, the tooth was carefully extracted to maintain the integrity of the labial plate. Some cases were treated with flapless surgery when the socket walls were intact. The infected periapical tissue or granulation tissue was thoroughly curetted. The socket was assessed for the presence or absence of a buccal alveolar bone fenestration or dehiscence defect.

Implant bed preparation was completed after standard protocols using incremental sharp spiral drills and copious chilled saline. The implant was placed according to the ideal three-dimensional implant position and good primary stability was achieved.

The labial defect was grafted using bone substitute (Sinbone HT®, Purzer Pharmaceutical, Taipei, Taiwan) or bovine bone matrix (Bio-Oss®, Geistlich Biomaterials, Lucerne, Switzerland). The gap between implant and socket wall was also filled with the bone substitute. A bioabsorbable collagen membrane (Periaid®, Franklin Lakes, NJ, USA) or (EZ CURE®, Biomatlante, Vigneux de Bretagne, France) was placed over the grafted site. Polysorb or nylon interrupted sutures were used to achieve passive soft tissue closure. No primary closure was intentionally applied, and collagen membrane may be partially open to the oral cavity.

Only three cases were treated with immediate provisional crown placement: two with intact extraction socket and one with dehiscence defect.

Antibiotics, analgesics, and chlorhexidine mouthwash were prescribed during the postoperative period. Sutures were removed 7–10 days postoperatively. Postoperative healing was uneventful. In submerged healing cases, second-stage surgery was performed 3 months after the initial procedure. A minimal incision was made at the crestal level to

remove the cover screw of the implant and for placement of a healing abutment. Implants were loaded in 3–4 months after implant placement.

The esthetic outcome in all cases was evaluated by PES, and only upper anterior sites (incisors and canine) were re-evaluated by PES again. Upper anterior sites were involved in 17 cases in the deficient socket group and 16 in the intact socket group.

Statistical analysis

All data were evaluated by the same operator. Intra-examiner reliability was evaluated by kappa (κ). Regarding the PES, t tests for equality of means were calculated, and $p \leq 0.05$ was considered to indicate statistical significance. All analyses were performed using the SPSS version 21 statistical software (SPSS Inc., Chicago, IL, USA).

Results

There were 50 implants placed in 50 patients in the observed period, with 25 patients (9 male and 16 female) in the deficient socket group (19 dehiscence-type and 6 fenestration defects) and 25 (8 male and 17 female) in the intact socket group (Figs. 1 and 2). The age of patients ranged from 23 to 76 years (mean, 48.6; median, 49). The distribution of the implants is shown in Table 1.

Within the follow-up period (4–12 months; median, 6.5 months), the overall implant survival rate was 100% in both groups. No implant failed even in extraction sockets with dehiscence or fenestration defects.

The reasons for tooth extraction in the deficient group were shown in Table 2. There were 15 cases with an apical lesion in deficient group and 6 cases with an apical lesion in intact socket group.

No complications were noted during the postsurgical healing period except one case with obvious mucosal recession after provisional crown delivery. The mucosal recession was corrected with soft tissue augmentation.

Intra-examiner reliability of all PES data was good (all $\kappa > 0.80$).

Comparing the esthetic outcomes of all cases (Figs. 3 and 4), a satisfactory aesthetic outcome was found with a PES of 8.4 ± 1.29 and 8.52 ± 1.05 for immediate implant placement in both deficient socket and intact socket groups, respectively (Table 3), with no significant intergroup difference ($p = 0.720$). In the upper anterior sites (incisors and canine), PES was 8.59 ± 1.18 and 8.63 ± 1.09 , respectively, and this difference was also not significant ($p = 0.926$) (Table 4).

Discussion

In the present study, immediate implantation in the socket with bony defect did not lead to an increase in complications compared with that in the intact socket. There was no implant failure after immediate implant placement in either group.

In our study, there were 21 cases with an apical lesion: 15 in the deficient socket group and 6 in the intact socket group. Quirynen et al. reported that apical endodontic

Table 1 Distribution of implants placed in deficient or intact sockets.

Location	Deficient socket (n = 25)		Intact socket (n = 25)
	Dehiscence	Fenestration	
Upper Incisor	10	6	15
Upper Canine	1	0	1
Upper Premolar	2	0	6
Lower Incisor	3	0	0
Lower Canine	0	0	0
Lower Premolar	3	0	3

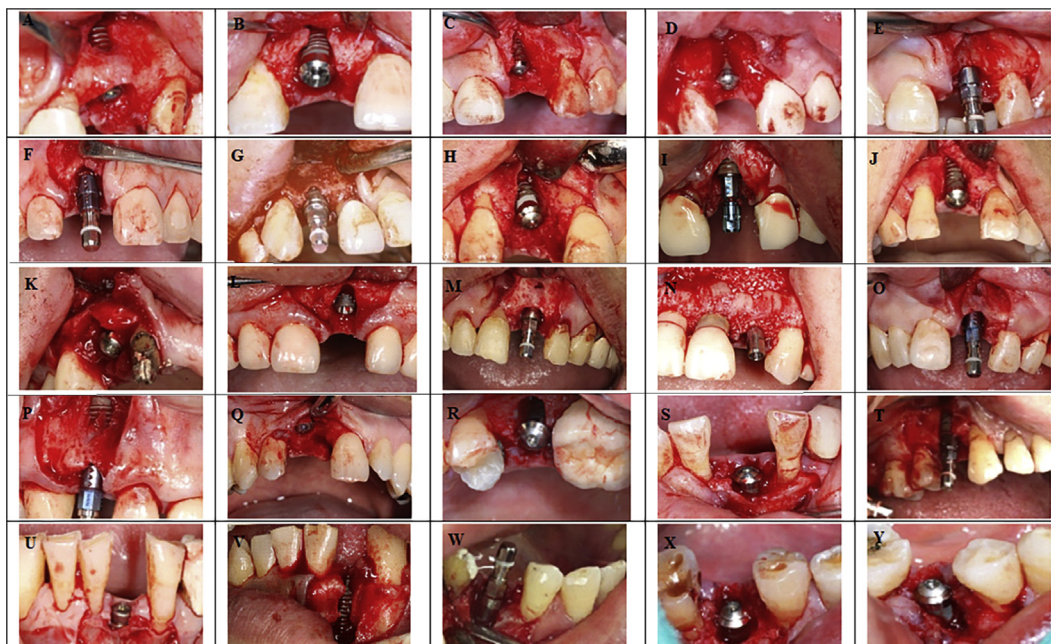


Figure 1 Immediate implant placement in extraction socket with fenestration or dehiscence defect after flap elevation.

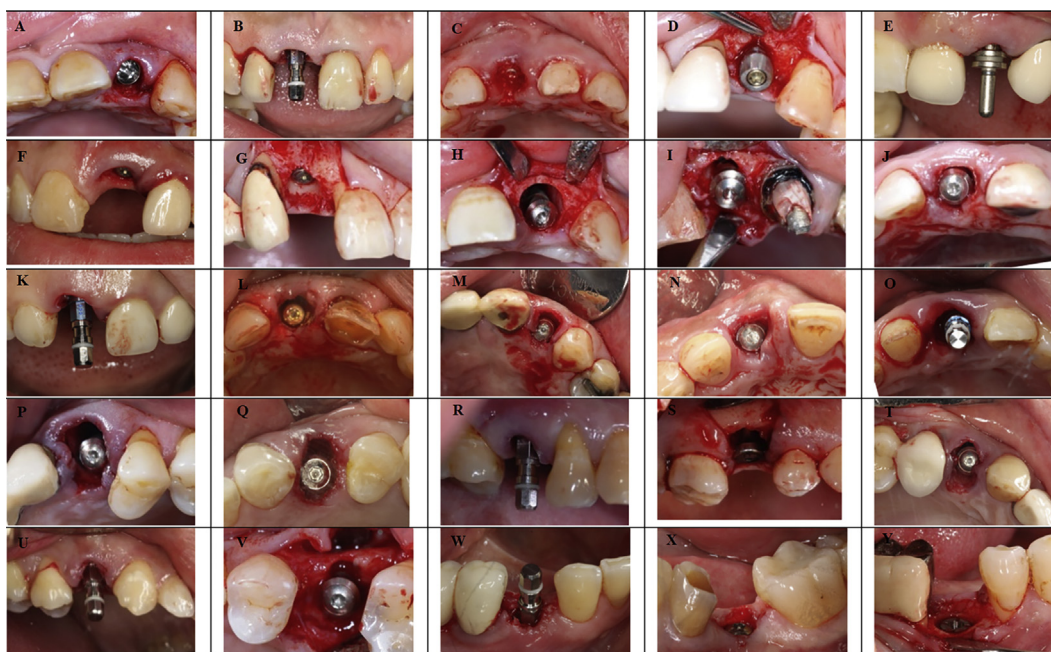


Figure 2 Immediate implant placement in the intact socket group.

pathology of the extracted tooth may induce retrograde periimplantitis.¹³ However, in our study, there was no implant failure, infection, or periapical lesion found around implant over the follow-up period.

A systematic review summarizing data from animal experiments, case reports, case series, and prospective studies showed similar success rates for implants placed into infected sites compared with those placed in non-infected sites.¹⁴ Another study suggested that the presence of chronic apical lesions does not affect the survival rate.¹⁵

In a retrospective study, immediately placed implants in 418 sites exhibited periapical pathology (76 fenestration and 29 dehiscence defects). They were followed for a mean of 67.3 months, and the cumulative survival rate was 97.8%. The survival rates of the immediate implants placed at sites demonstrating periapical pathology were comparable to those at sites without periapical pathology.¹⁶ Another systematic review predicted that the cumulative 5-year survival rate of immediate implants in sites with periapical lesions was 96.23%, and that their clinical outcomes were

Table 2 Reasons for tooth extraction in the study population.

	Deficient socket (n = 25)	Intact socket (n = 25)
Caries	7	10
Fracture	16	14
Periodontal problem	2	
Root resorption		1

comparable to those of immediate implants in healthy sites.¹⁷

Primary stability is essential for immediate implant placement. There should be at least 3–5 mm of residual bone height to provide implant stability. If the lesion around the tooth is carefully removed without affecting primary stability, then there is no problem for immediate implant placement in periapical lesion sites.

In a study comparing immediate and delayed implant placement in extraction sites with a labial bony defect of ≥5 mm in the esthetic zone, no clinically relevant differences were observed in marginal bone level change, survival rate, or esthetic outcome.¹⁸

Noelken et al. published survival and PES outcomes of 29 immediate implant placements in deficient sockets (fenestrations, dehiscences, or even total loss of buccal bone wall). They reported an implant survival rate of 100%. Even implant sites with facial bony deficiencies can be successfully treated and yield a favorable esthetic outcome using immediate implant insertion, immediate reconstruction, and immediate provisionalization techniques.¹⁹ In a previous study, Noelken and colleagues reported an implant

survival of 100% and favorable esthetic results with immediate implant placement in 16 patients with complete loss of the labial bone plate.²⁰

Immediate implant placement into a socket with a labial osseous dehiscence combined with bone graft and collagen membrane is a viable clinical technique to reconstitute the absence of the labial bone plate based on cone beam computerized tomography examination.^{19,21}

According to a systematic review, guided bone regeneration for the management of bone defects (dehiscence or fenestration defect) as immediate implant placement is a viable treatment option.²²

In our study, there was no implant failure even in the deficient socket group. In our experience, acute inflammation such as pus and abscess negatively affects soft tissue quality, thereby complicating soft tissue management. During guided bone regeneration (GBR) procedures, acute inflammation may result in infection, poor clinical results, more implant failures, or other complications. Therefore, an implant placed in a site with chronic inflammation or deficient socket was a viable treatment option.

Chen & Buser observed similar survival rates for immediate (type 1) and early (type 2) implant placement.²³ In their study result, recession of facial mucosal margin was common with immediate placement, and thin or damaged facial bone wall was a risk factor. In the upper anterior sites in our study, the PES of level of facial mucosa for the deficient and intact socket groups was 1.71 ± 0.47 and 1.88 ± 0.34 , respectively, and the difference was not significant.

In two cases with deficient sockets, there was obvious facial mucosa recession because the implant was positioned excessively close to the buccal side. One case was corrected by soft tissue augmentation with a connective tissue graft. Buser et al. presented the ideal implant position as



Figure 3 Final esthetics of immediate implant placement cases in the deficient socket group.



Figure 4 Final esthetics of immediate implant placement in the intact socket group.

Table 3 Mean pink esthetic score (PES) scores for immediate implant placement in the deficient and intact socket groups.

	Deficient socket (n = 25)	Intact socket (n = 25)	P-value ^a
Mesial papilla	1.60 ± 0.50	1.60 ± 0.58	1
Distal papilla	1.68 ± 0.48	1.72 ± 0.54	0.783
Curve of facial mucosa	1.64 ± 0.49	1.72 ± 0.46	0.554
Level of facial mucosa	1.72 ± 0.46	1.84 ± 0.37	0.316
Root convexity, soft tissue color and texture	1.76 ± 0.44	1.64 ± 0.49	0.365
Total PES	8.4 ± 1.29	8.52 ± 1.05	0.720

^a The level of statistical significance was set at 0.05 for all analyses.

Table 4 Mean pink esthetic score (PES) scores for immediate implant placement at upper anterior sites in the deficient and intact socket groups.

	Deficient socket (n = 17)	Intact socket (n = 16)	P-value
Mesial papilla	1.65 ± 0.49	1.50 ± 0.63	0.460
Distal papilla	1.82 ± 0.39	1.81 ± 0.40	0.937
Curve of facial mucosa	1.71 ± 0.47	1.75 ± 0.45	0.784
Level of facial mucosa	1.71 ± 0.47	1.88 ± 0.34	0.244
Root convexity, soft tissue color and texture	1.71 ± 0.47)	1.69 ± 0.48	0.912
Total PES	8.59 ± 1.18	8.63 ± 1.09	0.926

the anterior maxilla.²⁴ Funato et al. presented the implant axis as the key for ideal implant position.²⁵ In another study, implants with facial malposition showed three times more mucosal recession.²⁶ The ideal implant position and angulation would reduce the risk of facial mucosal margin recession, and the esthetic result would be favorable even in the deficient socket.

There was no significant difference in the scores of mesial or distal papilla between the two groups. In some cases, the papilla score was lower irrespective of whether the socket was deficient or intact. This was probably related to the adjacent teeth; if the adjacent teeth have periodontal problems and interproximal bone loss, the papilla score would be low.²⁷

An apically located interproximal bone level at the tooth neighboring the implant negatively influenced the papilla dimension.²⁸ The height of the papilla adjacent to the implant depended on the distance from the interproximal bone crest of adjacent teeth to the contact area. Rebuilding the interproximal bone height of adjacent teeth has unpredictable results. Therefore, loss of the interproximal bone of adjacent teeth would influence the esthetic score of the papilla, and a black triangle might be observed. The presence of a buccal defect in the socket may not influence the papilla score.

In our study, the esthetic results (PES) were not significantly different between the two groups, even for the upper anterior sites (incisors and canine). Although a socket with bony deficiencies would make an implant treatment procedure more complicated, all procedures were viably performed by an experienced dentist.

Numerous studies have demonstrated marked dimensional change of the alveolar ridge after tooth extraction, especially in the horizontal dimension, and rapid resorption in the first 3 months.^{29–31} This dimension change limits the

placement of the implant in the ideal position and implant angulation, especially in cases of sockets with a buccal defect. Ridge preservation or augmentation is one treatment option to correct the ridge defect, but it is time consuming and would increase the number of surgical procedures. Immediate implant placement combined with GBR is another choice. In our study, immediate implant placement in a deficient socket could also achieve favorable results.

This retrospective study analyzed the survival and esthetic results of immediate implant placement in deficient or intact extraction sockets. The esthetic outcomes were comparable between the two groups, and there was no implant lost. Immediate implant placement combined with GBR in deficient or intact sockets reduces the treatment time, number of surgical appointments, and may prevent poor implant position and poor implant angulation after ridge under significant dimensional change. When performed by experienced clinicians in well-selected cases, this procedure does not show an increased risk for biological or esthetic failure. Longer-term follow-up of esthetic results and clinical outcome are needed to evaluate the validity of immediate implants placement in deficient or intact sockets.

Declaration of Competing Interest

The authors have no conflicts of interest relevant to this article.

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