

Clinical Evaluation of Short and Wide-Diameter Implants Immediately Placed Into Extraction Sockets of Posterior Areas: A 2-Year Retrospective Study

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The objective of the study was to determine the short-term success rate of short and wide single-tooth implants, immediately placed into extraction sockets of the posterior area. A retrospective cohort study design was used. A total of 145 subjects received 162 short and wide-diameter single-tooth implants between 2006 and 2009. A minimal 7-mm residual height and 9-mm ridge width was available in all the implant sites, and the attached gingivae were at least 2 mm wide. All implants were placed and restored with the single crown by one experienced operator. The data were analyzed with descriptive statistics. All implants were placed in molar areas. There were 20 Ankylos implants with a diameter 5.5 or 7 mm and a length of 8 mm and 142 hydroxyapatite-coated implants with a diameter 5 or 6 mm and a length of 5.7 to 8 mm. One of the 162 implants failed before prosthetic restoration, resulting in a survival rate of 99.4% after loading. Patients were followed for up to 56 months (mean = 24 months) after loading of implants. The radiographic and clinical data revealed well-maintained hard and soft tissues with acceptable short-term results. For residual ridges with minimal height but adequate width, the immediate placement of short and wide-diameter implants in fresh extraction sockets may offer a simple and predictable treatment alternative if implants are positioned appropriately after a thorough preoperative analysis.

Key Words: *immediate implants, follow-up study, posterior area, short and wide diameter implant, extraction socket, single tooth*

INTRODUCTION

In recent years, immediate implant placement into the extraction socket after tooth extraction has become a popular surgical procedure. Several authors have reported satisfactory clinical outcomes and a high degree of

survival up to 5 years, which is comparable to conventionally installed implants.^{1,2} However, because of the anatomic and physiologic limitations, the immediate placement of dental implants in the posterior maxillary and mandibular regions presents specific challenges, which may be adversely affected by the bone defect, lack of soft tissue closure, and flap dehiscence over the extraction site.³

An alternative therapy in situations with limited amounts of bone available is the installation of short implants, defined as implants with a length of less than 10 mm.⁴⁻⁶ The use of short implants substantially simplifies the restoration of posterior

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segments of dentition⁷⁻⁹ and minimizes the incidence of complications associated with advanced and complex interventions before or simultaneous with the installation of long implants.^{10,11}

With a cumulative survival rate of 100% for 128 implant-supported single crowns in a 68-month study, Griffin and Cheung⁴ proposed that the use of short and wide hydroxyapatite-coated implants may offer a simple and predictable treatment alternative in posterior areas. In a report on 1030 implants placed in private practice, Nedir and colleagues¹² found that the survival rate for short implants was equal to that for longer implants when used to support single crowns or fixed partial dentures of 2 to 4 units. With a cumulative survival rate of 94% for implants and 91% for prostheses in a 5-year study, Teixeira et al¹³ advocated the application of short hydroxyapatite-coated implants to the posterior mandible. However, few clinical documentations have specifically addressed the feasibility of the immediate placement of short and wide-diameter implants after tooth extraction in the posterior area. Studies of healing of immediate non-submerged implants sites are limited, and further examination of this protocol for placement is required.

Placement of an implant in an ideal restorative position at the time of extraction of a multi-rooted tooth is often complicated by the presence of residual interradicular bone in which the morphology and/or location presents a challenge to the implant surgeon.¹⁴ Primary stability must be achieved, and the implant must be oriented appropriately. Failure to achieve proper 3-dimensional positioning can create restorative, soft-tissue, hard-tissue, or other complications. Thus, many preparations need to be finished before the surgery.

The aim of this retrospective study was to determine the success of short and wide-diameter dental implants immediately placed into extraction sockets of the posterior area from February 2006 through June 2009. These implants were restored with a single crown and platform-switching principles.

MATERIAL AND METHODS

Patients

This retrospective clinical study was performed in Guangdong Provincial Stomatological Hospital and Shenzhen Ai Kang Jiang Dental Hospital between January 2006 and June 2009. It included 145

consecutively treated patients (64 women and 81 men) with 162 implant-supported single crowns. All treatment was carried out by a single skilled operator (H.J.). The patients were followed for 12 to 56 months after restoration. The mean age of the 145 patients at the initial examination was 48 ± 11 year (range = 21–71 years). A total of 8 patients were smokers (10–30 cigarettes/day). The reasons for tooth extraction that indicated implant placement were dental caries (73 patients, 45.1%), periodontitis (52 patients, 32.1%), traumatic loss (30 patients, 18.5%) and implant failure (7 patients, 4.3%).

The medical and dental history of each patient was reviewed using a questionnaire. Clinical and radiographic examinations, including cone beam computerized tomography (CBCT, New/Tom 3G QR-DVT 9000, QR s.r.1, Via Silvestrini, Italy), were performed to assess each patient's general oral status and quantity and quality of the soft and hard tissues. Patients included were those who were physically able to tolerate conventional implant surgical and prosthetic procedures and were willing to comply with all aspects of implant treatment and follow-up evaluations. Exclusion criteria included systemic immune disorders, metabolic bone disease, uncontrolled diabetes mellitus, pregnancy, or therapeutic radiation to the head or neck within the previous 2 years. No abscess or active inflammation was found around the selected tooth planned for implant placement. Smoking was not considered a contraindication to treatment, but patients were advised that smoking is associated with an increased risk of implant failure. Locally, a minimal residual ridge width of 9 mm was required with a workable residual ridge height of 7 mm, and the attached gingival tissues were at least 2 mm wide for the implant sites.

Before surgery, bone availability at the selected tooth was assessed radiographically by the CBCT scan. The results of this evaluation were used to determine the appropriate implant length; short and wide (6 or 8 mm long; 5 or 7 mm wide) implants were considered suitable for rehabilitation of extraction sites with available bone of 7–15 mm high and 9–13 mm wide.

Surgical procedure

For all the teeth, extractions were performed atraumatically using an original luxator (Direta,

TABLE 1

Distribution of placed implants (n = 162) according to the position in the jaws and length of implants

Implant System	Implant Width and Length (mm)	Maxilla	Mandible
Bicon	5×6	1	4
	5×8	7	5
	6×5.7	3	8
	6×8	40	74
Ankylos	5.5×8	1	4
	7×8	5	10
Total		57	105
Percent		35.2	64.8

Sweden). In the removal of multi-rooted teeth, sectioning of the tooth in a mesial/distal dimension was accomplished with a high-speed handpiece and an appropriate bur (Aryane-2, Dentsply Maillefer, Switzerland), and the roots were removed carefully to preserve the lingual and buccal plates and all remaining interradicular bone. Thorough debridement of the extraction socket was performed. After tooth extraction, the extraction sites were evaluated, and sites with any bone defects were considered unsuitable for immediate implant.

All implants were placed in molar areas (Table 1). Twenty Ankylos implants (Dentsply-Friadent, Germany) with a diameter of 5.5 or 7 mm and a length of 8 mm were placed consecutively in the molar regions of 18 patients, and 142 Bicon implants (Arborway, Boston, Mass) with a diameter 5 or 6 mm and a length of 5.7 to 8 mm were placed consecutively in the molar regions of 127 patients. Grafting materials were placed around the implants as follows: collected autogenous bone fragments were placed around all the implants, and anorganic bovine bone matrix (Bio-Oss, Geistlich, city, state/country) was used around 6 Ankylos implants and 41 Bicon implants.

The implant neck was positioned about 2 mm below the crestal ridge, at least 3 mm below the buccal rim of the neighboring crestal bone, and a width of at least 2 mm was allowed for crestal bone between the implant and the neighboring teeth. After insertion, the stability of the implant was clinically assessed. Micromovement between the implant and the surrounding bone was avoided to allow successful healing to occur. The appropriate healing abutments were subsequently chosen and installed according to the platform switching technique,¹⁵ and these abutments were made from

high-density polyetheretherketone or surgical-grade titanium alloy (Ankylos, Dentsply-Friadent, or Bicon, Arborway). Different diameter implants were platform-switched with different healing abutments.

Chamber space occurred between the implant shoulder and the hard-tissue walls of the fresh extraction socket, which was packed with autogenous bone fragments harvested during the preparation of the implant sites; additional graft materials (anorganic bovine bone matrix, Bio-Oss, Geistlich) were used if the harvested autogenous bone fragments were inadequate for the chamber space. No covering membranes were used. The soft tissues were then adapted and sutured closely and tightly around the abutments to allow non-submerged healing.

The patients were instructed to start a systemic antibiotic half an hour before the procedure. After surgery, mouth rinsing with 0.12% chlorhexidine, twice daily for 6 days, was prescribed, together with the antibiotic (once daily for 3 days).

Prosthetic procedure

No implant-supported provisional restorations were used during the first 3 months. Three months later, the implants were restored with a single crown made from ceramic gold alloy or zirconia all-ceramic crowns (Procera, Sweden). Two examples are presented in Figures 1 and 2, respectively.

Implant success criteria

Implant success was defined as suggested by Buser et al,¹⁶ including (1) absence of any complaints, such as pain, dysesthesia, or paresthesia at the implanted area; (2) absence of recurring peri-implant infection and/or suppuration; (3) absence of perceptible mobility of implant; and (4) absence of radiolucencies at the implant-bone junction. The implants were considered successful in the absence of all of the aforementioned complaints at the most recent recall appointments. Clinical complaints such as pain, dysesthesia, or paresthesia at the implanted area were assessed through interviews with the patients. Peri-implant infection and/or suppuration were monitored through clinical observation of the implant sites. Absence of progressive deepening of probing depth was considered success. Absence of any perceptible implant mobility was considered normal. Absence of esthetic complaints of the

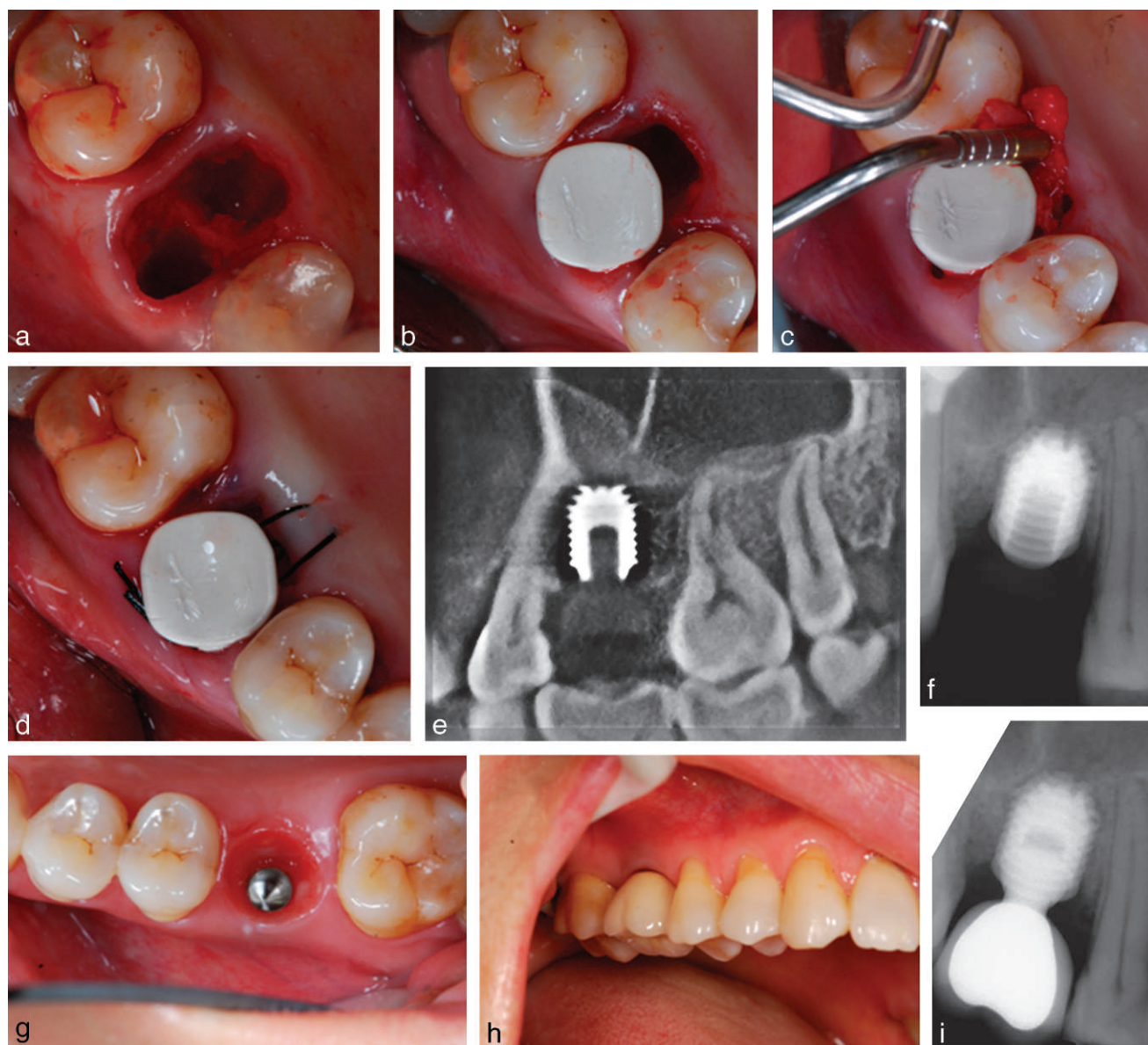


FIGURE 1. A hydroxyapatite-coated 6 × 5.7 mm implant was placed in the maxillary first molar of a 45-year-old female patient. Note the surgical and prosthetic process. (a) The socket site prepared for implant placement. (b) Occlusal view of the implant placed into the extraction socket without flap elevation. An appropriate healing plug inserter was placed immediately after implant insertion. (c) A chamber space that occurred between the implant and the hard tissue was filled with harvested autogenous bone fragments, and (d) the soft tissue was sutured tightly around the abutments to allow non-submerged healing. (e) Then cone beam computerized tomography and (f) a periapical radiograph were taken to assess the 3-dimensional position of the implant. (g) The clinical situation showing the gingival profile 3 months after surgery. (h) The restoration and (i) concomitant X ray.

patient or dentist (esthetic complications) was considered success.

Marginal bone evaluation

Periapical radiographs were taken at implant insertion, 6 months, 1 year, and thereafter each year. A conventional radiograph holder was used, and its position was manually adjusted for an

estimated orthognatic position of the film. No other method of standardization was used. The reference point for the reading was the implant platform (the horizontal interface between the implant and the abutment), and marginal bone remodeling was defined as the difference in marginal bone level relative to the bone level at the time of surgery. The radiographs were grouped as follows: implant

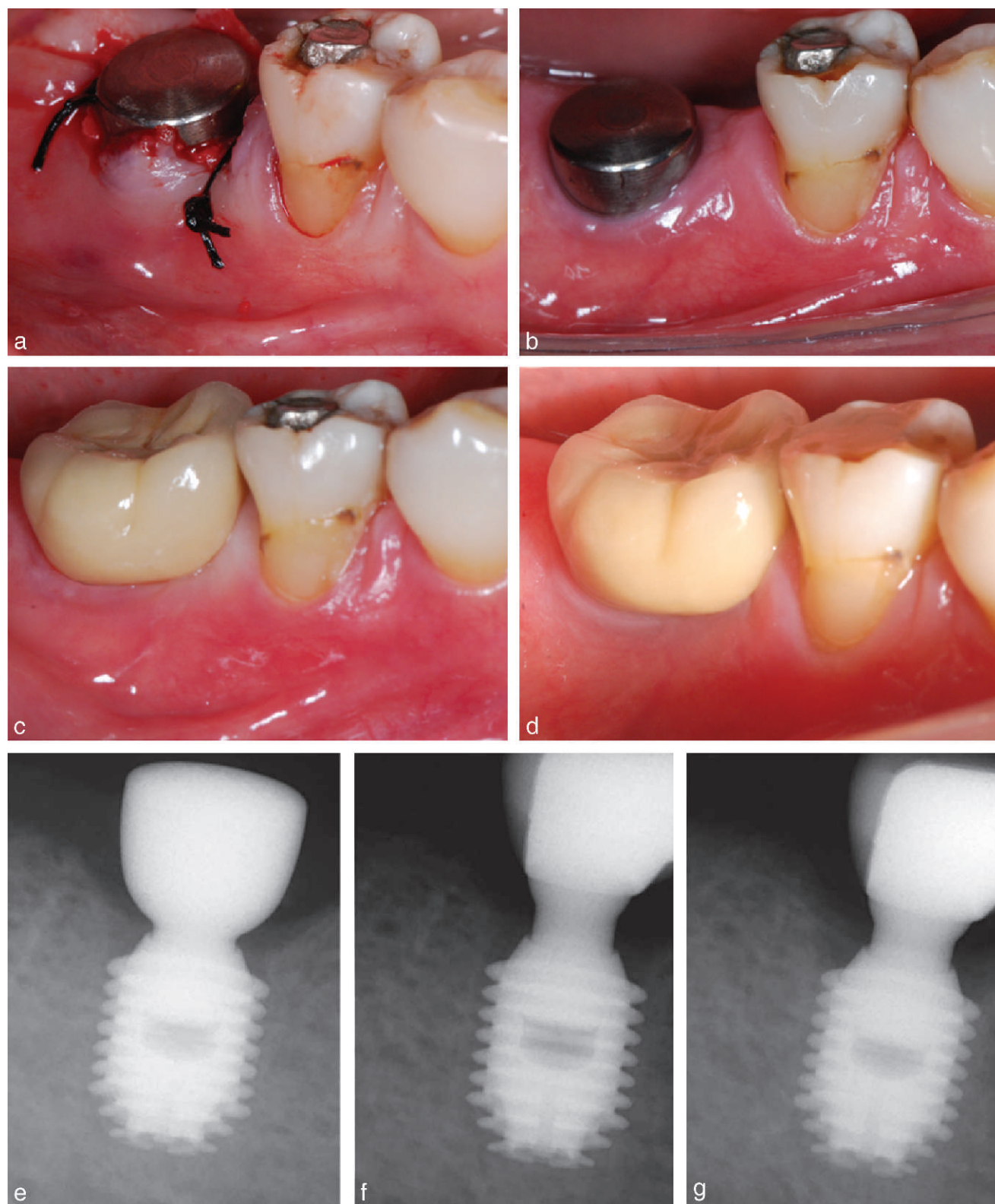


FIGURE 2. A hydroxyapatite-coated 6 × 8 mm implant was placed in the mandibular first molar of a 43-year-old female patient. (a) Non-submerged healing was allowed after implant insertion with flapless surgery. Clinical and radiographic situations were shown, respectively, (b and e) 3 months after installation, (c and f) 1 year later after loading, and (d and g) 2 years later after loading. (g) The vertical regenerative bone is shown around the implant.

insertion, 1-year follow-up, and 2 years and longer follow-up. According to the criteria, all individual implants exhibiting <1.0 mm bone remodeling during the first year of loading and, thereafter, <2 mm annually were considered a success (Figure 3).

RESULTS

No postoperative complications were recorded for any patients except for minor discomfort that subsided in a few days. One of the 162 implants failed before prosthetic restoration, resulting in success rate of 99.4%. Until October 2010, all the other 161 implants were followed for at least 12 months after restoration. The mean follow-up period for the 144 patients was 24 months (range = 12 to 56 months) after the definitive restorative was placed (Table 2). All the 161 implants met the success criteria evaluated at the most recent follow-up appointment. No clinical signs and symptoms or unusual radiographic findings were noted.

The single failure mentioned in the previous paragraph (diameter = 6 mm, length = 8 mm, Bicon) occurred during the first 3 months of healing, before prosthetic loading; it was located in the maxillary second molar of a female patient. Three months later, an Ankylos implant (diameter = 7 mm, length = 8 mm) was inserted and restored 4 months after insertion.

DISCUSSION

The present retrospective study was carried out with the aim of elaborating on the limited data available in the literature. In the present study, the short implants with a diameter ranging from 5 mm to 7 mm were consecutively inserted in the posterior single-tooth fresh socket immediately after extraction, and no significant bone loss was found among the post-prosthetic implants during a follow-up period of up to 56 months, although the detailed values of marginal bone loss were not calculated and recorded. No patients complained about esthetic and functional complications. According to the criteria proposed by Buser et al,¹⁶ the 161 single-tooth implants were considered successful.

Although use of one-stage implants was reported to be associated with an increased risk for complications,¹⁷ it has been reported that the use

of immediately loaded fast bone regeneration-coated implants in fresh extraction sockets is shown to be a predictable technique if implants are inserted in selected patients and positioned with great care after a thorough preoperative analysis.¹⁸ With regard to patient selection, Griffin and Cheung³ proposed that a minimal workable ridge height of 6 mm is required for initial stability of the implants, with a minimum of 1 mm thickness of buccal and lingual plates available.

Patients enrolled in this study met the requirements of immediate short implants and wide-diameter implant into the fresh single-extraction site of the posterior area, which were at least 9 mm of bone width and 7 mm of bone height. Furthermore, for esthetic concerns, the implants were inserted at least 3 mm into the alveolar bone. Because adequate implant-bone contact may be the main factor of the initial stability of the immediate implants, patient selection will influence the success rate.

In the past decade, the use of wide-diameter implants (diameter >3.75 mm) has increased, especially in posterior jaw, because it is generally accepted that wide-diameter implants improve the ability of posterior implants to tolerate the occlusal forces, create a wider base for proper prosthesis, and avoid the placement of 2 standard-size implants (3.75 mm) at one site to obtain a double-root prosthetic tooth.^{19–24} However, few reports have focused on the effect of immediate placement and non-submerged healing on a single short and wide-diameter implant.

Rassi et al⁹ evaluate prospectively the clinical and radiographic outcomes after 2 years of loading of 6mm long implants supporting single crowns in the posterior regions. A rate of bone resorption of 0.23–0.33 mm was observed during the first year and a rate of 0.21–0.39 mm was observed during the second year of function; most bone resorption occurred during the preloading period (0.34–0.38 mm). The major bone-level changes have been documented to occur during the first year of loading at implants installed in healed alveolar ridges and implants installed immediately into extraction sockets.^{25,26}

Besides poor bone quality and inadequate bone height, inadequate soft tissue in the posterior area is another challenge for immediate implant. In the present study, the flapless approach was used to

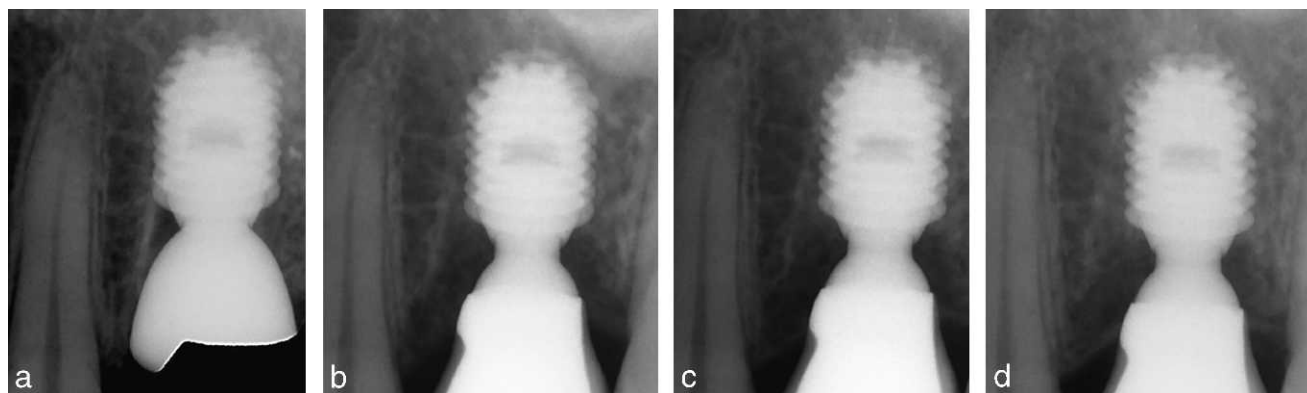


FIGURE 3. Radiographic documentations demonstrate excellent stability of the crestal peri-implant bone. (a) Postplacement radiograph of implant site. (b) Radiograph 3 months after loading. (c) Radiograph 1 year after loading. (d) Radiograph 3 years after loading.

minimize the marginal mucosa recession. It has been suggested that disruption of the vascular supply to the facial bone by the elevation of the surgical flaps may lead to marginal mucosa recession.^{27,28} Thus, several investigators have recommended placing implants into extraction sockets with minimal flap elevation²⁹ or without surgical flaps³⁰ in an attempt to minimize marginal mucosa recession. Van de Velde et al³¹ proposed that implants could successfully integrate in the posterior maxilla using a flapless approach with immediate loading similar to a conventional protocol, and the mucosal tissues around implants placed with a conventional flap changed significantly compared with flapless placed implants. Nadine³² reviewed the current literature with regard to the efficacy and effectiveness of flapless surgery for endosseous dental implants and concluded that flapless surgery appeared to be a plausible treatment modality for implant placement, demonstrating efficacy and clinical effectiveness.

In this study, a few devices were applied to overcome the limitations of the soft tissues of the posterior area, such as non-submerged healing, the use of wide-diameter implants, and the use of healing abutments. Graft materials (autogenous bone fragments or anorganic bone matrix) were used not only to fill in the chamber space but also to prevent soft tissue from collapsing. Healing abutments were placed as high as the level of marginal mucosa to prevent the soft tissue from the lateral pressure, and the placement of healing abutments contributed to the formation of the appropriate gingival profile, thus avoiding a second surgery.

The necessity of grafting seems to depend on the distance between the implant surface and the extraction socket wall, and the use of graft materials helps to ameliorate post-therapy crestal bone loss if a horizontal defect dimension is present after implant placement.^{14,33,34} In the present study, grafting materials (autogenous bone fragments or anorganic bone matrix) were placed around all the immediate implants to help prevent resorption of alveolar ridge and collapse of soft tissue, and non-submerged healing was allowed after the tight suture of soft tissue around the appropriate healing abutment. No significant bone loss or marginal mucosa recession were found during follow-up periods.

CONCLUSIONS

The present study demonstrated the feasibility of non-submerged healing modality with regard to immediate implant placements and concomitant bone grafting. This is the first report to elaborately address the successful immediate placement of the single-tooth implant after extraction in the posterior area, which may offer a simple and predictable treatment with the dental implant in the posterior area. The mean follow-up duration in the present study was 24 months. Observations should be rendered in the future for longer-term results.

ABBREVIATION

CBCT: cone beam computerized tomography

TABLE 2

Follow-up period for the 161 implants (excluding the failed implant)	
Time (months)	No. of Implants
12–24	86
25–48	67
49–56	8
Total	161

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