Clinical And Radiographical Evaluation Of Osseointegration Around Immediate Endosseous Implant Using Fresh-frozen Bone Allograft

Yasser Mohammed El-Makaky

Lecturer of Oral medicine, Periodontology, Oral Diagnosis & Radiology Department, Faculty of Dentistry, Tanta University, Egypt
Corresponding Author: yassermakaky@yahoo.com

Abstract: ***Background*:** This study aimed to evaluate osseointegration clinically and radiographically around dental implants placed into fresh extraction sockets with Fresh-frozen bone allograft. ***Methods:*** A clinical trial was carried out on thirty fresh extraction sockets in15 males and 12 females patients with age range from 23 to 45 years, sockets implanted with immediate endosseous implant and grafted with Fresh-frozen bone allograft. Clinical parameters **(**modified Plaque Index, Modified sulcus bleeding index and attachment level) were recorded at 3, 6 and 12 months postoperatively. Implant stability was measured by Perio-test immediately post-implantation and after 12 months. Radiographic evaluation was done at baseline and 12 months post-surgery. **Results:** The results demonstrated that none of the implants failed to integrate and all patients showed favorable clinical and radiographic findings at the 1-year follow-up examination. Comparison of modified Plaque Index, modified sulcus bleeding index, and attachment level at different periods of follow up was not found statistically significant. Radiographic analysis revealed that there was not statistically significant differences in the linear distance from the implant shoulder to the first visible alveolar bone contact (DIB) at all follow up periods. Periotest evaluation showed that all implants were well osseointegrated and stable. **Conclusion**: Fresh-frozen bone allograft can be used successfully to improve osseointegration around dental implants in fresh extraction sockets.
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Key words*:* Fresh-frozen bone allograft*,* dental implants, fresh extraction sockets*,* Periotest.

1. Introduction

The healing of an extraction socket often produces bone resorption, which may compromise the site for implant placement (Kohal et al., 1998). A bone dimension of 4 mm in buccolingual width and 7 mm in height has been said to be the minimum quantity necessary for placement of an endosseous implant (Lekholm and Zarb 1985).

It has been shown that following tooth extraction, when conventional dentures are placed immediately, bone crest resorption is about 23% after a 6-month period, with a further 11% loss after another 2 years (Cornelini et al., 2000). Resorption of the buccal wall of the extraction socket may produce abuccal concavity in the alveolar process; this fact usually determines that an implant be placed more lingually than the neighboring teeth, producing a compromised esthetic situation (Zitzmann et al., 1996).

Placement of an implant immediately after tooth extraction can help to maintain the bone crest and may lead to ideal implant positioning from a prosthetic point of view (Watzek et al., 1995) The use of immediate implants have the clinical advantages of reduction in morbidity, reduction in treatment time, preservation of residual ridge width and height, and an optimal esthetic result. With regard to implant utilization, there can be a reduction in treatment costs if graft and membrane use is not necessary, the implant placement may be guided by the bone socket, an easier definition of implant position can be provided, and better opportunities for osseointegration can exist because of the healing potential of the fresh extraction site (Grunder et al., 1999).

These benefits are usually accompanied by a minor drawback resulting from the lack of adaptation of the alveolar bone in the cervical region of the implant. This space is similar to a circumferential vertical defect and can be occupied by soft tissues (Brunel et al., 1998). In large bony defects, this void can be colonized by epithelial cells, which induces fibrointegration and then implant failure (Paolantonio et al., 2001).

Several techniques have been used to establish bone tissue and fill this peri-implant defect. With these approaches, bone graft materials are often used with or without membranes. The use of the graft materials varies and includes autografts, allografts, xenografts and alloplast materials (Jones et al., 2006).

The use of autogenous bone is the gold standard procedure for the reconstruction of bone defects because it is the only graft material that exhibit the three desired properties of bone graft materials: osteogenesis, osteoinduction, osteoconduction.

The autogenous bone graft has rapid incorporation and consolidation with a lack of immunologic considerations (Marx and Garg 1998; Barone et al. 2009). However, the harvest technique has considerable limitations, as follows: donor-site morbidity, post operative pain and swelling, inappropriate form, increased blood loss, increased operative time and lack of sufficient quantities in procedures requiring large amounts of graft (Buckley et al. 2005; Jacotti 2006). These limitations have led clinicians and researchers to investigate some alternatives to the autogenous bone graft. One of these is the use of fresh frozen bone (FFB) graft from tissue banks. FFB graft is considered a safe material, from both immunologic and virologic points of view (Buckley et al. 2005).

It should, however, be noted that most of the research on FFB has been conducted in the field of orthopaedic reconstructive surgery and very little has been conducted in the oral and maxillo-facial field (Viscioni et al. 2009). Therefore the goal of the current study was to evaluate, clinically and radiographically, the use of FFB around endosseous dental implant in fresh extraction sockets.

2.Materials and Methods:

2.1.Subjects:

A clinical trial was carried out on thirty fresh extraction sockets in15 males and 12 females patients with age range from 23 to 45 years; they were selected from the outpatient clinic, Faculty of Dentistry, Tanta University. Each patient was scheduled for at least one single-rooted tooth extraction and an immediately placed implant. Patients were given detailed information relating to the study purpose and signed surgical release forms. Indications for tooth extraction included endodontic treatment failure, tooth fracture and tooth with severe periodontal attachment loss (refractory periodontitis and aggressive periodontitis).

**Inclusion criteria*

- The immediate implant sites have 4- wall sockets with favorable remaining bone.
- Presence of at least 4 mm of bone beyond the root apex to provide primary implant stability.
- A minimum of 10 mm of bone height and 4 mm of bone idth.
- Single rooted tooth from first bicuspid to first bicuspid

**Exclusion criteria:*

- Presence of fenestrations or dehiscences of the residual walls.
- Presence of acute periapical pathology at the level of implant site.
- Presence of acute and chronic systemic disorders such as uncontrolled diabetes, hemorrhagic disorders and other conditions that can affect wound healing responses.
- Poor oral hygiene, traumatic occlusion, smokers and presence of parafunctional habits.

2.2.Methods:

2.2.1.Preoperative intraoral therapy:

Each case was evaluated through examination of diagnostic casts for intra-arch relationship, panoramic and periapical radiographs to evaluate the anatomic conditions.

-All patients were subjected to proper oral hygiene instructions, scaling and root planning for all teeth and periodontal treatment if needed to provide an oral environment more favorable to wound healing

2.2.2.Surgical procedure:

One hour prior to each of the implantation procedure Amoxicillin (1g) was administered intramuscular (none of the patients were sensitive to the Penicillin). Each patient was asked to rinse her mouth with 0.2% chlorhexidine solution. All the surgical procedures were performed under local anesthesia and strict aseptic conditions. Intrasulcular incisions were made to raise full thickness mucoperiosteal flap and the teeth were carefully removed by a gentle extraction using forceps in order to protect and to preserve the alveolar bone (Fig.1). Sockets were curetted and irrigated with saline to remove granulation tissue and residual periodontal ligament. Surgical sites were prepared according to the standard procedures using standard drills as recommended by the manufacture (Hammerle & Karring 1998) using the bony walls as guide with maximum use of bone apical to the extraction socket without impinging on vital structures.

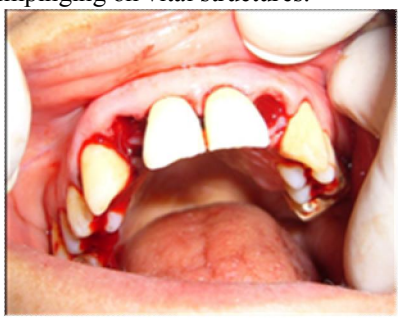

Fig (1)

Swiss plus (Zimmer, Carlsbad, USA) implant system was used in this study. The length which used ranged from 10mm to 14mm with 3.7mm, 4.2mm and 4.8mm diameter that were placed immediately in each extraction socket (Fig. 2).

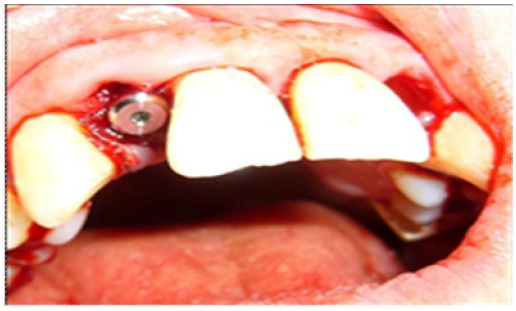

Fig (2)

Fixture site was drilled starting firstly with a pilot drill with 2.3mm to initiate osteotomy with accurate position and direction. Intermediate drill followed the pilot drill; the drill was kept in one vertical direction in up and down movement while rotating to remove cut bone from depth of the drilling site. Prepared socket length checked by depth gauge which was graduated into 8, 10, 12, 14,16mm.The final drill was used according to diameter of each fixture. Manual key and ratchet were used for implant insertion. The implants were placed 3-5mm beyond the apex to achieve primary stability. The cover screw was placed on the top the implant (Fig. 3).

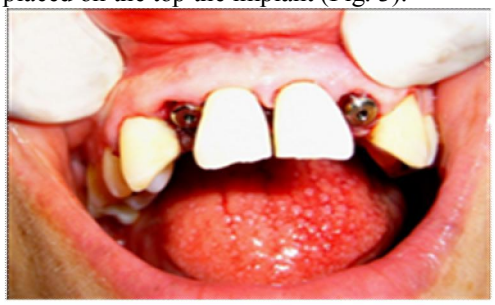

Fig (3)

The residual gap between the socket wall and implant threads was grafted with FFB (BioMed, North America, United States) (Fig. 4). Prior to wound closure with simple interrupted suture, releasing incisions were performed to allow better flap adaptation around implant neck (Fig.5).

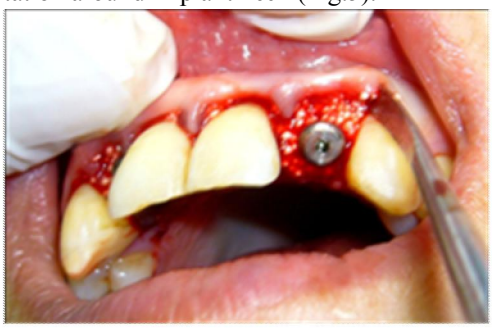

Fig (4)

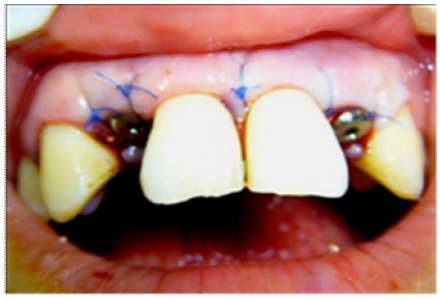

Fig (5)

2.2.3.Post operative care:

Antibiotics, anti-inflammatory and chlorhexidine mouth wash were prescribed to all patients.Amoxicillin 1 gm was administrated 1 hour before surgery. Amoxicillin 500mg every 8 hours was continued for 5 to 7 days post-surgery. Instruction for good oral hygiene measures was also given. Further advices included adhering to a soft diet and avoiding trauma to the gingival tissue at the implant site especially in the first few weeks. Sutures were removed after 7 days and patients were examined every week during first 3 weeks following surgery then monthly until termination of study.

2.2.4.Prosthetic procedure:

Six month later the cover screw was removed and the transfer coping was mounted on the implant and covered with the transfer cap. An elastomeric impression was taken. The transfer technique was used for insertion of the laboratory components and wax rim was used to record the vertical occlusal dimension and mounting the cast on the articulator and ceramo-metal restorations were fabricated and cemented on the implant (Fig. 6).

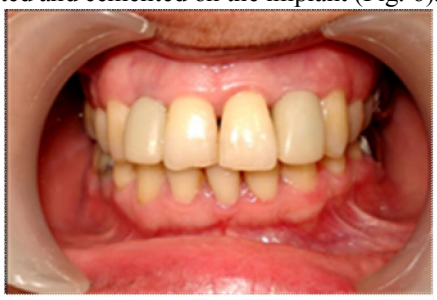

Fig (6)

2.2.5.Clinical evaluations:

The following parameters were evaluated at 3, 6 and 12 months of implant insertion A-**Modified plaque index (**Mombelli et al., 1987) at four aspects around the implants: score 0, no detection of plaque; score 1, plaque only recognized by running a probe across the smooth marginal surface of the implant; score 2, plaque can be seen by the naked eye; and score 3, abundance of soft matter.

B-**Modified sulcus bleeding index** (Mombelli et al.,1987) at four aspects around the

implants: score 0, no bleeding when a periodontal probe is passed along the gingival margin adjacent to the implant; score 1, isolated bleeding spot visible; score 2, blood forms a confluent red line on margin; and score 3, heavy or profuse bleeding.

C- **Clinical Attachment level** (Ramford, 1967): It was measured as the distance from the implant shoulder to the bottom of pocket at 6 sites on each implant as in probing depth. The mean attachment level was calculated for each implant.

D-Implant success: According to Albrektsson et al (1986) the criteria of success were include the following:

- Absence of persistent subjective complains such as pain and foreign body sensation.
- Absence of peri-implant infection with suppuration.
- Absence of mobility.
- Absence of continuous radioluency around the implant.
- Vertical bone loss less than 1.5 mm in the first year.

E-Implant stability was measured by Periotest instrument (Periotest; Siemens, Bensheim, Germany). Immediately after implant placement and 12 months after implant placement with implant mount in place. The readings were correlated with a grading scale provided by manufactures of Periotest instrument

F-Radiographic evaluation: Intra-oral periapical radiographs were taken using parallel long cone technique with Rinn XCP (DENTSPLY Friadent Schweiz, Nidau, Switzerland.) film holder and custom- fabricated bite blocks. All radiographs were taken using the Imago dental machine (Milano, Italy). All films were Kodak ulta-speed periapical dental film (F Speed films, Kodak Insight films, Eastman Kodak, Rochester, NY), using implant shoulder as references point. All radiographs were processed under standardized conditions using an automatic processing machine. The distance between the implant shoulder and first visible bone to implant contact (DIB) mesially and distally was measured. It was evaluated immediately after implant insertion and at 12 months post-insertion. The analog films were digitized with a resolution of 600 dots per inch, printed out in a standardized format (12 × 18 cm), and analyzed using the distance between the tips of the implant threads (1.25 mm) for calibration
(Michael et al., 2010). For each implant, one DIB value was calculated based on the average of the mesial and distal value (Fig. 7).

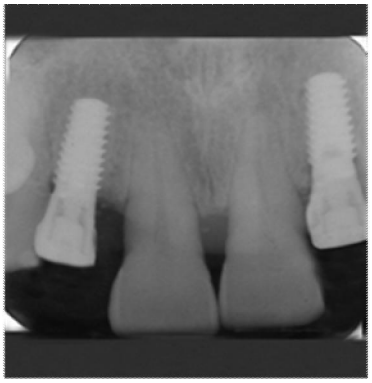

Fig (7)

3.Results

3.1.Clinical findings:

A total of 30 implants were placed for 27 patients. The patients attended the follow-up recall till the end of the study period (12 months). All patients were selected systemically free. Their ages ranged between 23-45 years. During the 12 months postoperative follow up, all patients showed no postoperative inconveniences and all implants showed successful signs of osseointegration with no signs of failure (soft tissue dehiscence, infection, looseness of the implant).

Table (1) and figure (8) showed that the mean value of modified plaque index was increasing with time of measurement where it was 0.32±0.19 at three months and increase to 0.43±0.12 and 0.54±0.30 at six and 12 months, respectively. These differences were not statistically significant.

Table (1): Modified Plaque Index at different periods of follow up

Period of follow up	Patients
At 3 month:	
Range	0-0.5
Mean	0.32
SD	0.19
At 6 months:	
Range	0.25-0.5
Mean	0.43
SD	0.12
Z	1.342
P	0.180
At 12 months:	
Range	0.28-1.0
Mean	0.54
SD	0.30
Z	1.730
P	0.084

The mean value of modified sulcus bleeding index was increasing with time of measurement where it was

0.43± 0.19 at three months and increase to 0.46±0.22 and 0.54±0.17 at six and 12 months, respectively.

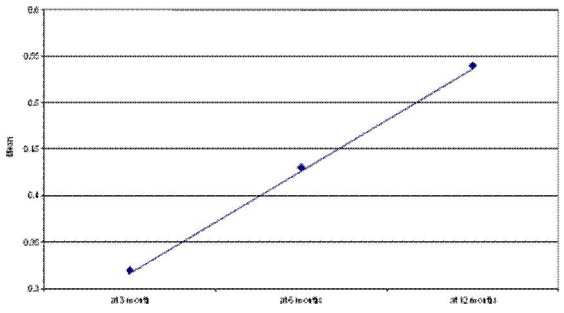

Figure (8): Modified Plaque Index at different periods of follow up

These differences were not statistically significant (table 2) (figure 9).

Table (2): Modified sulcus bleeding index at different periods of follow up

Period of follow up	Patients
At 3 months:	0.25-0.75
Range	0.43
Mean	0.19
SD	
At 6 months:	0.25-0.75
Range	0.46
Mean	0.22
SD	0.577
Z	0.564
P	
At 12 months:	
Range	0.25-0.75
Mean	0.54
SD	0.17
Z	1.342
P	0.180

*Significant

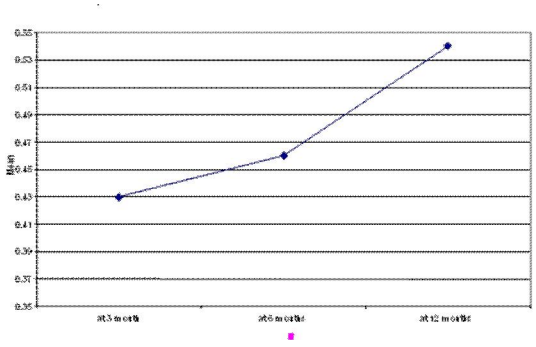

Figure (9): Modified sulcus bleeding index at different periods of follow up

The clinical attachment level showed a little increase from 1.16±0.11mm at three months to 1.21±0.11mm and 1.29±0.11mm at six and 12 months, respectively with no statistically significant differences(table.3) (figure.10).Table (4) demonstrated that there is no significant difference between mean Periotest values immediately after implant placement(-2.10) and Periotest value after 12months(-1.90).

3.2.Radiographic Findings

The periapical radiographs taken immediately after implant placement and after 12months for all implants revealed no signs of continuous peri-implant radiolucency, at the postoperative radiographic examination, the mean DIB was 1.21±0.18mm at base line and increased to 1.27±0.18mm at 12 months with no statistically significant difference (Table.5).

Table (3): Attachment level at different periods of follow up

Period of follow up	Patients
At 3 months:	
Range	1-1.3
Mean	1.16
SD	0.11
At 6 months:	
Range	1-1.3
Mean	1.21
SD	0.11
Z	0.921
p	0.357
At 12 months:	
Range	1.2-1.5
Mean	1.29
SD	0.11
Z	1.841
p	0.066

Table (4): Periotest values at different periods of follow up

Period of follow up	Patients
Base line	
Mean	-2.10
SD	1.79
At 12 months	
Mean	-1.90
SD	1.59
Student's unpaired t test value	0.26
p value	*P* more than 0.05
Significance	Not significant

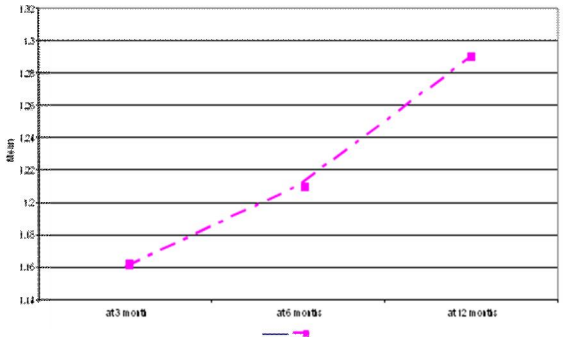

Figure (10): Attachment level at different periods of follow up

Table (5): DIB at different periods of follow up

Period of follow up	Patients
Base line:	
Range	1-1.5
Mean	1.21
SD	0.18
At 12 months:	
Range	1-1.5
Mean	1.27
SD	0.18
Z	1.414
P	0.157

4. Discussion

Immediate placement of implants in fresh extraction sockets may provide a successful treatment procedure (Villa et al., 2010). Alveolar bone volume preservation following placement of dental implants in fresh extraction sockets improves esthetic and functional prosthodontic result (Kan et al., 2003). In the present study, 30 implants were inserted immediately after extraction of hopeless teeth in jaws of 27 subjects. To strengthen the clinical data, radiographical examinations of peri-implant tissues were conducted. In the current study preoperative meticulous scaling, root planing, sockets curettage and antibiotics were prescribed mandatory for the patients to minimize the effect of bacteria in the surgical area. This is in accordance with Gher et al., (1994) who recommended this regimen and emphasized that a good oral hygiene was a fundamental critical success factor to obtain a well controlled subjects and avoid implant failure. In this study the primary stability was achieved by engaging 3 to 5mm of bone beyond the root apex and using suitable size implant, this is in accordance with Schwartz-Arad et al., (2000) who stressed on the extreme for maximum degree of primary stability and close bone to implant contact. Two stages implant type was selected in this study to keep the implant out of function and reduce the effect of micro movement during the healing period to gain osseointegration, this is in agreement with Severson et al., (2000). The rational for reflecting full thickness mucoperiosteal flaps in this study was threefold; first, it facilitates tooth removal, which can be quite delicate, especially when the tooth is fractured or in case of root resorption.Second, a flap allows the clinician to inspect the buccal socket wall properly for fenestrations and dehiscencies. Third, flapless surgery increases the risk of perforation. This is in accordance with Mish, (1999) who reported that, the full thickness flap allows preservation of the delicate soft tissue from laceration and subsequent infection.In the present study, simultaneous approach of combination of bone grafts with implant placement reduced numbers of surgical intervention. This is in agreement with Hammerle and Karring, (1998) who reported that combination of bone grafts with implant placement resulted in shortening of the treatment time, ideal placement of the implant into the alveolar housing of the lost tooth. In the present study the implant stability was measured by Periotest instrument. It measures the dampening effect against objects by a percussion rod that is electronically guided by a microcomputer. A force of 12–18 N is developed on a piston rod that impacts an implant, 04 times per second for 04 times (16 impacts). The more stable the implant, the quicker the percussion rod rebounds back in the handpiece. The microcomputer calculates the time that the rod is in contact with the implant and converts it into Periotest value readings. These values range from -8 to +50 numbers. Negative values indicate that the implant is stable and well osseointegrated. A study conducted by Truhlar et al., (1994) and Misch, (1999) found that the Periotest instrument is capable of assessing implant stability. In this study, the average values of Periotest at baseline and after 12 months post implantation were -2.10 and -1.90 respectively. These values denote significant implant stability and osseointegration. The clinical and radiographical results of the present study reported that the Modified plaque index, Modified sulcus bleeding index, mean attachment level, DIB and the mean periotest value increased insignificantly in throughout the study period (12 months) with no significant effects on implants stability and survival. According to Alberktsson et al., (1987) and Roos-Jansaker et al., (2006) stated that implant success has been defined as bone loss during the first year should not exceed 1.5mm. The observed acceptable changes in the clinical and radiographical parameters can be explained by many normally expected factors like surgical trauma, micro-gap between abutment and implant and decreased bone remodeling after implant

placement; this is in agreement with Schou et al., (2002) who suggested that the impaired remodeling during the healing phase can be causative factors for initial bone loss to implants during the first year of functional loading. In the present study according to Albrektsson et al., (1986) the criteria of success and based on the favorable short-term results of the this study, immediate endossous dental implant augmented with FFB graft may be considered to be a successful treatment strategy with a cumulative implant survival rate 100% after 1 year of function. This result is comparable to other short- term studies using the same protocol (more than 94%) (Hui et al.,2001, Kan et al., 2003, Cornelini et al.,2005, Barone et al.,2006). This is also in accordance with Carinci et al., (2009) who reported that a high survival rate (100% survival rate) and success rate for implants inserted into FFB. In agreement with our findings, superior results were achieved with FFB graft when compared to the guided tissue regeneration technique performed during implant placement (Piattelli et al. 1996; Simion et al. 1994). Further, some studies have shown that the osteogenic potential of FFB is conserved (Mizutani et al. 1990) and its cells have the potential to grow in vitro (Simpson et al. 2007). Therefore, -80˚_C freezing of bone tissue may not routinely kill all cells within the tissue (Heyligers and Klein-Nulend 2005). The quantification of growth factors in human allografts supports the hypothesis that allografts have osteoinductive potential and promote graft integration (Wildemann et al. 2007). This is also in accordance with Franco et al.,(2009) who reported that FFB is a reliable material for alveolar bone restoration with a predicable average of resorption.

Conclusions:

Within the limits of this study, the clinical and radiographic results have demonstrated that FFB graft can promotes bone regeneration around implants immediately placed in fresh extraction sockets. The survival rates of 100% after 1 year suggest that immediate implantation is an alternative and predictable surgical technique for the replacement of missing teeth.

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