

Immediate Placement Implant in Fresh Extraction Socket: A Clinical Study of Seven Cases

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ABSTRACT

Aims and objectives: To reduce the prolonged waiting period post tooth extraction for rehabilitation with implants. This study was carried out to determine the outcome of implants placed into fresh extraction sockets with the simultaneous use of particulate bone graft. Patient response to rehabilitation with immediate placement single tooth implants was monitored clinically and radiographically.

Materials and methods: Among seven patients, with the average age of 28 years were treated for single tooth replacement in fresh extraction sockets in the esthetic zone by means of 2 stage immediate placement of implant. Bioactive glass particulate bone graft was used as bone graft material. Reason for teeth loss was caries, trauma and internal resorption. All patients were followed clinically and radiographically for 1 year after loading of implant.

Results: Follow-up was done after stage I surgery (placement of implant) for pain, soft tissue dehiscence, inflammation, altered sensation at site of implant placement monthly for 4 to 6 months. After giving final prosthesis, patients were evaluated for bleeding index (Muhlemann and Son), plaque index (Turesky- Gilmore-Glickman) gingival index (Loe and Silness), marginal bone loss (parallel cone technique using IOPA) with follow-up at 6th and 12th months. All the implants were osseointegrated at the time of abutment placement. Radiographic examination showed only slight marginal bone around the implants.

Conclusion: Hence, implants can be placed successfully in fresh extraction socket using bioactive glass (perioglass) particulate bone graft material to fill gap between implant and bone through a submerged (2 stage) surgical technique.

Keywords: Osseointegration, Peri-implant bone gap, Alloplastic bone graft, Submerged implant placement.

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INTRODUCTION

Dental implant treatment has revolutionized oral rehabilitation in partially and fully edentulous patients. According to the original Branemark's protocol for implant placement, a 3 months soft and hard tissue healing period following tooth removal and an additional 3 to 6 months of load free period was recommended (Albrektsson et al 1981, Branemark 1983). This always led to a prolonged waiting period.

After extraction of teeth, alveolar bone resorption may be so severe that if left uncontrolled, may lead to severe bone deficiency, which may in turn, even contraindicate the placement of an implant.¹ Immediate implant placement in fresh extraction sockets allows placement of implants during the same visit at which the tooth is extracted, which reduces morbidity and decreases treatment time, allow placement of implant in ideal position from the prosthetic point of view. It also helps to preserve the height of the alveolar bone and to avoid marginal bone loss that typically occurs during socket healing after extraction.^{2,3}

When the implant is placed immediately after tooth extraction, it is anchored to a small part of 3 to 5 mm subapical alveolar bone, which provides it with satisfactory initial stability. The size of the peri-implant bone defect (horizontal defect dimension) has effect on the amount of bone-implant contact area. As the gap between implant and socket wall widens, the amount of bone-implant contact (BIC) area decreases and the BIC area shift apically.⁴

The aim of the study was to observe bone healing after the immediate placement of an implant into a fresh extraction socket via clinical inspection and standardized radiographs over a period of 1 year after loading of the implant.

MATERIALS AND METHODS

Among seven patients were treated by immediate implants placed into fresh extraction sockets of maxillary anterior and mandibular anterior and posterior region. Reasons for extraction were internal resorption, fractured teeth and grossly carious teeth, which could not be salvaged by restorative procedures. EZ titanium, HA coated, acid etched and sandblasted, internal hex, screw type, 2 stage implants were used.

Patient inclusion criteria⁵ were age between 18 and 40 years, adequate bone height apical to extraction socket (more than 5 mm to provide initial implant stability), buccolingual and mesiodistal dimension of alveolar crest more than 6 mm to allow placement of at least a 3.75×10 mm implant, bone quality type 2 and type 3, normal to thick flat gingival biotype, presence of single failing tooth, good oral hygiene and ideal soft tissue contour at the facial aspect of the tooth.

Exclusion criteria included patients with uncontrolled systemic disease, untreated periodontal disease, smoking, bruxism, loss of labial crest of bone after extraction (fenestration and dehiscence), inadequate mouth opening (<4 cm), insufficient interocclusal space to accommodate prosthetic component and debilitating temporomandibular joint pathosis.

Preoperative Evaluation of Implant Site

Clinical Evaluation of Soft and Hard Tissue and Dentition

Gingiva was examined for texture, consistency and thickness. Transgingival probing was done to evaluate bone topography. Occlusion, periodontal integrity of dentition, teeth alignment and interocclusal space was also assessed.

Radiographic Evaluation

Preoperative computed tomographic (CT) scan of jaw, IOPA and OPG, were taken to assess the quality and quantity of bone at the implant placement site, dimensions of the tooth to be extracted (root length and root width at CEJ) and

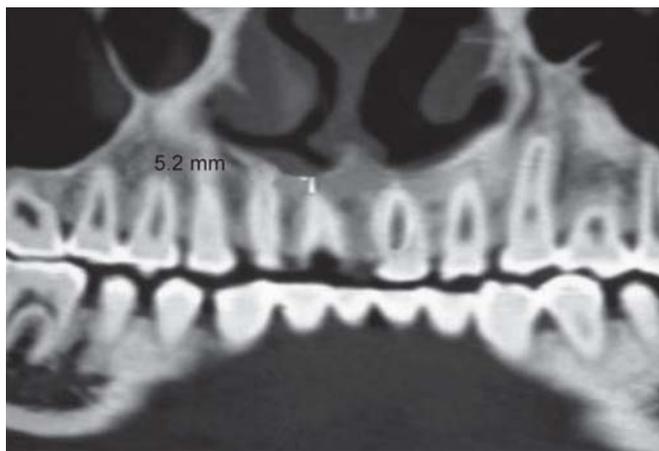


Fig. 1: Coronal CT scans of jaw showing height of periapical bone between root apex maxillary right central incisor and floor of nasal cavity

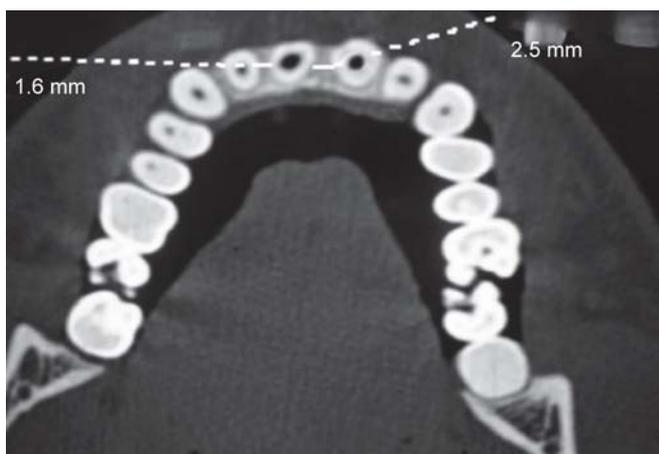


Fig. 2: Axial CT scan of maxilla showing dimension of interdental bone mesial and distal to maxillary central incisor

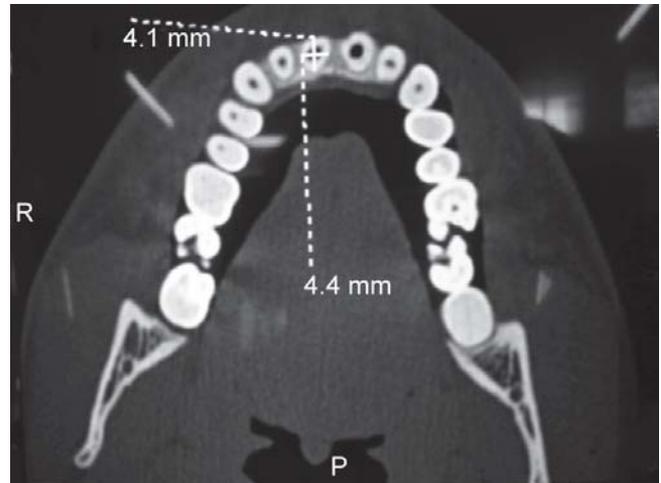


Fig. 3: Axial CT scan of maxilla showing root dimension at the level of crestal bone

proximity of the implant site to vital anatomical structures (Figs 1 to 3). All these parameters were used as a guide in determining the size of the implant to be used.

Dental Models and Clinical Photographs

Dental models were articulated on semiadjustable articulator to evaluate the centric relationship, interarch occlusal clearance and occlusal discrepancy for esthetic evaluation.

Surgical Procedure

Patient was planned to be operated under local anesthesia (LA). The patient was advised to take antibiotics and analgesics 1 hour before surgery (amoxicillin 500 mg and ibuprofen 600 mg).⁶ The tooth scheduled for immediate placement implant was systematically removed following minimal mucoperiosteal flap reflection. Periotome was used to remove the tooth as atraumatically as possible (Figs 4 and 5). Vernier caliper was used to measure the dimension of the tooth. Immediate implant placement was performed only if the labial cortical plate was intact.

Surgical Steps

Stage 1: Placement of Implant

Osteotomy was initiated with the 2 mm pilot drill. Considering the natural anatomical position of maxillary anterior teeth in the jaw, the osteotomy was started on the palatal wall of socket at the junction of the coronal 2/3rd and apical 1/3rd, so that implant is placed in the mesio-distal and buccolingual center of the future prosthesis.⁷ The osteotomy was extended 3 to 5 mm beyond the apex of socket⁸⁻¹⁰ (Fig. 6). Using sequentially large drill sizes, the osteotomy site was enlarged; the size for the final drill was kept 0.5 mm less than the diameter of the implant. Ez-Hi Tec, titanium, HA-coated, acid-etched and sandblasted,



Fig. 4: Fractured right maxillary central incisor

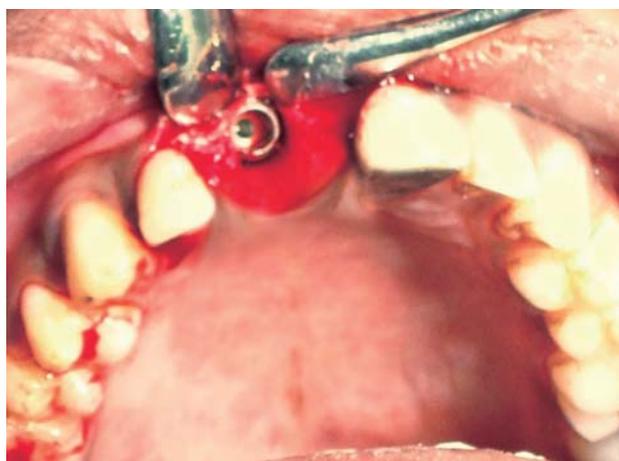


Fig. 7: Implant submerged 1 to 2 mm below alveolar crestal bone

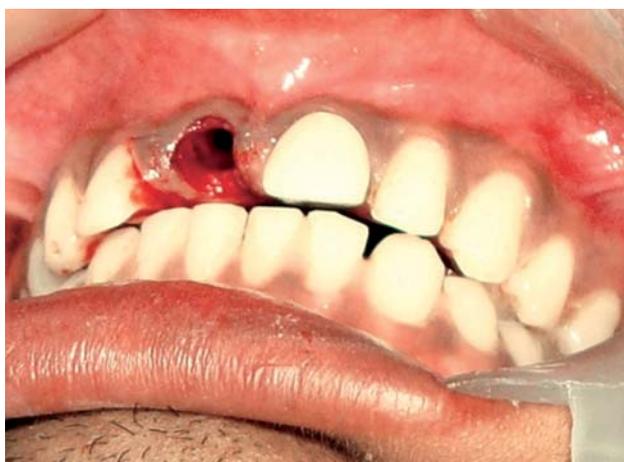


Fig. 5: Atraumatic extraction of tooth with minimum flap reflection

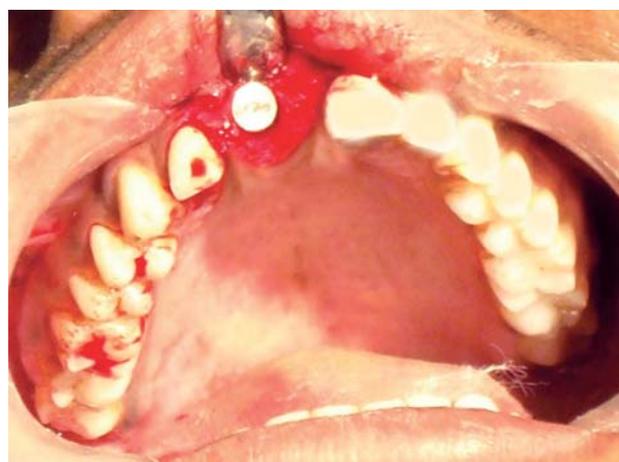


Fig. 8: Cover screw inserted into implant



Fig. 6: Buccal cortical plate is intact and osteotomy started in palatal wall at the junction of coronal and apical one-third

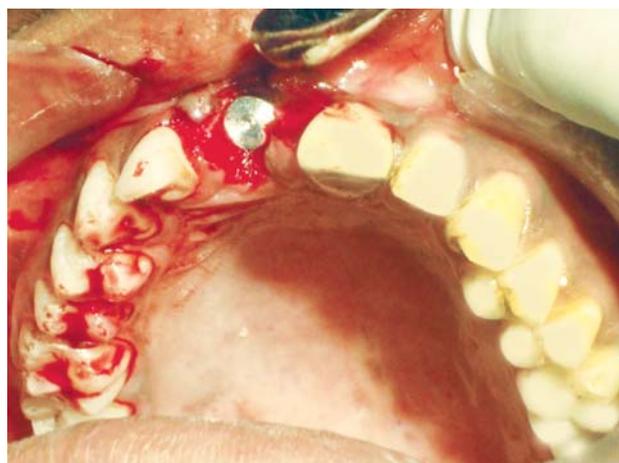


Fig. 9: Bioactive bone graft fills the peri-implant gap

internal hex, screw type, 2 stage implant was used. The implant was tightened in the clockwise direction using a ratchet and submerged 1 to 2 mm below the crestal bone (Fig. 7). A cover screw was placed over the implant (Fig. 8). The space between the implant and the socket wall was filled with bioactive particulate bone graft material (Fig. 9).

No membrane was used over the bone graft. Primary soft tissue closure was done over implant (Fig. 10).

Intraoral periapical radiographs (using X-ray RVG) was taken immediately after placement of the implant (Fig. 11). The patient was given oral antibiotics, anti-inflammatory analgesics for 5 days postoperatively and 0.2% hexidine

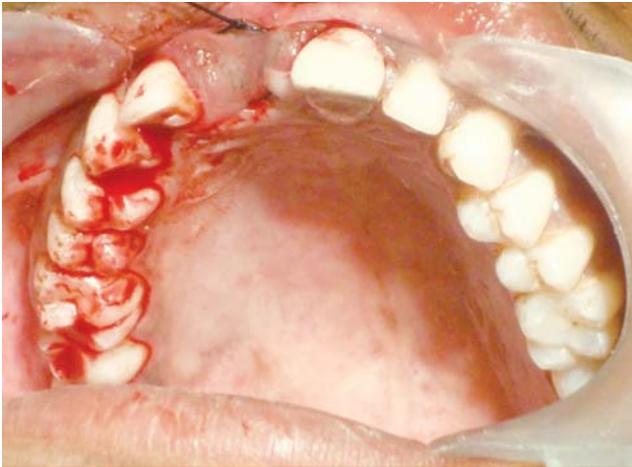


Fig. 10: Primary closure of soft tissue



Fig. 12: Abutment placed 6 months after implant placement

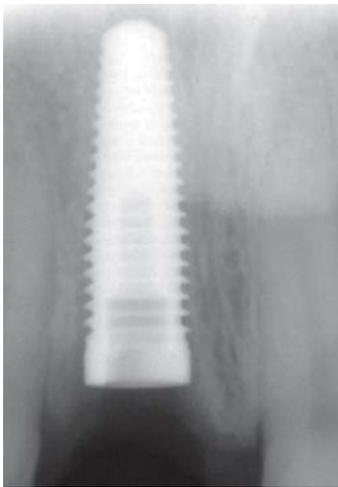


Fig. 11: X-ray IOPA taken after implant placement shows implant parallel to adjacent teeth



Fig. 13: PFM prosthesis

mouthwash 2 weeks postoperatively. Patient was evaluated 1 week after surgery and then monthly for a period of 4 to 6 months after implant placement.

Stage 2: Surgical Exposure of Implant

Time interval between stage 1 and 2 varied from 4 to 6 months depending upon the site of implant placement and quality of bone. The procedure was carried out under LA. With no. 15 blade, a circular incision was given over the implant site, the cover screw was removed and healing cap was placed. Soft tissue around the healing cap was sutured.

Prosthetic Phase

After 15 days of the second surgery, the healing cap was removed and a two-piece internal hex abutment was placed in the implant (Fig. 12). Impression was taken with elastomer impression material using open tray technique. PFM crown was given (Fig. 13). X-ray IOPA was taken after 1 year after loading of to assess marginal bone loss (Fig. 14).

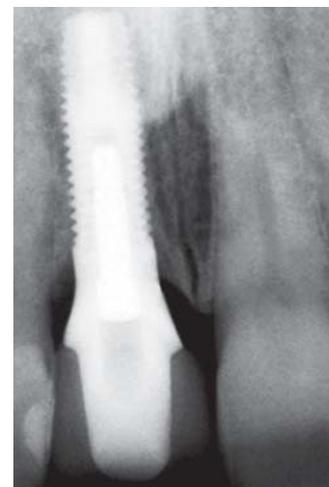


Fig 14: X-ray IOPA taken after 12 months showing marginal bone loss

RESULTS

Among seven patients with single missing teeth were rehabilitated with titanium, HA-coated, acid-etched and sandblasted, internal hex, screw type, 2 stage implants at

7 sites under local anesthesia as outdoor patients. The most frequent site for immediate implant placement was the esthetic zone, i.e. anterior region of maxilla and occasionally, the mandible. Follow-up was done after stage 1 surgery monthly for 4 to 6 months. After giving final prosthesis, the patients were followed up at 1st, 3rd and 6th 12 months and were evaluated clinically as well as radiographically.

All the implants were stable and none of the implants lost osseointegration at the 6th and 12th month visit. All the implants were osseointegrated at the time of abutment placement. The time between abutment connection and definite restoration varied from 1 to 2 weeks.

Marginal bone level as inspected during 2nd stage surgery was situated close to cover screw. Even at the site with localized marginal bone loss due to trauma, such as root fracture and resorption, healing was satisfactory where bone graft were placed. No sign of gingival retraction was seen in any of the sites in the 1 year follow-up study.

Table 1 shows that most of the patients were in the age group of 21 to 30 years, i.e. 3 (42.85%), with a mean age of 28 years. Out of seven patients, four were male (57.15%) and three were female (42.85%).

Table 1: Distribution of patients of single tooth implant according to age and sex

Age group	Male	Female	Total
0-10	0	0	0
11-20	1	1	2
21-30	2	1	3
31-40	1	1	2
Total	4	3	7

Table 2: Teeth involved and cause of tooth extraction

Site	Causes of tooth loss			
	Trauma	Caries	Root resorption	Periodontal disease
Maxillary central incisor	2	1	0	0
Maxillary lateral incisor	1	1	0	0
Mandibular lateral incisor	0	0	0	1
Mandibular second premolar	0	0	1	0

Table 3: Distribution of patients according to site and dimension of implant

Case no.	Site of implant placement	Bone quality type	Implant dimension	
			Diameter (mm)	Length (mm)
1	Maxillary right central incisor	3	4.2	16
2	Maxillary right central incisor	3	4.2	13
3	Maxillary left central incisor	3	4.2	13
4	Maxillary left lateral incisor	3	3.75	13
5	Maxillary right lateral incisor	3	3.75	13
6	Mandibular left lateral incisor	2	3.75	11.5
7	Mandibular right second premolar	3	3.75	11.5

Table 2 shows that trauma is the most common cause for loss of tooth (42.85%) and second most common cause is caries (28.57%). Maxillary central incisor is most commonly subjected to trauma. Five implants were placed in the maxilla (71.28%), two implants were placed in mandible (28.58%). Three implants were placed in the region of maxillary central incisor while two in the region of the maxillary lateral incisor.

Table 3 shows that bone quality was evaluated by tactile sense during surgery and compared with radiographic examination and classified according to Lekholm and Zarb (1985). Six patients had quality 3 bone—thin layer of compact bone surrounding a core of dense trabecular bone, found in the maxillary anterior region and two patients had quality 2 bone—thick layer of compact bone surrounding dense trabecular bone and was found in mandibular anterior region.

Table 4 shows that after stage 1 surgery, there was complete absence of pain, inflammation, soft tissue dehiscence, altered sensation, suggestive of uneventful healing in all implants.

p-value for plaque index according to Wilcoxon signed rank test is as follow: 0 to 1 month (p-value = 0.564), 0 to 6 months (p-value = 0.102) 0 to 12 months (p-value = 0.180). No statically significant difference was found in plaque (Table 5).

Index between 0 and 12 months follow-up treatment visit (Graph 1).

p-value for gingival index according to wilcoxon signed rank test is as follow (Table 6):

0 to 1 month (p-value = 1.000), 0 to 6 months (p-value = 0.083) 0 to 12 months (p-value = 0.414). No statically significant difference found in gingival index between 0 and 12 months follow-up treatment visit (Graph 2).

p-value for bleeding index according to Wilcoxon signed rank test is as follow (Table 7):

0 to 1 month (p-value = 1.000), 0 to 6 months (p-value = 0.083) 0 to 12 months (p-value = 0.083). No statically significant difference found in bleeding index between 0 and 12 months follow-up treatment visit (Graph 3).

Table 4: Clinical evaluation of implant site after stage 1 surgery

Case no.	Site of implant	Local inflammation and infection	Pain	Soft tissue dehiscence	Altered sensation
1	Maxillary right central incisor	A	A	A	A
2	Maxillary right central incisor	A	A	A	A
3	Maxillary left central incisor	A	A	A	A
4	Maxillary right lateral incisor	A	A	A	A
5	Maxillary left lateral incisor	A	A	A	A
6	Mandibular left lateral incisor	A	A	A	A
7	Mandibular right second premolar	A	A	A	A

A: Absent

Table 5: Evaluation of plaque index implant site in postloading phase

Visit	N	Mean ± SD	Minimum	Maximum
0 month	7	1.714 ± 0.756	1	3
1 month	7	1.571 ± 0.535	1	2
6 months	7	1.143 ± 0.378	1	2
12 months	7	1.286 ± 0.488	1	2

Table 6: Evaluation of gingival index implant site in postloading phase

Visit	N	Mean ± SD	Minimum	Maximum
0 month	7	1.000 ± 0.816	0	2
1 month	7	1.000 ± 0.000	1	1
6 months	7	0.571 ± 0.535	0	1
12 months	7	0.714 ± 0.488	0	1



Graph 1: Plaque index mean graphs

Table 7: Evaluation of bleeding index implant site in post-loading phase

Visit	N	Mean ± SD	Minimum	Maximum
0 month	7	1.429 ± 0.535	1	2
1 month	7	1.429 ± 0.535	1	2
6 months	7	1.000 ± 0.000	1	1
12 months	7	1.000 ± 0.000	1	1



Graph 3: Bleeding index mean graphs



Graph 2: Gingival index mean graphs

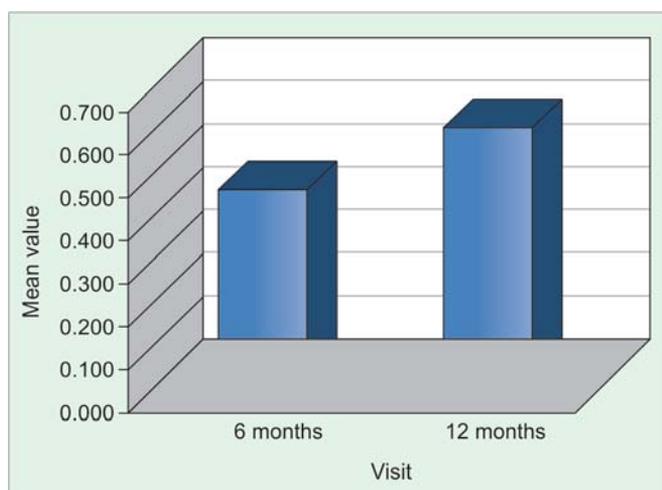
Tables 8 and 9: Crestal bone loss, as measured from the BIC to implant-abutment junction using (Dental Planning Software, Somatome Digital AS, Germany 2011) and standard parallel cone-beam technique at the end of 6 and

Table 8: Distal marginal bone loss assessment after loading

Parameter	N	Mean ± SD	SE of mean	Mean difference	Paired t-test p-value
Distal bone loss 6 months	7	0.463 ± 0.046	0.017		
Distal bone loss 12 months	7	0.611 ± 0.146	0.055	-0.149	0.051 ¹

Table 9: Mesial marginal bone loss assessment

Parameter	N	Mean \pm SD	SE of mean	Mean difference	Paired t-test p-value
Mesial bone loss 6 months	7	0.474 \pm 0.066	0.025	-0.159	0.057 ¹
Mesial bone loss 12 months	7	0.633 \pm 0.152	0.057		

**Graph 4:** Distal bone loss (in mm)**Graph 5:** Mesial bone loss (in mm)

12 months, was statistically nonsignificant when measured by paired t-test (Graphs 4 and 5).

DISCUSSION

Immediate placement of implants in fresh extraction sockets have several advantages over Branemark's protocol for conventional implant placement: Total treatment time and number of surgical procedures is reduced, more ideal implant positioning is possible, soft tissue height and contour are better preserved in the esthetic zone, opportunities for osseointegration are better due to healing potential of fresh extraction socket.¹¹

EZ Hi-Tec titanium, hydroxyapatite-coated acid-etched and sandblasted, internal hex, screw type, 2 stage implants were used in this study. As titanium is biocompatible, inert

in nature, resistant to tarnish and corrosion and has rapid ability to repair instantaneously, it is used very successfully in intrasosseous applications.

The quality of implant surface influences wound healing at implantation site and subsequently affects osseointegration.¹² HA coating, acid-etching, sandblasting increases the surface area of the implant, thus increasing the implant bone surface contact area and thereby implant stability. Threaded implants are preferred over cylindrical implants because threads of screws maximize the contact area, improve implant stability and favor the dissipation of interfacial stress.

In our study, implants were countersunk 1 to 2 mm below alveolar crestal bone to achieve adequate bone level at the time of implant exposure. Interdentally, bone between the root sites gets resorbed in the healing process, thus making countersinking of the implant below the alveolar crest essential.¹³

A major moot point is whether it is necessary to fill the gap between the implant and the extraction socket. According to Becker et al when immediate implants were placed within alveolar confines, without using graft materials or barrier membrane, high survival rates were reported.¹⁴ Carlsson et al evaluated titanium implants with initial gap widths of 0.00, 0.35 and 0.85 mm. At the end of 6 weeks, the control group had bone contact reaching 90%, whereas the 0.35 and 0.85 mm sites had residual gap of 0.22 and 0.54 mm respectively.

Wilson et al in his study placed 5 titanium plasma sprayed implants in one patient. One served as control in native bone, whereas four were placed in fresh extraction sockets. After 6 months of implant placement, bone implant contact in the control group was 72%; in two immediate implants with small peri-implant bone defect (<1.5 mm) at the time of implant placement, bone implant contact area was 50%. In the other two implants where peri-implant bone defect was >4 mm and in which e-PTEF membrane was used, the bone implant contact area was 17%. It was concluded from this study that peri-implant bone defect was the most important factor in determining bone-implant contact area and membrane was not useful in the site where peri-implant bone defect was <1.5 mm.¹⁵

While autogenous bone remains the material of choice, the creation of a 'second' surgical site and the associated morbidity of the donor tissue poses problems at times. As

an alternative, allograft and xenografts have risks of cross-infection. When different graft materials are used with or without membrane, it is concluded that biomaterial, such as Bio-oss and hydroxyapatite when placed in submerged situation, promote better healing. Thus, synthetic bone graft materials are being preferred by more clinicians.

Bone gap in excess of 1.5 mm after placement of implants can be eliminated by implantation with bioactive glass particulate bone graft.¹⁵ Bioactive particulate bone graft induces sequential reaction that encourages bonding to hard and soft tissue.

Gelb et al in a human study had to prematurely remove ePTFE membrane in 39% of treated sites.¹⁶ Becker et al reported 41% of membrane removal rate in immediate post-extraction implant placement as a consequence of exposure or infection.¹⁷ Schwartz-Arad and Chaushu observed no difference in membrane-treated implant as compared with control sites, suggesting that use of membrane may be limited to cases of fenestration, dehiscence, or large peri-implant defects in the immediate implant protocol.¹⁸

Primary flap closure of the implant site is an important factor to prevent infection and epithelial downgrowth during the crucial healing period.¹⁹ In the present study to achieve primary closure periosteal releasing incision was given and flap was coronally repositioned.

In present study, the observed marginal bone level change around the experimental implants was low. In fact, the 12-month mean vertical bone loss of 0.633 ± 0.152 was clinically not significant when measured by paired t-test which was in accordance with the study by Paolantano et al.²⁰ Similarly, the 6 months mean for plaque index and sulcular bleeding index also showed no statistically significant differences by Wilcoxon's signed rank test.

The technology of prosthetic replacement of missing single teeth is still evolving. In the present study, the two piece antirotational internal hex is the abutment used for replacing the crowns. Antirotational internal hex abutment design provides the greatest lateral stability to lateral and torsional forces occurring during mastication.²¹ Cement retained crown was fabricated with porcelain fused to metal and cemented with glassionomer cement. The success criteria suggested by Smith and Zarb²² for edentulous patients were utilized and applied to each of the 6 implant sites, which were examined during the last recall visit. Each implant was examined and found to be asymptomatic and without any clinical evidence of mobility. Radiographically, all the implants showed absence of interfacial radiolucency. Gingival inflammation and plaque formation was found to be less, which indicates that patients with single tooth replacement can exhibit good oral hygiene. The following

are the limitations of the study and should be kept in mind while interpreting the results.

1. The sample size of the study patients is small.
2. Longer follow-up is required to thoroughly evaluate the success rate.
3. The procedure is still costly to many patients seeking single tooth replacement.

Advantages of immediate placement implants over conventional implants are: It prevents the bone resorption and remodeling of socket that could otherwise occur, preserve alveolar bone anatomy, better osseointegration than conventional implant, allow ideal implant position with favorable load distribution, reduced treatment time and surgical procedure, soft tissue contours and height are better preserved in esthetic zones, better acceptance of the treatment plan by the patient, and reduced the period of edentulousness.

CONCLUSION

The present study shows that immediate placement of implant in fresh extraction socket using alloplastic bone graft material to bridge the small gap between implant and socket and a submerged surgical technique provides clinically and radiographically good result. Use of bone graft without membrane for small bone gap and primary flap closure results in lower rates of complication. The longitudinal functional stability of immediate implants proves that immediate implantation must be as optional treatment plan when teeth have to be extracted.

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