Immediate Occlusal Loading of Implants Placed in Fresh Sockets After Tooth Extraction

Roberto Crespi, MD, MS[1]/Paolo Capparè, MD[1]/
Enrico Gherlone, DDS, MD, PhD[3]/George E. Romanos, DDS, DMD, PhD[4]

***Purpose**: The aim of this study was to evaluate the clinical and radiographic outcome of dental implants immediately placed and loaded into fresh extraction sockets after 18 months. **Materials and Methods**: Twenty-seven patients, 15 women and 12 men, received a total of 160 implants; 150 were placed immediately after extraction. The sockets in the study had fully preserved walls, and 10 were placed in healed sites. Immediately after surgical procedure, all patients received the temporary prosthetic reconstruction in occlusion. Five months postsurgery, definitive metal-ceramic restorations were cemented on abutments. Follow-up visits were performed for the assessment of clinical parameters. Intraoral digital radiographic examinations were performed 3 and 18 months after implant placement. **Results**: Minor swelling of the gingival mucosa was observed, but no mucositis or flap dehiscence with suppuration were found. Mean marginal bone loss 1 year 18 months after immediate loading was 0.65 ± 0.58 mm to the mesial side and 0.84 ± 0.69 mm to the distal side in the maxilla and 1.13 ± 0.51 mm mesially and 1.24 ± 0.60 mm distally in the mandible. There was no difference between splinted and nonsplinted implants with respect to marginal bone loss. **Discussion and Conclusion**: Within the limits of this clinical study, the results indicate that immediate loading of implants placed in immediate extraction sites can be carried out successfully.* (Case Series) Int J Oral Maxillofac Implants 2007;22:955–962

Key words: *fresh extraction socket, immediate implants, immediate loading*

The placement of implants in fresh extraction sockets[1–4] allows placement of the implant during the same visit at which the tooth is extracted, which reduces morbidity, decreases the treatment time, and preserves bone in the residual alveolar ridge.[5] Furthermore, placement of an implant immediately after tooth extraction may help maintain the bone crest and lead to ideal implant positioning from a prosthetic point of view.[6] The internal and external dimensions of extraction sockets and thus the dimensions of the residual alveolar ridge change if sockets are left without treatment[7,8]; if uncontrolled, this resorption will lead to bone deficiencies that sometimes may contraindicate the placement of dental implants.[9] Lekovic et al[10] and Iasella et al[11] showed that about 45% of the residual alveolar ridge may be resorbed after tooth extraction and that the majority of this resorption takes place in the first 6 months after extraction.

An abundance of evidence supports the immediate loading of implants with high success rates, which shortens the treatment time. Becker et al[12] found a total success rate of 93.3% with immediately placed implants; similarly, Rosenquist and Grenthe[13] obtained an average survival rate of 93%. Watzek et al[14] achieved a cumulative survival rate of 92.4% for maxillae and 94.7% for mandibles after 3 years of loading. However, few studies have been published

[1]Assistant Professor, Department of Dentistry, "Vita Salute" University, San Raffaele Hospital, Milan, Italy.
[2]Research Associate, Department of Dentistry, "Vita Salute" University, San Raffaele Hospital, Milan, Italy.
[3]Professor, Department of Dentistry, "Vita Salute" University, San Raffaele Hospital, Milan, Italy.
[4]Clinical Professor, University of Rochester, Eastman Department of Dentistry, Rochester, New York.

Correspondence to: Dr George Romanos, University of Rochester, Eastman Department of Dentistry, 620 Elmwood Avenue, Rochester, NY 14620. Fax: +585 473 5254. E-mail: Georgios_Romanos@urmc.rochester.edu

on clinical outcomes of immediate loading of implants positioned in fresh extraction sites in both the mandible and maxilla.

Furthermore, Aires and Berger[15] compared implants immediately loaded in edentulous sites with implants loaded immediately in extraction sites. Seventy-five implants were placed in 9 jaws of 7 patients. Twenty-nine of these implants were placed in fresh extraction sockets and were loaded in less than 3 weeks. The authors concluded that the success rates for implants immediately loaded in extraction sites were comparable with those for edentulous sites.

Since scientific documentation is very scarce on this topic, the aim of the present study was to evaluate the clinical and radiographic outcomes of dental implants immediately placed and loaded into fresh extraction sockets.

MATERIALS AND METHODS

Patient Selection

Twenty-seven patients, 15 women and 12 men with a mean age of 57 years (range, 42 to 72 years), were randomly selected for this prospective study. The following inclusion criteria were adopted:

- Good general health
- The presence of hopeless teeth requiring extraction
- Absence of signs of acute infection around the alveolar bone
- At least 3 mm of bone beyond the root apex

When resonance frequency analysis (RFA) demonstrated an implant stability quotient (ISQ) greater than 60, and an insertion torque of at least 30 Ncm was achieved, immediate loading was performed.

Exclusion criteria were the presence of chronic systemic disease, smoking of more than 15 cigarettes/d, bruxism habits, and poor oral hygiene. All patients gave their informed consent for immediate implant loading.

Surgical Protocol

The patients received 1 g amoxicillin prior to surgery and 1 g twice a day for a week after the surgical procedure. Surgery was performed under local anesthesia (optocain 20 mg/mL with adrenaline 1:80,000).

The teeth were carefully removed and the sockets debrided. A periodontal probe was used to verify the integrity of the 4 walls of the fresh sockets. Partial-thickness miniflaps were designed to achieve primary closure. No lateral incisions were made.

Implant sites were prepared with standard drills. The bony walls were followed as a guide. The bone was underdrilled apical to the extraction sockets; at least 3 mm of bone remained beyond the root apex. No countersinking was used. Two different diameters (3.75 mm and 5.0 mm) and 2 different lengths (10 mm and 13 mm) were used. The implants were placed 1 mm below the buccal level of alveolar crest to improve primary implant stability. Small autogenous bone chips (debris) were placed in the gaps of more than 2 mm between implant surfaces and socket walls. The quality of alveolar bone was evaluated during surgery for each site.[16]

One hundred sixty titanium implants (Outlink; Sweden & Martina, Padova, Italy) were placed. The implant has a 0.8-mm machined neck and a rough-surfaced body (titanium plasma spray) with a progressive thread design. One hundred fifty implants were placed immediately after extraction, and 10 were placed in healed sites and splinted with adjacent implants placed in fresh extraction sockets to complete full-arch rehabilitation. Thirty-two implants had a diameter of 5 mm, while 128 implants had a diameter of 3.75 mm (Figs 1 and 2).

The number of placed implants in relation to position in maxilla and mandible is reported in Tables 1a and 1b.

When the ISQ was greater than 60 and a minimum insertion torque of 30 Ncm could be achieved, the implants were immediately loaded. An oval cross-sectional temporary abutment (Sweden & Martina) made of resin was placed (Fig 3). Occlusion parallelism was checked, and modifications were made if required. The abutments were removed from the implants, modified extraorally, and re-placed on the implants. The junction between the abutment and the implant was located 1 mm below bone margin in all cases. Partial-thickness flaps were coronally positioned and sutured to protect the implant sites (Fig 3). Chlorhexidine mouthwash was prescribed twice daily for the next 15 days.

Prosthetic Protocol

Immediately after the surgical procedure, all patients received temporary prosthetic restorations. Prefabricated acrylic resin crowns were used for single-tooth replacements. For partial or complete temporary prostheses, fixed temporary restorations with a fiber-reinforced framework were custom-fit with acrylic resin around the margins or the abutment and affixed with temporary cement (Fig 4; Temp Bond, Kerr Manufacturing, Romulus, MI). Distal cantilevers were avoided. All temporary crowns were in full contact in centric occlusion. Occlusal surfaces were flattened to reduce horizontal relations. All patients followed a soft diet (avoiding bread and meat) for 2 months.

Fig 1 Preoperative clinical view of a patient with advanced periodontal disease.

Fig 2 Occlusal view immediately after implant placement.

Table 1a Distribution of Implants in Relation to Location—Maxilla

Tooth	No. of implants
Right	
First molar	2
Second premolar	14
First premolar	14
Canine	7
Lateral incisor	6
Central incisor	13
Left	
Central incisor	8
Lateral incisor	8
Canine	13
First premolar	12
Second premolar	1
First molar	0

Table 1b Distribution of Implants in Relation to Location—Mandible

Tooth	No. of implants
Right	
First molar	5
Second premolar	5
First premolar	6
Canine	7
Lateral incisor	2
Central incisor	0
Left	
Central incisor	0
Lateral incisor	2
Canine	6
First premolar	4
Second premolar	5
First molar	7

Fig 3 Immediate placement of implants, resin abutments, and sutures.

Fig 4 Temporary prosthesis 12 hours after implant placement.

Follow-up

Follow-up visits were performed by a dental hygienist at 1, 3, 6, 12, and 18 months after implant placement. The following clinical parameters were checked: plaque, Bleeding Index at 4 surfaces around the implants, pain, occlusion, and prosthesis mobility.[17–19] Success criteria for implant survival were implant stability and the absence of radiolucency around the implants, mucosal suppuration and pain.

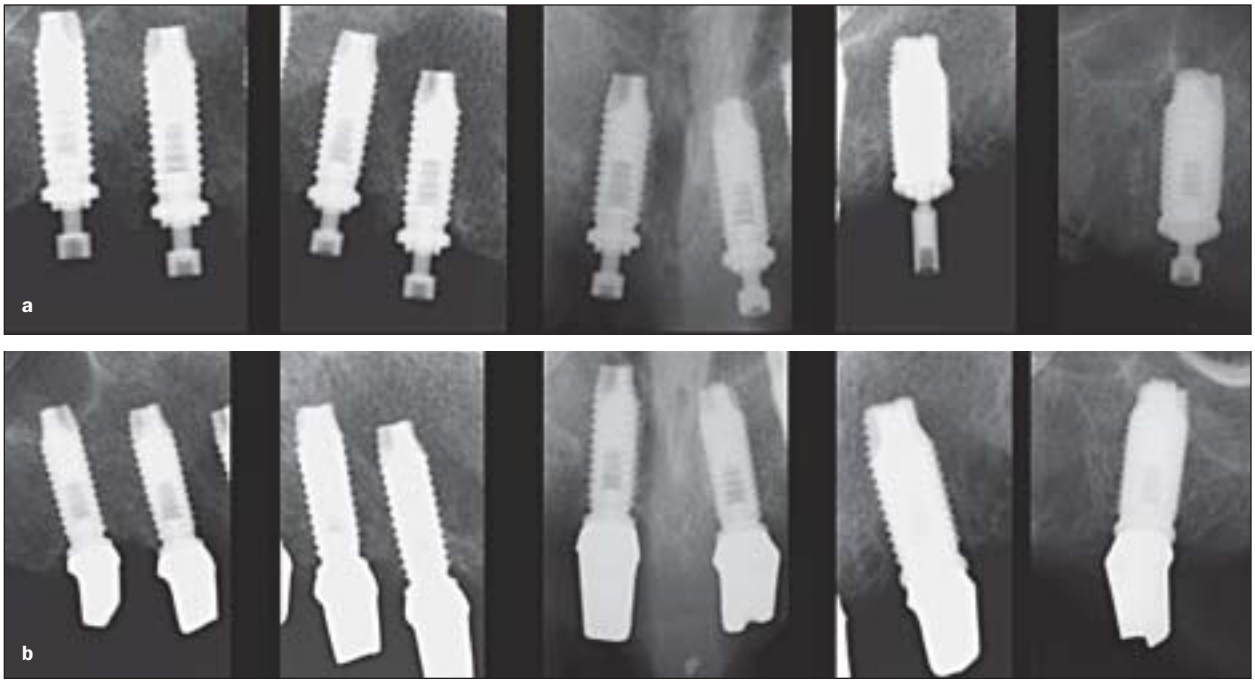

Fig 5 Radiographs of the patient *(a)* before tooth extraction and after implant placement and *(b)* at the 18-month follow-up examination.

Fig 6 The definitive ceramic-fused-to-metal restoration.

Radiographic Examination

Intraoral digital radiographic examinations (Schick CDR Schick Technologies, Long Island City, NY) were made when acetalic abutments were placed (ie, 3 months postsurgery) and 18 months after implant placement. Periapical radiographs were taken perpendicular to the long axis of the implant with a long-cone parallel technique using an individualized occlusal template to measure the marginal bone level. A radiologist measured the changes in marginal bone height over time. To assess marginal bone level, the most coronal point of the implant in contact with the bone mesially and distally was used as the reference point. The difference of bone level was measured radiographically using specialized software (Schick Technologies; Fig 5).

The marginal bone loss was evaluated at 18 months of healing. Mesial and distal bone loss was calculated both in maxilla than in mandible, and the resulting data were presented as means values and standard deviations.

Placement of the Definitive Prosthesis

Three months after the implant placement, the temporary crowns and resin abutments were removed. Transfer copings were inserted into the internal hexes of the implants with a seating instrument and secured with abutment screws. Impressions were made with a polyether material (Impregum; ESPE, Seefeld, Germany) using an individual impression tray. Prepared definitive metal abutments were screwed onto the osseointegrated implants.

Five months after implant placement, definitive metal-ceramic restorations were cemented onto the definitive abutments. The occlusal contacts were distributed over the arch with anterior guidance (group guidance in lateral excursions), with light contact on the distal cantilevers for full-arch prostheses (Fig 6).

RESULTS

In total, 35 prosthetic reconstructions were inserted: the number and type of reconstructions are reported in Table 2.

Surgical and Prosthetic Procedure

After an 18-month follow-up period, the cumulative survival rate was 100% for all implants. There were no patient dropouts. Bone type was judged to be primarily types 2 and 3 (Lekholm and Zarb).[16] Wound healing around the resin abutments was good, which enabled good adaptation to the temporary prostheses. Minor swelling of the gingival mucosa was observed in the first days after surgery, but no mucositis or flap dehiscence with suppuration were noted. Ten occlusal screws unscrewed in provisional plastic abutments. There were no complications in association with the definitive ceramic-fused-to-metal restorations.

Clinical Parameters

Plaque accumulation was 2% at baseline and 5% after 18 months. The Bleeding Index was 3.0% at baseline and 5.3% at the 18-month follow-up examination. No pain or prosthesis mobility was reported.

Radiographic Evaluation

The results from the radiographic evaluation were reported in Tables 3a and 3b. In the maxilla, the mean marginal bone loss 18 months after immediate loading was 0.65 ± 0.58 mm mesially and 0.84 ± 0.69 distally. In the mandible, the mean mesial bone loss was 1.13 ± 0.51 mm, while the mean distal bone loss was 1.24 ± 0.60 mm. There was no difference in bone remodeling after 18 months for splinted versus nonsplinted implants.

Table 2 Types of Prosthetic Restorations

	Single-tooth restorations	Fixed partial dentures	Full-arch prostheses	Total
Maxilla	6	10	8	24
Mandible	3	5	3	11

Table 3a Marginal Bone Loss 18 Months After Immediate Functional Loading—Maxilla

	Mesial		Distal	
Bone loss	n	%	n	%
0.0	40	36.0	40	36.0
0.1 to 0.5	25	22.6	24	21.6
0.6 to 1.0	33	29.7	24	21.6
1.1 to 2.0	12	10.8	22	19.9
> 2.0	1	0.9	1	0.9

No. and percentage of implants in each category shown.

Table 3b Marginal Bone Loss 18 Months After Immediate Functional Loading—Mandible

	Mesial		Distal	
Bone loss	n	%	n	%
0.0	15	30.6	15	30.6
0.1 to 0.5	5	10.2	7	14.4
0.6 to 1.0	15	30.6	15	30.6
1.1 to 2.0	14	28.6	11	22.4
> 2.0	0	0	1	2.0

No. and percentage of implants in each category shown.

DISCUSSION

The present study was carried out in 27 patients and involved the placement of 160 dental implants, 150 in fresh postextraction sites and 10 in healed sites. No implant failures were reported. At the 18-month follow-up, in the maxilla the mean crestal bone loss was 0.65 ± 0.58 mm mesially and 0.84 ± 0.69 distally. In the mandible, mean bone loss was greater—1.13 ± 0.51 mm mesially and 1.24 ± 0.60 distally. These results may be explained by the high initial stability of implants and perhaps by the use of an acrylic resin temporary abutment, which may have functioned as a shock absorber. The use of an acrylic resin temporary abutment immediately after implant placement limits the functional occlusal forces directed toward bone, and this effect appears to be a major advantage in preventing the destabilization of implants.[20]

Similar results were reported by Hui et al,[21] who compared the immediate placement of implants in extraction sites (n = 11) with the immediate placement and restoration of 13 extraction sites in the anterior maxilla. Heavy smokers and patients with bruxism were excluded. Machined-surface Brånemark System implants 13 to 18 mm long were placed with torque values of 40 to 50 Ncm; bicortical anchorage was achieved where possible. No implants were lost, and no complications were encountered. The authors noted that the provisional restorations preserved the gingival contours, resulting in better esthetic outcomes in the immediate provisionalization group.

Aires and Berger[15] compared the results of implants immediately loaded in edentulous sites with implants loaded immediately in extraction sites. Seventy-five implants were placed in 9 jaws of 7 patients; 2 patients received implants in both the maxilla and mandible. Of the 75 implants placed, 29 were placed in immediate extraction sites. Twenty-six of these were loaded less than 3 weeks postsurgery. Of the 75 implants placed, 62 were loaded early (less than 3 weeks postsurgery). Two implants have been

lost. The remaining 13 implants were submerged and allowed to heal; none of the submerged implants failed. One of the implants lost had been placed in an extraction site and 1 in a nonextraction site. Thus, the success rate for implants immediately loaded in extraction sites was comparable to that for immediately loaded implants in edentulous sites.

Malo et al[22] coordinated a multicenter study with 116 machined Brånemark System implants with various diameters and configurations placed in 76 patients and loaded immediately or early. The implants were placed in the esthetic zone using underpreparation of apical osteotomies to increase initial stability such that the insertion torque was greater than 30 Ncm for all implants. Twenty-four patients smoked more than 10 cigarettes per day. The authors reported an overall success rate of 96.5% (112 of 116) and a success rate of 100% (22 of 22) for implants placed in fresh extraction sockets. None of the smokers lost implants, leading the authors to conclude that initial implant stability was more important than smoking in influencing implant survival and normal healing with this group. A higher failure rate was noted with 3.3-mm diameter implants, although the difference was not statistically significant, possibly because of the small sample size.

Glauser et al[23] reported on a 38-patient series in which 102 implants were placed; 23 were placed in immediate extraction sites and immediately loaded, 8 were placed in incompletely healed extraction sites, and 71 were placed in healed sites. Twelve smokers were included. Ninety-seven percent of the implants (99 of 102) were clinically successful at 12 months. The authors concluded that neither smoking nor immediate or recent extraction sites had an effect on survival outcome.

Chaushu et al,[24] however, reported a higher survival rate and greater predictability for implants placed in healed sites compared with those placed in fresh extraction sockets. They studied 26 immediately restored cylindric, press-fit hydroxyapatite-coated implants. Seventeen implants were placed in immediate extraction sockets; 9 were placed in completely healed alveolar ridges. Occlusal contacts in centric occlusion were described as "minimized." Three of 17 implants placed in extraction sockets failed within the first month, for a survival rate of 82.4%, while all implants placed in healed ridges survived. All of the failed implants were placed in the maxilla in sites prepared using a combination of conventional drilling and osteotome bone compression.

Degidi and Piattelli[25] followed 646 implants under various clinical conditions. While they did not specifically report the number of implants placed in extraction sockets compared with those placed in healed ridges, they indicated that they only had 2 failures with 58 single-tooth implants. Both of these failures occurred in immediate extraction cases, where bone condensation had been performed for site preparation. In addition, the authors noted that in both cases the patients exhibited parafunctional habits and had probably applied excessive forces to the implants early in the healing process.

In a clinical case of an edentulous female (heavy smoker under chemotherapy) who received implant-supported complete restoration in the maxilla and mandible using an immediate loading procedure, Romanos and Johansson[26] presented histologic data from retrieved biopsy specimens. All implants were osseointegrated to some extent and surrounded by dense lamellar bone. However, around the upper parts of the implants much of the bone had been resorbed. The histomorphometric evaluation of bone-implant contact revealed a mean of approximately 51% of the available surface and a mean bone volume of approximately 52%.

Rocci et al[27] placed 97 machined-surface implants in the partially edentulous maxillary arches of 46 patients, 8 of whom were smokers. Bruxers were excluded. The authors used an elaborate surgical guide and flapless surgery and placed prefabricated provisional restorations. Eight percent of the implants were mobile within 8 weeks. Five of the lost implants were single-tooth replacements, of which 2 had been placed into fresh extraction sockets.

Preservation of alveolar bone volume following tooth extraction facilitates subsequent placement of dental implants and leads to an improved esthetic and functional prosthodontic result. In a clinical and radiographic study, Schropp et al[28] assessed bone formation in the alveolus and the contour changes of the alveolar process following tooth extraction. The tissue changes over a 12-month period after removal of a premolar or molar in 46 patients were evaluated by means of measurements on study casts, linear radiographic analyses, and subtraction radiography. The results demonstrated that major changes occurred in the first year after tooth extraction.

Since 1998, when Wohrle[29] first reported 14 consecutive cases in which an immediate placement procedure was used for single-tooth restoration in the esthetic zone with immediate provisionalization, many authors have reported encouraging results in applying immediate restoration protocols in fresh extraction sites.

Covani et al[30] analyzed bone healing and remodeling around 15 implants placed immediately after the removal of 15 single-rooted teeth in 10 patients. All implants were placed within the alveolar confines, limiting, in most cases, small peri-implant bone defects. After implant placement, the distance from the buccal to lingual bone plate was measured. No

membranes or filling materials were used. Primary flap closure was performed in all cases. The mean buccolingual distance reported was 10.5 ± 1.52 mm at the time of implant placement and 6.8 ± 1.33 mm at second-stage surgery. They concluded that coronal bone remodeling around immediate implants showed a healing pattern with new bone apposition around the neck of the implants but horizontal width reduction of the bone ridge.

Barone et al[31] evaluated the 12-month clinical success of 18 single-tooth implants inserted immediately after tooth extraction in 18 patients and restored the same day with temporary abutments and crowns, with nonfunctional loading. All experimental sites showed an absence of fenestrations or dehiscences of the bone walls and a residual gap between implant surfaces and surrounding bone walls ≤ 2 mm. During the 12-month follow-up period, 1 implant was removed 4 weeks after placement following an abscess. All remaining implants healed with no complications and were assessed as stable and successful after 12 months. They suggested that immediate placement and restoration of a single implant can be a valid and successful option of treatment in the case of single compromised teeth. Moreover, their treatment protocol eliminated the need for a removable provisional restoration and appeared to maintain the pre-existing architecture of the soft and hard tissues in most cases.

The present clinical study confirmed that immediate loading of implants can be done successfully in either immediate extraction sites or edentulous ridges. The advantages of this 1-stage procedure include primarily immediate function and esthetics. There is no need for a temporary full denture. Second-stage surgery was eliminated and adjacent papillae were well preserved, which is important for good esthetic results. The procedure reported makes it possible to treat patients who refuse to accept a healing period of 4 to 6 months. However, further clinical and histologic studies of the immediate loading of implants placed in fresh extraction sites are necessary.

REFERENCES

1. Becker W, Schenk R, Higuchi K, Lekholm U, Becker B. Variation in bone regeneration adjacent to implants augmented with barrier membranes alone or with demineralized freeze-dried bone or autologous graft: A study of dogs. Int J Oral Maxillofac Implants 1995;10:143–154.
2. Simion M, Dahlin C, Trisi P, Piattelli A. Qualitative and quantitative comparative study on different filling materials used in bone tissue regeneration. A controlled clinical study. Int J Periodontics Restorative Dent 1994;14:199–215.
3. Cornelini R, Cangini F, Covani U, Wilson TG Jr. Immediate restoration of implants placed into fresh extraction sockets for single-tooth replacement: A prospective clinical study. Int J Periodontics Restorative Dent 2005;25:439–447.
4. Covani U, Barone A, Cornelini R, Crespi R. Soft tissue healing around implants placed immediately after tooth extraction without incision: A clinical report. Int J Oral Maxillofac Implants 2004;19:549–553.
5. Prosper L, Gherlone E, Redaelli S, Quaranta M. Four-year follow up of larger-diameter implants placed in fresh extraction sockets using a resorbable membrane or a resorbable alloplastic material. Int J Oral Maxillofac Implants 2003;18:856–854.
6. Shanaman R. The use of guided tissue regeneration to facilitate ideal prosthetic placement of implants. Int J Periodontics Restorative Dent 1992;12:257–260.
7. Lekovic V, Kenney EB, Weinlaender M, et al. A bone regenerative approach to alveolar ridge maintenance following tooth extraction. Report of 10 cases. J Periodontol 1997;68:563–570.
8. Camargo PM, Lekovic V, Weinlaender M, et al. Influence of bioactive glass on changes in alveolar process dimensions after exodontia. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2000;905:581–586.
9. Denissen HW, Kalk W, Veldhuis HA, van Waas MA. Anatomic consideration for preventive implantation. Int J Oral Maxillofac Implants 1993;82:191–196.
10. Lekovic V, Camargo PM, Kokkevold PR, et al. Preservation of alveolar bone in extraction sockets using bioadsorbable membranes. J Periodontol 1998; 69:1044-1049.
11. Iasella JM, Greenwell H, Miller RL, et al. Ridge preservation with freeze-dried bone allograft and a collagen membrane compared to extraction alone for implant site development: A clinical and histologic study in humans. J Periodontol 2003;72:990-999.
12. Becker BE, Becker W, Ricci A, Geurs N. A prospective clinical trial of endosseous screw-shaped implants placed at the time of tooth extraction without augmentation. J Periodontol 1998;69:920–926.
13. Rosenquist B, Grenthe B. Immediate placement of implants into extraction sockets: Implant survival. Int J Oral Maxillofac Implants 1996;112:205–209.
14. Watzek G, Haider R, Mensdorff-Pouilly N, Haas R. Immediate implants and delayed implantation for complete restoration of the jaw following extraction of all residual teeth: A retrospective study comparing different types of serial implantation. Int J Oral Maxillofac Implants 1995;10:561–567.
15. Aires I, Berger J. Immediate placement in extraction sites followed by immediate loading: A pilot study and case presentation. Implant Dent 2002;11:87–94.
16. Lekholm U, Zarb GA. Patient selection and preparation. In: Brånemark P-I, Zarb GA, Albrektsson T (eds). Tissue-Integrated Prostheses: Osseointegration in Clinical Dentistry. Chicago: Quintessence, 1985:201–209.
17. Ainamo J, Bay I. Problems and proposals for recording gingivitis and plaque. Int Dent J 1975;25:229–235.
18. Mombelli A, Lang NP. The diagnosis and treatment of periimplantitis. Periodontol 2000 1998;17:63–76.
19. Smedberg JI, Lothigius E, Bondin I, Frykholm A, Nilner K. A clinical and radiological 2-year follow-up study of maxillary overdentures on osseointegrated implants. Clin Oral Implants Res 1993;4:39–46.
20. Tepret F, Sertgöz A, Basa S. Immediately loaded anterior single-tooth implants: Two cases. Implant Dent 2005;3:242–247.
21. Hui E, Chow J, Li D, Liu J, Wat P, Law H. Immediate provisional for single-tooth implant replacement with Brånemark system: Preliminary report. Clin Implant Dent Relat Res 2001;3:79–86.

22. Malo P, Friberg B, Polizzi G, Gualini F, Vighagen T, Rangert B. Immediate and early function of Brånemark System implants placed in the esthetic zone: A 1-year prospective clinical multicenter study. Clin Implant Dent Relat Res 2003;5(suppl 1):37–46.
23. Glauser R, Lundgren A, Gottlow J, et al. Immediate occlusal loading of Brånemark TiUnite implants placed predominantly in soft bone: 1-year results of a prospective clinical study. Clin Implant Dent Relat Res 2003;5(suppl 1):47–56.
24. Chaushu G, Chaushu S, Tzohar A, Dayan D. Immediate loading of single-tooth implants: Immediate versus non-immediate implantation. A clinical report. Int J Oral Maxillofac Implants 2001;16:267–272.
25. Degidi M, Piattelli A. Immediate functional and non-functional loading of dental implants: A 2- to 60-month follow-up study of 646 titanium implants. J Periodontol 2003;74:225–241.
26. Romanos GE, Johansson CB. Immediate loading with complete implant-supported restorations in an edentulous heavy smoker: Histologic and histomorphometric analyses. Int J Oral Maxillofac Implants 2005;20:282–290.
27. Rocci A, Martignoni M, Gottlow J. Immediate loading in the maxilla using flapless surgery, implants placed in predetermined positions, and prefabricated provisional restorations: A retrospective 3-year clinical study. Clin Implant Dent Relat Res 2003;5(suppl 1):29–36.
28. Schropp L, Wenzel A, Kostopoulos L, Karring T. Bone healing and soft tissue contour changes following single-tooth extraction: A clinical and radiographic 12-month prospective study. Int J Periodontics Restorative Dent 2003;23:313–323.
29. Wohrle PS. Single-tooth replacement in the aesthetic zone with immediate provisionalization: Fourteen consecutive case reports. Pract Periodontics Aesthet Dent 1998;10:1107–1114.
30. Covani U, Cornelini R, Barone A. Bucco-lingual bone remodeling around implants placed into immediate extraction sockets: A case series. J Periodontol 2003;74:268–273.
31. Barone A, Rispoli L, Vozza I, Quaranta A, Covani U. Immediate restoration of single implants placed immediately after tooth extraction. J Periodontol 2006;77:1914–1920.