Immediate Loading of Single-tooth Implants: Immediate Versus Non-immediate Implantation. A Clinical Report

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The hypothesis of the present study was that immediate loading of implant-supported restorations replacing single missing teeth could be a successful procedure. The present study compared the clinical success of immediately loaded single-tooth implants placed in fresh extraction sites to that of immediately loaded single-tooth implants placed in healed sites. From the years 1997 to 1998, 26 patients, ranging in age from 18 to 70 years, presented for the placement of 28 immediately loaded implants intended to support single-tooth ceramometal restorations. Nineteen implants were placed into fresh extraction sites, and 9 implants were placed into healed sites. Temporary prefabricated acrylic resin crowns were prepared and adjusted. At the time of traditional second-stage surgery (3 to 6 months after implantation), the implants were restored with single-tooth ceramometal prostheses. The survival rates were 82.4% and 100% for immediate and non-immediate implants, respectively. Follow-up ranged from 6 to 24 months from the day of implant placement, with a mean of 13 months for the immediate implants and 16.4 months for the non-immediate implants. Radiographic marginal bone loss after 3 to 6 months did not extend beyond the abutment-implant junction. Within the limits of the present investigation, immediate loading of single-tooth implants placed in healed sites is a possible treatment alternative. Immediate loading of single-tooth implants placed in fresh extraction sites carried a risk of failure approximating 20% in this patient population. (Int J Oral Maxillofac Implants 2001;16:267–272)

Key words: *immediate implant loading, immediate implant placement, implant-supported dental prosthesis, single-tooth dental implants*

Histologically, osseointegration ad modum Brånemark is defined as "a direct connection between living bone and a load-carrying endosseous implant at the light microscopic level."[1] Brunski and coworkers[2,3] found that fibrous connective tissue encapsulation can occur when an implant is loaded immediately after placement, while a stress-free period for wound healing encourages a direct bone-implant interface. Those studies support the traditional concept that, since the initial wound-healing period is critical, loads applied prematurely to implants may jeopardize initial stabilization.[2–4] As a result, a minimum waiting period of 3 months in the mandible and 6 months in the maxilla was advocated prior to applying any load to an implant.

The hypothesis of the present study was that immediate loading of implants supporting single-tooth restorations could be a successful procedure. The present study compared the clinical success of immediately loaded single-tooth implants placed in fresh extraction sites to that of immediately loaded single-tooth implants placed in healed sites.

MATERIALS AND METHODS

From the years 1997 to 1998, 26 consecutive patients (20 females and 6 males) ranging in age from 18 to 70 years (mean 44 years) presented for the placement

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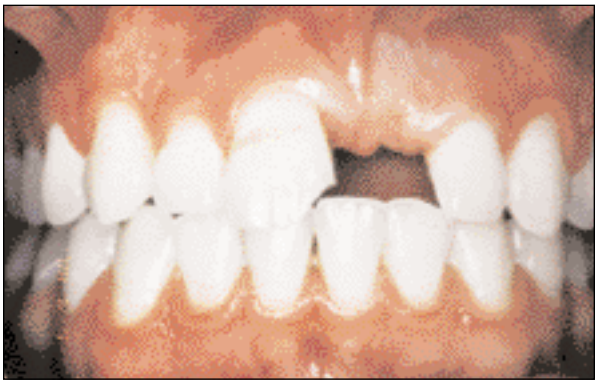

Fig 1a Pretreatment intraoral photograph in a non-immediate implantation site.

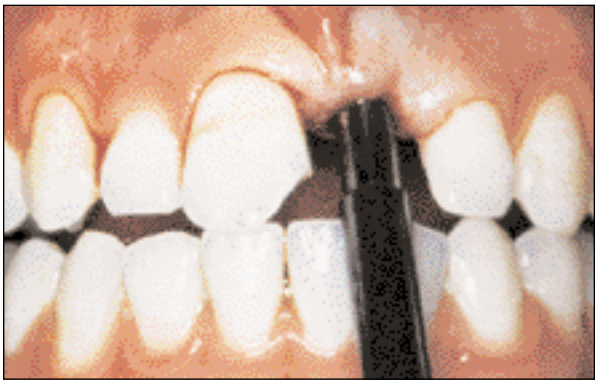

Fig 1b The osteotome is inserted in the maxillary alveolar bone. Notice the soft tissue contouring at the papillae and gingival margins.

of 28 implants intended to support single-tooth ceramometal restorations. All patients were in good health, with no chronic systemic disease or smoking habits, and gave their informed consent for immediate implant loading. Nineteen implants were placed into fresh extraction sites, and 9 implants were placed into healed sites. A single surgeon performed all the surgical procedures. Twenty-one Steri-Oss (Yorba Linda, CA) and 7 Alpha Bio (Petah-Tikva, Israel) hydroxyapatite- (HA) coated cylindric implants were used. As a potential site for immediate implant placement, teeth indicated for removal had to demonstrate at least 5 mm of bone beyond the root apex and at least 12 mm height and 5 mm width of available bone. Teeth without a labial plate, described in 1993 by Gelb[5] as "no-wall" defects, and/or teeth with periapical lesions were excluded. Indications for tooth extraction and immediate implant placement included a history of trauma resulting in root fractures, residual roots, or non-restorable crowns. No apparent periodontal disease and no periapical inflammatory involvement were diagnosed. Oral examination focused on the "smile line," intra-arch relationship, buccolingual width, and maxillomandibular relationship. Tomograms and periapical radiographs were evaluated for mesiodistal width (interradicular distance), residual bone beyond the apex, socket width, and root angulation.

The implant treatment alternatives were explained to the patient. The possibilities of 1-stage surgery and loading versus 2-stage surgery, or 1-stage surgery and a 3- to 6-month waiting period before implantation, were emphasized. Informed consent for the described procedure was obtained.

One gram of amoxicillin was administered 1 hour prior to surgery. Chlorhexidine rinses were used prior to surgery, and amoxicillin (500 mg 3 times daily) and chlorhexidine rinses were continued for 5 to 7 days postsurgery. For immediate implantation (Fig 1a), no flaps were designed to achieve primary closure, and no incisions were made. Teeth were carefully removed and the sockets debrided. Through the socket openings, osteotomies were prepared with standard drills, using the bony walls as guides. Maximum use was made of bone apical to the extraction sockets. The distance between the gingival margin and bone was measured with a periodontal probe. This distance was added to the desired implant length, and the buccal gingival margin served as the height reference point. A 2-mm pilot drill was then used.

In the maxilla, a 2.7-mm Steri-Oss osteotome was then pushed into the osteotomy site while using a rotatory action. The osteotome was left in place for at least 1 minute to allow for flexure of the bone and simultaneous compression of the buccal and palatal bony plates (Fig 1b). This enabled both bone condensation and widening. A series of drills and osteotomes were used to complete preparation of the site. In extraction sites, a "try-in" was placed to verify the depth of the 3.8-mm osteotomy. For non-immediate situations, a try-in was placed to verify osteotomy depth. The implant was placed to within 8 mm of the bone (Fig 1c). Implant placement was performed with the aid of a mallet and a 2-mm osteotome to tap over the cover screw. In the mandible, drilling was performed according to the standard protocol. The final drill had to be used in a single, continuous, steady motion.

In non-immediate situtations, to preserve the papillae of the adjacent teeth and to prevent recession of their gingival margins, no flap was raised. A round high-speed bur was used for soft tissue contouring. Care was taken not to extend the cut edge

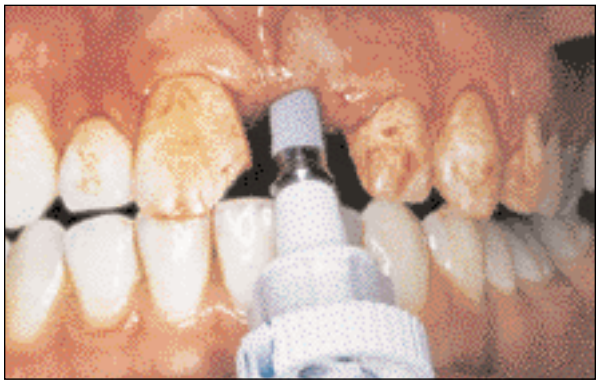

Fig 1c A maxillary implant is placed to within 8 mm of bone.

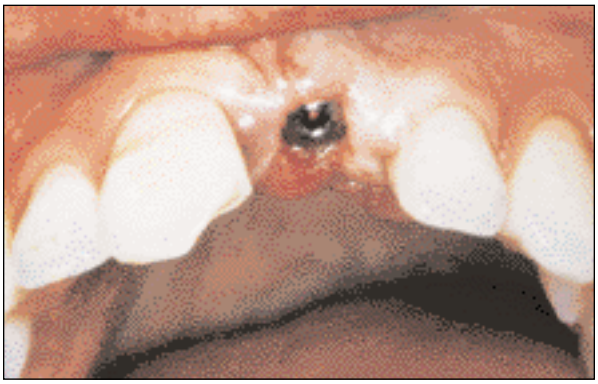

Fig 1d The implant is placed at the most coronal part of the buccal alveolar crest.

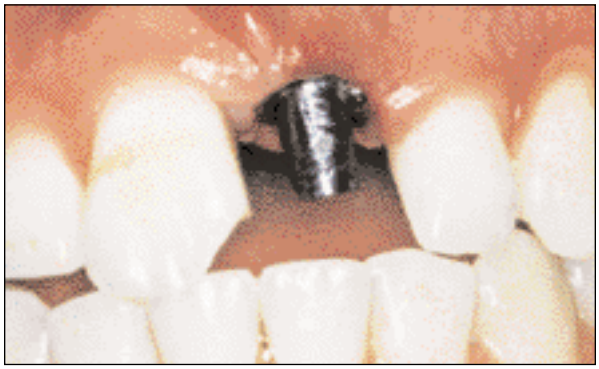

Fig 1e Steri-Oss HL fixed abutment in place. Notice the soft tissue contouring.

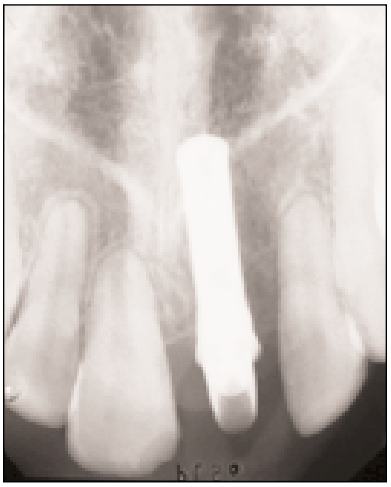

Fig 1f Periapical radiograph showing Steri-Oss HL fixed abutment in place.

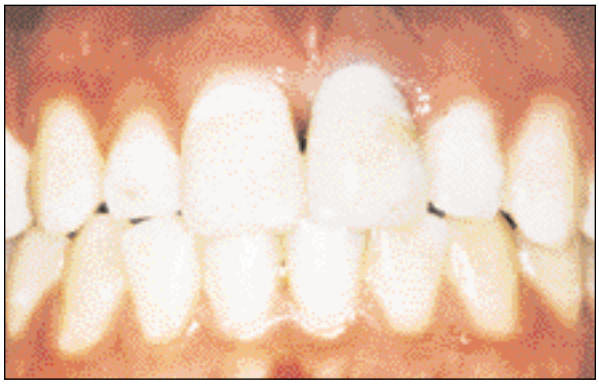

Fig 1g Clinical view at the 1-year follow-up. Note the interdental papilla between the 2 central incisors, which has reached the contact point.

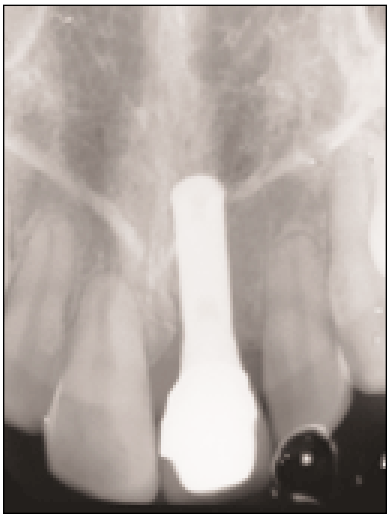

Fig 1h Radiograph at the 1-year follow-up.

of the attached mucosa on the labial side to a level higher than the labial gingival margin of the adjacent central incisor.

To ensure implant location at the most coronal part of the buccal alveolar crest in both the maxilla and mandible, no countersink drill was used. The longest (mean 14 mm, range 12 to 16 mm) and widest (mean 3.8 mm, range 3.25 to 4 mm) possible implants were placed. A distance of no less than 3 mm from the adjacent cementoenamel junction was maintained so as to achieve a normal emergence profile. The implant was placed at the most coronal part of the alveolar crest (Fig 1d).

The cover screw was removed, and the implant's location at the alveolar crest was verified. A Steri-Oss HL fixed abutment was then placed, the occlusion was checked, and the required modifications were marked. The abutment was then removed from the implant and modified extraorally. Abutment height was reduced to the minimum required for retention during the healing period. It was then replaced on the implant (Figs 1e and 1f).

In immediate implantation sites, small autogenous bone chips (bur debris) were placed in the gap between the implant and socket walls when needed. The buccal and lingual soft tissue edges were sutured to enable maximal approximation and to ensure soft tissue coverage of the bone chips. In non-immediate sites, there was no need for suturing.

Final tightening of the abutment was performed with a 35-Ncm torque wrench and 0.050-inch Hex Insert (Steri-Oss). A temporary prefabricated acrylic resin crown was prepared and adjusted with acrylic resin to the gingival margin and placed on the abutment with a minimum of temporary cement. Contact in centric occlusion was minimized.

The patient was seen once a month for a subsequent 3- to 6-month period. At the time of traditional second-stage surgery (3 to 6 months after implantation), periapical radiographs of the implant sites were taken. The implants were restored with single-tooth ceramometal prostheses by 2 prosthodontists (Figs 1g and 1h).

RESULTS

Healing was generally uneventful, swelling was minimal, and patients did not require any analgesics.

Table 1 presents the characteristics of the immediately placed implants, most of which were placed in the maxilla. In 2 mandibular sites, initial stabilization was not achieved and immediate loading was not performed. Three immediate implants failed during the first month following implantation, resulting in a survival rate of 82.4%. All 3 patients involved were over 50 years of age. In each of those patients there was initial discomfort, followed by pain and excessive mobility; 2 of these patients also experienced swelling with purulent exudate. The implants were removed as soon as possible, and after a 2-month waiting period traditional implantation was successfully performed. Table 2 presents the characteristics of the non-immediately placed implants. All the non-immediate implants survived the healing period, resulting in a 100% short-term survival.

Follow-up ranged from 6 to 24 months, with a mean of 13 months for the immediate implants and 16.4 months for the non-immediate implants (calculated from the day of implantation).

All surviving implants (immediate and non-immediate) were immobile, asymptomatic, and radiographically surrounded by bone at the time of second-stage surgery. Radiographic marginal bone loss after 3 to 6 months did not extend beyond the abutment-implant junction.

DISCUSSION

Several studies have shown that mandibular implants could be successfully placed into immediate function.[6–19] Cameron and associates[20,21] showed that intimate bone-implant contact may occur in the presence of micromovement, but not in the presence of macromovement.

The basic concept behind the present study was that immediate loading is not an absolute contraindication, but rather a relative one. Most available studies on the subject have offered solutions for full-arch reconstruction.[6,7,9–12,14,17,19] In such cases, the occlusal load is maximal and therefore requires maximal initial stability and support. For full-arch restorations, intra-arch stabilization is possible, and cross-arch stabilization is a recommended guideline. Salama and colleagues[10] showed that 2 immediately loaded implants placed bilaterally in strategic locations can support a 10-unit provisional fixed restoration. For single-tooth restorations, the adjacent teeth can withstand a major part of the occlusal forces. Acrylic resin temporary crowns were used to prevent transmission of some of the load directly to the implant. In addition, in the present study the initial abutment was shortened as much as possible to enable a thicker acrylic resin occlusal width, but no more than 2 to 3 mm, to further diminish the occlusal forces.

Several factors influence stability: the potential bone-implant surface area (as dictated by length,

Table 1 Patient Characteristics for Implants Placed Immediately After Extraction

Patient	Age (y)	Implant data			Site	Bone quality†	Complications	Final restoration (mo)	Follow-up (mo)
		Type*	Diameter (mm)	Length (mm)					
1	35	Steri-Oss	3.8	14	Maxillary canine	2	None	6	18
2	37	Steri-Oss	3.8	14	Maxillary first premolar	3	None	8	18
3	28	Steri-Oss	3.8	14	Maxillary first premolar	3	None	10	14
4	70	Steri-Oss	3.8	14	Maxillary first premolar	3	Failed	—	—
4	70	Steri-Oss	3.8	14	Maxillary second premolar	4	Swelling	8	12
4	70	Steri-Oss	3.25	14	Maxillary lateral incisor	2	None	8	12
5	60	Steri-Oss	3.8	14	Maxillary canine	2	Failed	—	—
6	60	Steri-Oss	3.8	14	Maxillary first premolar	3	Failed	—	—
7	30	Alpha Bio	4	13	Maxillary first premolar	4	None	10	12
8	35	Steri-Oss	3.8	14	Maxillary second premolar	4	None	6	12
9	35	Steri-Oss	3.8	14	Maxillary canine	2	None	6	18
10	34	Steri-Oss	3.25	16	Maxillary lateral incisor	2	None	6	6
11	55	Steri-Oss	3.8	14	Maxillary second premolar	4	None	6	18
12	30	Steri-Oss	3.8	14	Maxillary first premolar	3	None	6	18
13	25	Steri-Oss	3.8	14	Mandibular first premolar	2	None	3	24
14	30	Steri-Oss	3.8	12	Mandibular second premolar	2	None	3	6
15	35	Alpha Bio	4	13	Mandibular first premolar	2	None	3	9
16	40	Alpha Bio	4	13	Mandibular first premolar	2	None	3	6
17	55	Alpha Bio	4	13	Mandibular canine	2	None	3	6
Mean	43.9		3.8	13.8				6.7	13

*All implants were HA-coated cylinders.
†According to Lekholm and Zarb.[24]

Table 2 Patient Characteristics for Implants Placed After a Healing Period

Patient	Age (y)	Implant data			Site	Bone quality†	Complications	Final restoration (mo)	Follow-up (mo)
		Type*	Diameter (mm)	Length (mm)					
1	35	Steri-Oss	3.8	14	Maxillary canine	2	None	6	6
2	30	Steri-Oss	3.8	12	Maxillary lateral incisor	2	None	6	24
3	45	Steri-Oss	3.8	14	Maxillary central incisor	2	None	6	24
4	18	Steri-Oss	3.8	16	Maxillary central incisor	2	None	6	24
5	55	Alpha Bio	4	16	Maxillary second premolar	4	None	8	18
6	60	Steri-Oss	3.8	14	Maxillary second premolar	4	None	8	16
7	63	Alpha Bio	4	16	Mandibular first premolar	2	None	3	12
8	58	Steri-Oss	3.8	14	Maxillary first premolar	3	None	6	12
9	33	Alpha Bio	4	13	Mandibular first premolar	2	None	3	12
Mean	44.1		3.87	14.4				5.8	16.4

*All implants were HA-coated cylinders.
†According to Lekholm and Zarb.

width, screw-type vs. cylinder, and microtexture); bone quality; and initial bone-implant contact. It was clear that use of the widest and longest implants was desirable; however, the question is, what is the minimum required? In the present study, the shortest implant used was 12 mm; its width was 3.8 mm. It cannot be concluded whether shorter implants can be immediately loaded as single-tooth replacements, but the use of implants that are at least 12 mm long and 3.8 mm wide results in a good opportunity for survival.

In the present study, cylindric HA-coated implants were used for immediate loading procedures. The advantages of HA include faster osseointegration, proportionally greater bone-implant contact, and greater reverse-torque resistance compared to non-coated implants.[22] In an animal study, immediate loading of HA-coated blade implants resulted in osseointegration, compared to fibrous union for titanium blade implants.[13] In another report, micromovement of 150 μm applied to initially unstable, HA-coated implants placed in the canine femoral

condyle resulted in bony integration, while fibrous union was observed with titanium implants.[23]

The advantages of this 1-stage procedure are obvious and include immediate function and esthetics. There is no need for a temporary denture. Second-stage surgery is eliminated and adjacent papillae are well preserved, contributing to the final esthetic result.

Until more data are gathered and published, the surgeon, the prosthodontist, and the patient must be aware of potential complications, and treatment alternatives should be thoroughly emphasized to the patient. Based on this patient population, it is suggested that the immediate loading method should be limited to healed sites. Further clinical and histologic studies are necessary to promote routine clinical application of this technique.

CONCLUSION

Within the limits of the present investigation, immediate loading of single-tooth implants placed in healed sites was a possible treatment alternative. Immediate loading of single-tooth implants placed in fresh extraction sites carried a failure risk approximating 20% in this patient population.

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