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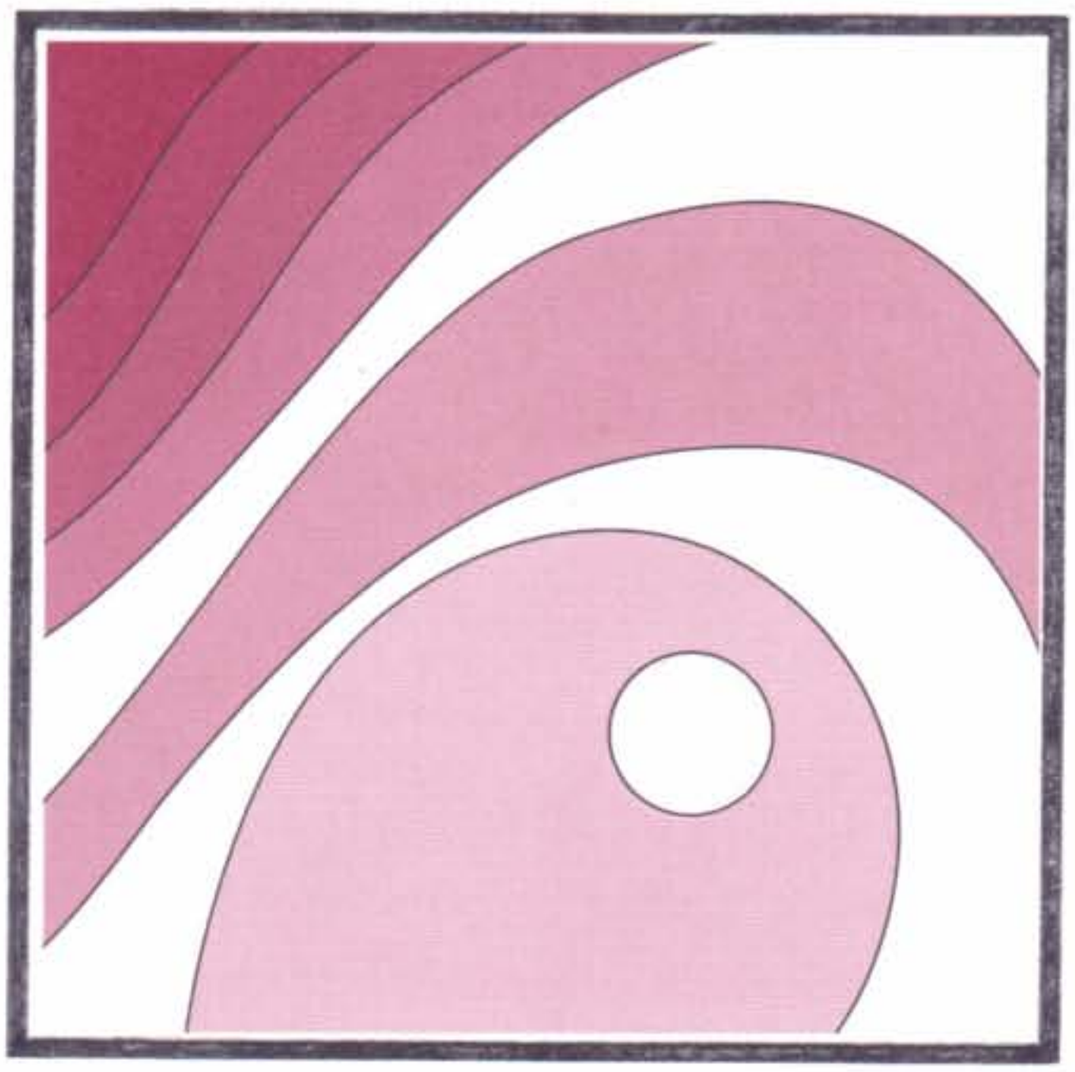

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Immediate Provisional Restoration of Postextraction Implants for Maxillary Single-Tooth Replacement

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The timing of implant placement and loading following tooth extraction has recently undergone substantial reconsideration. The authors tested a protocol of immediate loading of single implants placed at the time of tooth extraction in a consecutive case series. Thirty-three patients received a single implant-supported crown to replace a maxillary anterior tooth at the time of extraction. Regular recalls were planned for the following 4 years. One implant did not integrate, and another became unstable secondary to facial trauma. Overall patient satisfaction and clinical and radiographic parameters were good. (Int J Periodontics Restorative Dent 2006;26:371–377.)

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The clinical success of modern implant-supported prosthodontics has been attributed to strict adherence to the surgical and prosthetic protocols prescribed by Brånemark. One of the original requirements was a 3- to 6-month period after surgery that was free of loading, which could jeopardize implant osseointegration and lead to deposition of fibrous, scar-like tissue around the implant.[1] However, several recently published papers studying early and immediate loading protocols[2–10] have questioned this requirement. The paradigm "no load on implants during healing" has thus shifted to "no micromovements of implants."

Depending upon the presence or absence of occlusal contacts in intercuspal position, a distinction has been made between "immediate loading" and "immediate function."[6] The latter has been advocated for anterior teeth, where esthetic and phonetic function can be satisfactorily achieved without loading in the intercuspal position. It is important to note that the absence of contact points with the opposing dental arch is not a load-free situation.

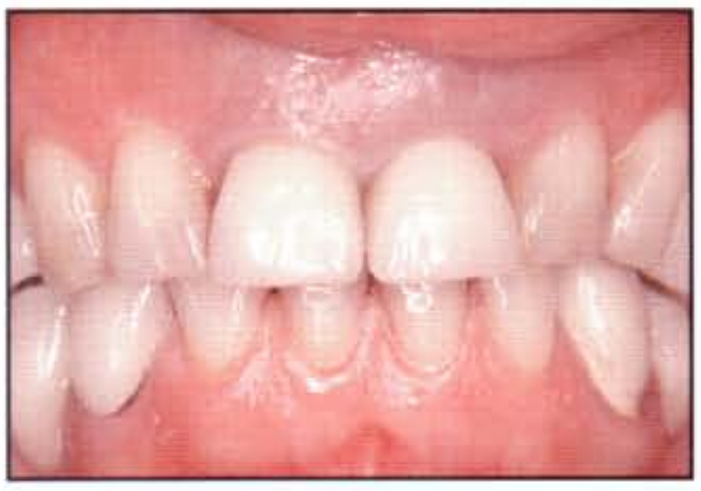


Fig 1 (left) *Initial clinical appearance. The patient experienced pain when pressure was applied to the maxillary left central incisor, but no swelling or clinical signs of inflammation were detectable.*

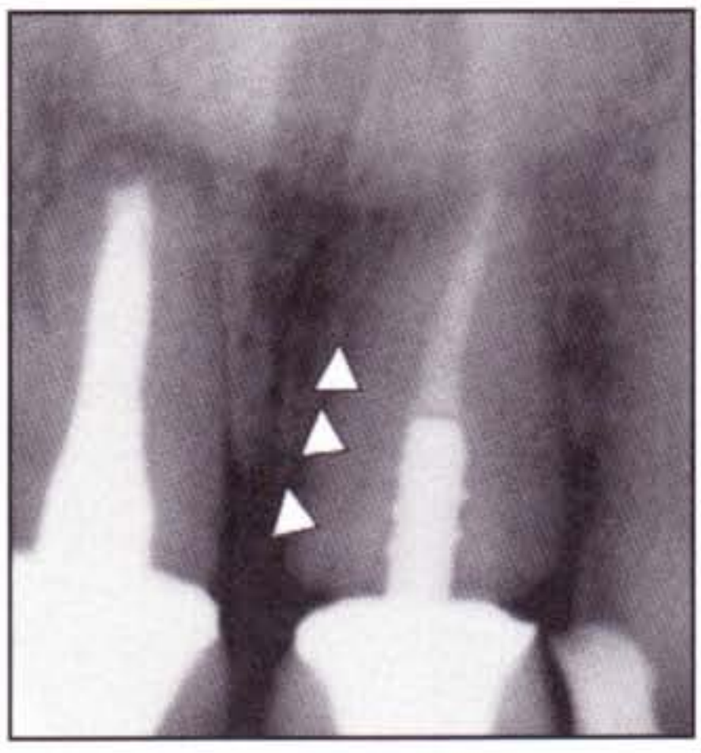


Fig 2 (right) *Periapical radiograph showing a visible vertical fracture of the root of the maxillary left central incisor* (arrowheads).

Another requisite of the original protocols of the 1980s was a 6-month time span between extraction and implant placement.[11] To minimize bone resorption after tooth loss and to reduce the number of surgeries, immediate postextraction placement of implants has been proposed and investigated.[12,13]

Combining these two "shortened" protocols might provide additional benefits. The present study investigated the clinical and radiographic outcome of maxillary single-tooth replacement using a crown supported by an implant placed at the time of tooth extraction, providing immediate esthetic and phonetic function.

Method and materials

The present study evaluated 33 consecutive patients (16 men and 17 women) ranging in age from 24 to 58 years who sought treatment for single-tooth replacement. Thirteen central incisors, nine lateral incisors, four canines, and seven first premolars were extracted; the reason for extraction was root fracture. Complete dental and medical histories were obtained, and comprehensive clinical and radiographic evaluations were performed. Patients had to fulfill the following inclusion criteria:

- Absence of chronic systemic diseases
- No smoking habit
- No significant bone loss, both at the extraction site and at adjacent teeth (cementoenamel junction–bone crest distance > 4 mm)
- At least 13 mm of bone ridge height
- At least 4 mm of residual bone beyond the apex of the root to be extracted
- Good primary stability of the placed implant
- Absence of parafunctional habits
- Absence of active periodontal disease

The participants signed an informed consent document approved by the local ethical committee.

Patients were asked to take amoxicillin (2 g 1 hour before surgery and 1 g twice a day after surgery during the following week); they were also asked to rinse with 0.2% chlorhexidine for 2 minutes before surgery and twice daily for 1 week after surgery. A nonsteroidal anti-inflammatory (650 mg naproxen sodium twice a day) was prescribed to all patients for 2 days after surgery.

An example of the procedure is shown in Figs 1 to 7. A careful circular fibrotomy was performed to extract the tooth with minimal trauma to the alveolar bone. Preparation of the bone site was done with drills of increasing diameter and/or condensing osteotomes, depending on bone quality and quantity. The buccal aspect of the extraction socket was not involved in site preparation, and implants were placed in a slightly more palatal position than the natural tooth.

The implant was at least 4 mm longer than the extraction socket, as measured by a 15-mm periodontal probe (UNC 15, Hu-Friedy). This cutoff was set arbitrarily to help achieve primary stability. The distance between the buccal gingival margin and the bone crest was carefully checked because it was considered crucial to the esthetic result. The head of the

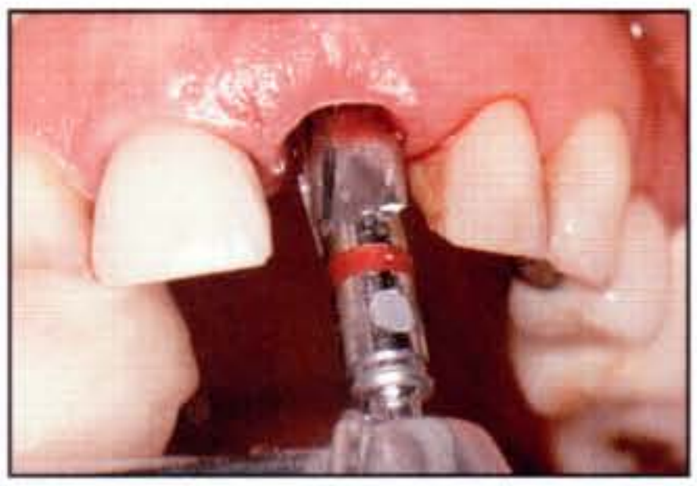


Fig 3a *The implant placement procedure. No incision was made in the soft tissues to ensure the best esthetic result; instead, the site was prepared with calibrated drills.*

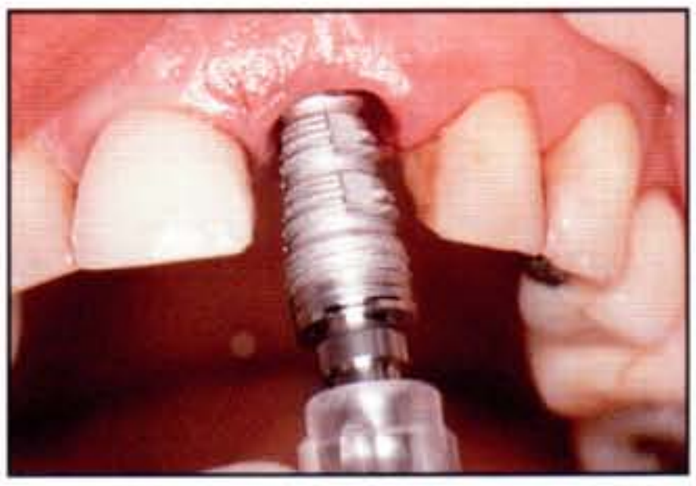


Fig 3b *The implant was carefully placed in the extraction socket. The length of the implant was chosen so that the head of the implant would be 2 to 3 mm apical to the gingival crestal edge.*

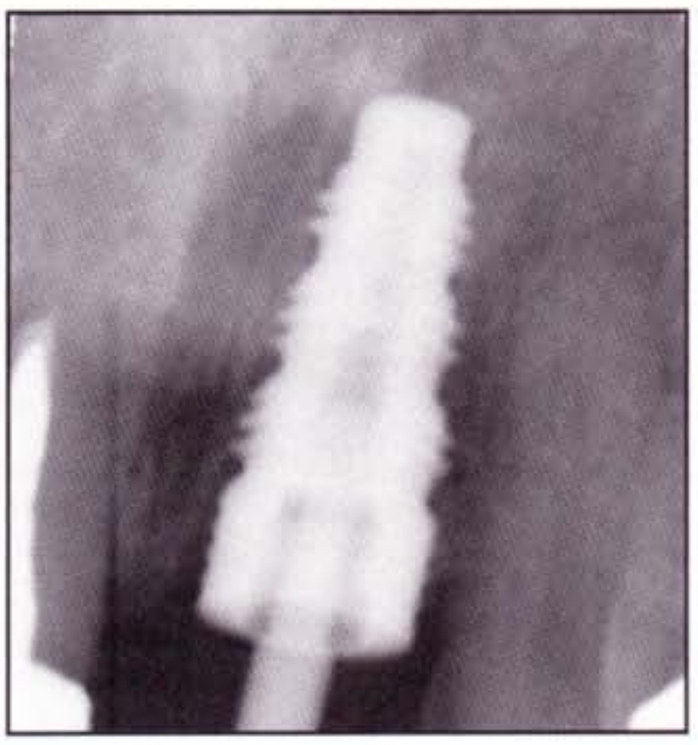


Fig 4 *Periapical radiograph showing perfect adaptation of the implant to the ad hoc prepared extraction socket.*

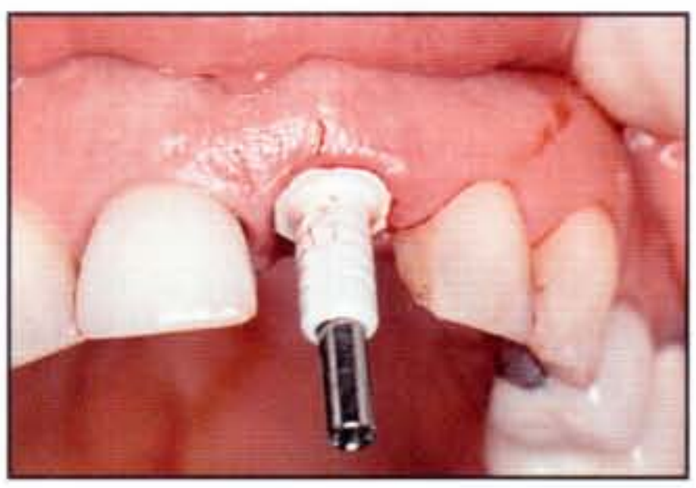


Fig 5a (left) *Provisional abutment placement.*

Fig 5b (right) *The abutment was adapted to support the provisional crown.*

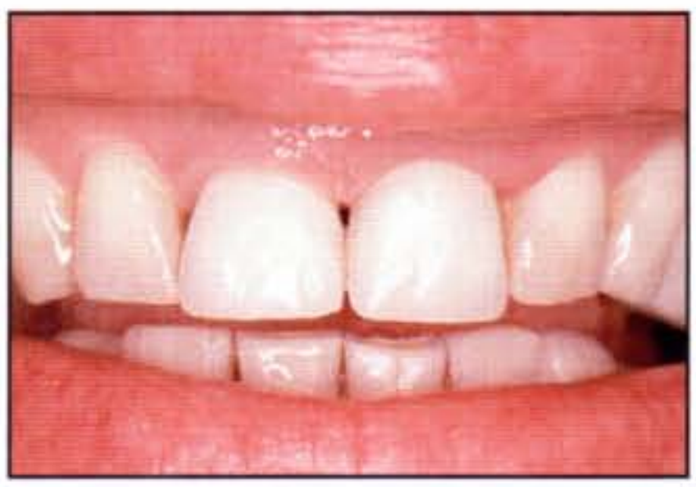
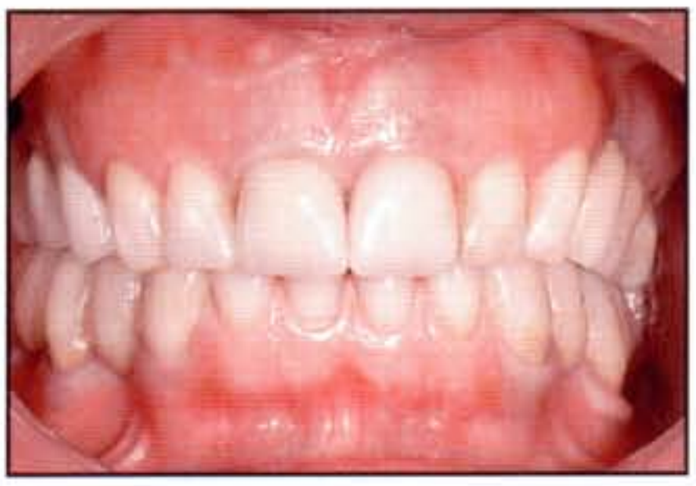


Fig 6 (left) *Six-month follow-up visit. The provisional crown was replaced with a porcelain-fused-to-metal crown. The maxillary left central incisor presented a 1-mm-wide recession in comparison to the right central incisor. No clinical signs of inflammation and no implant mobility were detectable.*

Fig 7 (right) *Four-year follow-up visit. A gingivoplasty by means of a diamond bur was performed on the right central incisor to achieve symmetry of the soft tissue contours on the central incisors.*



implant was placed 2 to 3 mm apical to the crestal edge, with 3 mm used when the gingival biotype was particularly thin. The implant diameter was chosen to minimize the gap between the extraction socket walls and the implant. When needed, small autogenous bone grafts (using drilling debris retrieved by an Osteotrap filter, Omnia) were also used to fill the residual gap between the implant and bone socket walls. The surgical procedure was completed by checking the mechanical stability of the implants.

A provisional abutment (Frialit II Protect, Friadent) was screwed into the implant. Its adaptation to the surrounding tissues was checked, and it was then removed and prepared by a dental technician. Its shoulder was carved to accurately follow the gingi-

val marginal anatomy. A provisional acrylic resin crown was finally prepared and adjusted to fit the abutment without overcontouring the gingival margin; finally, the provisional crown was luted with temporary cement. No contact between the provisional crown and the teeth of the opposing arch was allowed in the intercuspal position and during eccentric movements. The buccal and lingual soft tissue edges were sutured with polypropylene 6-0 (Perma Sharp, Hu-Friedy) to ensure maximum adaptation of soft tissues to the crown.

Care was taken to avoid any movement of the implant when screwing the abutment in and out and tapping the provisional crown. Patients were carefully informed of the risks of parafunctional habits, with further reminders provided via audiovisual media, and were instructed to avoid unnecessary load on the provisional crown. A soft diet was prescribed for 6 weeks, and the use of chewing gum was prohibited.

A follow-up visit was performed once a month during the following 6 months. After 6 months, impressions were made, and the provisional crown was replaced with a porcelain-fused-to-metal single crown, using a Frialit MH6 abutment (Friadent). A 3-month recall protocol was adopted for the next 4 years. At the 6-month follow-up visit, and then on a yearly basis, radiographs and photographs were obtained and compared to the previous ones to detect any changes in hard and soft tissue conditions. Patient satisfaction was recorded at each follow-up visit using a 10-point scale (0 = completely unsatisfactory result; 10 = complete satisfaction).

Results

The healing course after extraction and implant placement was generally uneventful. Minimal swelling was seen in four patients. Table 1 shows patients, sites, bone quality, implants, and follow-up characteristics. Six patients previously included in the study were treated according to the protocol, but the placed implants did not show primary stability, and the procedure was discontinued. Thus, they are not included in Table 1. Only 1 of the remaining 33 implants did not integrate and was unstable at the 2-month recall appointment; it was removed, and after 40 days of healing, another implant was successfully placed in the same site and immediately loaded. Another implant became unstable 47 days after placement as a consequence of facial trauma. It was removed and immediately replaced with another implant. All the other implants remained stable, with no probing depth increases found during follow-up visits and no apparent bone loss according to radiographs. All the implants appeared to be surrounded by bone after 6 months, and similar results were observed after 4 years of follow-up. The papillae, when present, were never lost, and the achieved esthetic results were highly satisfactory for the patients (mean score at the 4-year recall visit = 9.3 ± 0.65).

Table 1 Patient and implant characteristics and events

Patient (sex)	Age (y)	Implant diameter (mm)	Implant length (mm)	Site	Bone quality	Complications	Follow-up (mo)
1 (F)	38	4.5	13	Left lateral incisor	2	None	48
2 (F)	53	4.5	13	Right lateral incisor	2	Swelling	48
3 (M)	41	5.5	13	Left central incisor	3	None	52
4 (M)	56	5.5	13	Right central incisor	3	Failure	2
5 (M)	36	4.5	13	Right lateral incisor	2	None	46
6 (F)	24	4.5	13	Right central incisor	3	Swelling	46
7 (M)	49	4.5	15	Right lateral incisor	2	None	40
8 (M)	56	5.5	13	Left central incisor	3	None	48
9 (M)	42	5.5	15	Right central incisor	2	None	50
10 (F)	38	4.5	15	Right first premolar	3	None	34
11 (M)	32	5.5	13	Left central incisor	3	None	36
12 (F)	58	4.5	15	Right lateral incisor	2	None	28
13 (M)	39	5.5	15	Right central incisor	2	Swelling	34
14 (M)	45	4.5	13	Right first premolar	3	None	37
15 (M)	43	4.5	15	Left lateral incisor	2	None	34
16 (F)	38	4.5	13	Left first premolar	3	None	40
17 (F)	42	4.5	13	Right first premolar	2	None	31
18 (F)	42	5.5	15	Right central incisor	2	None	28
19 (M)	39	4.5	13	Right lateral incisor	2	None	24
20 (M)	35	4.5	15	Left lateral incisor	3	None	22
21 (F)	54	4.5	15	Right canine	3	None	21
22 (F)	48	5.5	13	Right first premolar	2	None	19
23 (F)	37	4.5	13	Left central incisor	2	Swelling	18
24 (F)	32	5.5	13	Right central incisor	2	None	18
25 (M)	35	4.5	15	Left canine	3	None	16
26 (F)	27	4.5	13	Left central incisor	2	Failure	2
26 (F)*	27	4.5	15	Left central incisor	2	None	14
27 (F)	57	3.8	13	Right lateral incisor	2	None	15
28 (M)	29	4.5	15	Left canine	3	None	14
29 (M)	51	4.5	15	Left central incisor	3	None	13
30 (F)	51	5.5	15	Right canine	3	None	13
31 (M)	33	4.5	13	Right first premolar	2	None	12
32 (F)	33	4.5	13	Right first premolar	3	None	12
33 (M)	42	4.5	13	Left central incisor	2	None	12

* Second attempt following failure.

Discussion

The implant-supported prosthesis represents one of the main achievements in the history of dental therapy. However, some aspects of the originally suggested protocols, ie, a stress-free healing period and the time span relative to tooth extraction, were based more on empirical observations than on scientific evidence, and they have been questioned recently.

The present study is a consecutive case series and thus suffers from a lack of random allocation of patients into treatment and control groups. Although they represent a low level of evidence, it has been acknowledged that case reports and case series often represent the first line of evidence.[14] Within the limits of this study design, therefore, a case series can be useful to preliminarily investigate a proposed treatment protocol.

Concerning immediate loading, a recent Cochrane review[15] of the literature found only two controlled, prospective trials suitable for inclusion, and both were studies of mandibular teeth. The authors concluded that, while it is conceptually possible to successfully load oral implants immediately after their placement in mandibles of adequate density and volume in carefully selected patients, it is still unknown how predictable this approach is; in fact, the reviewed studies showed strong differences, with success rates ranging from 80.3% to 100%.[6,15–23]

Moreover, to the best of our knowledge, very few studies[6,24] and no randomized controlled trials have dealt with immediate loading of single, immediate postextraction implants in the maxilla. It is thus reasonable to conclude that this procedure adds another risk factor that may affect implant failure rates in the maxilla, and therefore should be carefully evaluated and discussed with the patient in terms of potential risks and benefits.

After tooth extraction, bone undergoes a conspicuous, rapid resorption: on average, 23% of the bone mass is lost within the first 6 months following extraction, and another 11% is lost within the following 2 years.[7] This process is more evident in the maxilla. Implant placement immediately following tooth extraction maximizes the available bone,[23,25] facilitating prosthetically optimal implant placement. It also lowers the number and length of required appointments, thereby minimizing costs.

Elimination of a second-stage surgery (with obvious lower morbidity), the freedom of neighboring teeth from involvement in either removable or fixed provisional appliances, and the improved maintenance of soft tissue architecture[26] are the most important benefits of this single-stage procedure.[27,28] The results of this study show that the first two goals can be achieved and suggest that the latter is very plausible, with stable results at 4 years.

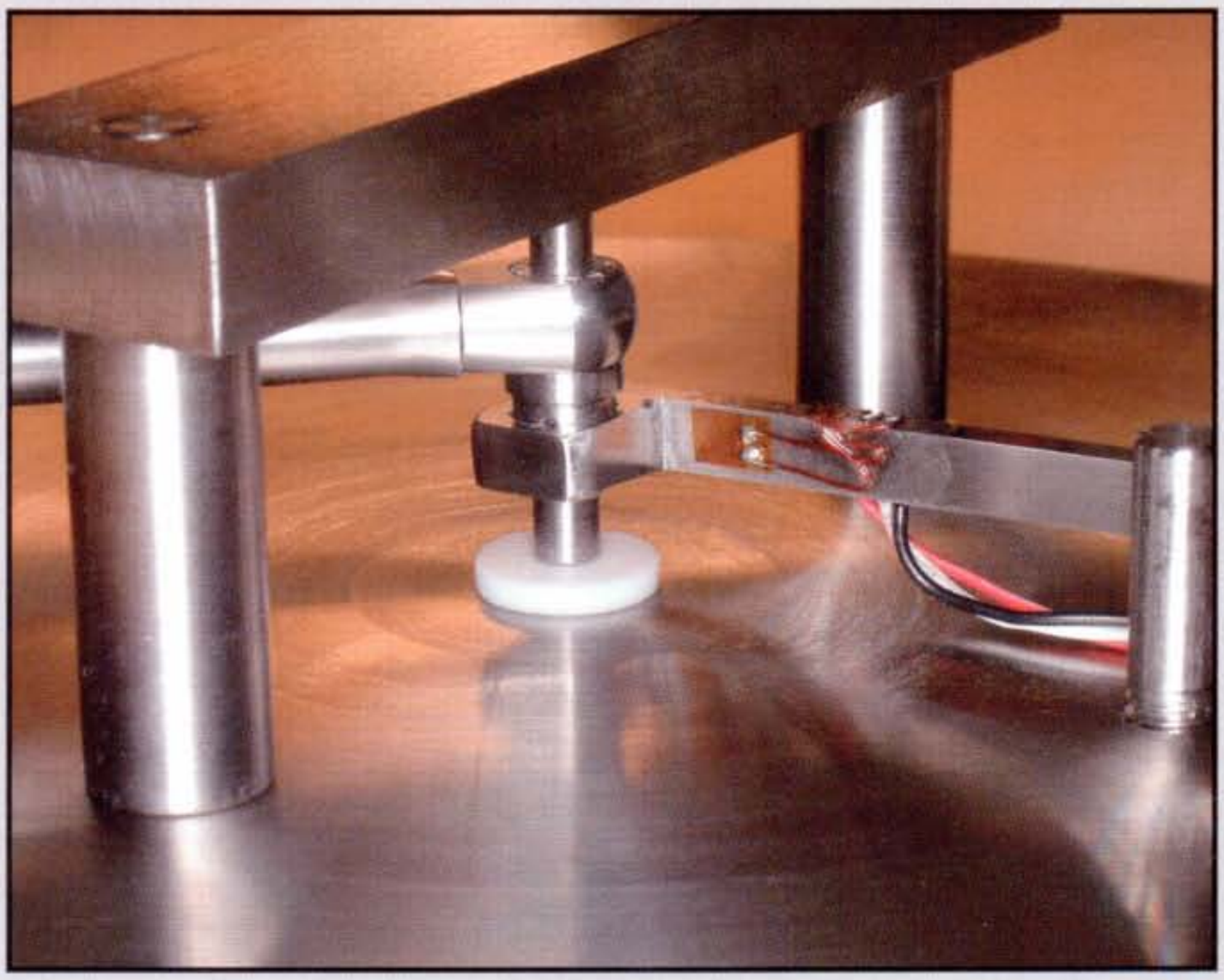
A debated issue is the assessment of primary stability of an implant that is placed in a fresh extraction socket. In this study, primary stability was assessed clinically. There are not yet sufficient data regarding validity, sensitivity, and specificity of other ad hoc instrumental devices.[28]

We could not find any apparent cause for one of the two implant failures; the other was directly involved in a facial trauma. The retrieved implant was thoroughly checked by the manufacturer for defects but was proven normal.

In three cases, the extracted fractured root showed clinical and radiographic signs of infection. This is usually considered a contraindication to the immediate postextraction placement of an implant.[27,29] The only change in the protocol for these sites was a careful curettage of the alveolar socket and rinsing with an antibiotic solution (rifampicin). No differences were observed during healing, and all three cases were completed successfully. However, an ad hoc prospective study should be designed before recommending this procedure in the presence of signs of infection, and the risks of failure in these cases should be carefully discussed with the patient.

Conclusions

In the present study, the esthetic and functional results of single anterior maxillary implants immediately placed postextraction and restored with provisional crowns were satisfactory, both from the patients' and clinicians' viewpoints. Nevertheless, this clinical report should be confirmed by randomized, prospective, controlled studies before the proposed surgical and prosthetic protocol is recommended for general use.



References

1. Sutherland S. Evidence-based dentistry: Part V. Critical appraisal of the dental literature: Papers about therapy. J Can Dent Assoc 2001;67:442–445.
2. Smidt A. Esthetic provisional replacement of a single anterior tooth during the implant healing phase. J Prosthet Dent 2002;87:598–602.
3. Mayer T, Hawley C, Gunsolley J, Feldman S. The single tooth implant: A viable alternative for single tooth replacement. J Periodontol 2002;73:687–693.
4. Levine R, Rose L, Salama H. Immediate loading of root-form implants: Two case reports 3 years after loading. Int J Periodontics Restorative Dent 1998;18: 333–343.
5. Romanos G, Toh C, Swaminatan D. Peri-implant bone reactions to immediately loaded implants. An experimental study in monkeys. J Periodontol 2001;72:506–511.
6. 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.
7. Carlsson G, Persson G. Morphologic changes of the mandible after extraction and wearing of dentures. Odontol Rev 1967;18:27–54.
8. Lazzara R, Testori T, Meltzer A, et al. Immediate occlusal loading (IOL) of dental implants: Predictable results through DIEM guidelines. Pract Proced Aesthet Dent 2004;16(4):3–15.
9. Cornelini R, Scarano A, Covani U, Petrone G, Piattelli A. Immediate one-stage postextraction implant: A human clinical and histologic case report. Int J Oral Maxillofac Implants 2000;15:432–437.
10. Ledermann P. Stegprothetische Versorgung des zahnlosen Unterkiefers mit Hilfe von plasmabeschichteten Titanschraubenimplantaten. Dtsch Zahnartzl Zeit 1979;34:907–911.
11. Adell R, Lekholm U, Rockler B, Brånemark P. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. Int J Oral Surg 1981;10:387–416.
12. Lazzara R. Immediate implant placement into extraction sites: Surgical and restorative advantages. Int J Periodontics Restorative Dent 1989;9:332–343.
13. Werbitt M, Goldberg P. The immediate implant: Bone preservation and bone regeneration. Int J Periodontics Restorative Dent 1992;12:206–217.
14. Jenicek M. Clinical Case Reporting in Evidence-Based Medicine. Oxford: Butterworth-Heinemann, 1999.
15. Esposito M, Worthington H, Coulthard P. Interventions for replacing missing teeth: Different times for loading dental implants. Cochrane Database Syst Rev 2003;(1): CD003878.
16. Cooper L, Felton D, Kugelberg C, et al. A multicenter 12-month evaluation of single-tooth implants restored 3 weeks after 1stage surgery. Int J Oral Maxillofac Implants 2001;16:182–192.
17. Glauser R, Ree A, Lundgren A, Gottlow J, Hammerle C, Scharer P. Immediate occlusal loading of Brånemark implants applied in various jawbone regions: A prospective, 1-year clinical study. Clin Implant Dent Relat Res 2001;3:204–213.
18. Glauser R, Ruhstaller P, Gottlow J, Sennerby L, Portmann M, Hammerle C. 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;5:47–56.
19. Ericsson I, Nilson H, Lindh T, Nilner K, Randow K. Immediate functional loading of Brånemark single tooth implants. An 18 months' clinical pilot follow-up study. Clin Oral Implants Res 2000;11:26–33.
20. Ericsson I, Randow K, Nilner K, Peterson A. Early functional loading of Brånemark dental implants: 5-year clinical follow-up study. Clin Implant Dent Relat Res 2000;2:70–77.
21. Malo P, Rangert B, Dvarsater L. Immediate function of Brånemark implants in the esthetic zone: A retrospective clinical study with 6 months to 4 years of follow-up. Clin Implant Dent Relat Res 2000;2:138–146.
22. Barone A, Covani U, Cornelini R, Gherlone E. Radiographic bone density around immediately loaded oral implants. Clin Oral Implants Res 2003;14:610–615.
23. Covani U, Crespi R, Cornelini R, Barone A. Immediate implants supporting single crown restoration: A 4-year prospective study. J Periodontol 2004;75:982–988.
24. Petrungaro P. Immediate implant placement and provisionalization in edentulous, extraction, and sinus graft sites. Compend Contin Educ Dent 2003;24(2):35–100.
25. 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.
26. 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.
27. Kinsel R, Lamb R. Development of gingival esthetics in the edentulous patient with immediately loaded single-stage, implant-supported fixed prostheses. Int J Oral Maxillofac Implants 2000;15:711–721.
28. Friberg B. On Bone Quality and Implant Stability [thesis]. Göteborg, Sweden: Univ of Göteborg, 1999.
29. Kupeyan H, May K. Implant and provisional crown placement: A one-stage protocol. Implant Dent 1998;7:213–219.