

IMMEDIATE LOADING OF BRÅNEMARK IMPLANTS IN EDENTULOUS MANDIBLES: A PRELIMINARY REPORT



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A study involving the immediate loading of Brånemark implants in the edentulous mandibles of 10 patients is reported. The design involved the immediate loading of four widely distributed implants with a transitional fixed implant-supported prosthesis at first-stage surgery, avoiding the need for a removable prosthesis. A sufficient number of additional implants are allowed to heal in the conventional manner to provide sufficient support for a definitive fixed prosthesis even if all of the immediately loaded implants fail. Preliminary results have been favorable, with all patients functioning with a fixed implant prosthesis from the day of first-stage surgery. (Implant Dent 1997;6:83-88)

The success of Brånemark implants in achieving osseointegration has been well documented clinically, radiographically, and histologically. Predictable results have been reported when clinicians adhere to the recommended protocol for placement and reconstruction.¹

Although the protocol for direct bone to implant contact was originally described by Brånemark et al^{2,3} using submerged implants, others have observed the same apposition of bone in nonsubmerged implant systems.^{4,5} Previous studies have demonstrated the clinical feasibility of early⁶⁻⁸ and immediate^{9,10} loading of Brånemark implants. Piattelli et al⁸ reported a tight contact of new bone to implant surfaces histologically and histomorphometrically in both loaded and unloaded nonsubmerged implants. A histologic pattern of lamellar, cortical bone thicker than that observed in unloaded implants was reported around the necks of early (30 days) loaded screw implants.¹¹

Edentulous patients treated with implants may wear an interim removable soft-lined complete denture during the healing period. To further protect the implants from premature loading, some clinicians recommend not wearing a denture at all, or at least not during the initial healing phase. The psychological effects of being without a denture may preclude some patients from seeking implant treatment and the transition from the natural dentition to edentulism may be difficult. Treatment may be delayed by

some patients to the point where bone loss could complicate or even contraindicate the placement of implants without complex grafting procedures.

Alternative procedures are necessary to provide certain patients with optional types of prostheses during the healing phase. Previous reports of immediate and early loading of implants with fixed and removable interim prostheses have been reported using different designs with varying results. The purpose of this study was to evaluate a surgical and prosthodontic technique for immediately loaded Brånemark implants that provides a fixed prosthesis from the day of first-stage surgery.

MATERIALS AND METHODS

Ten patients with an age range of 45 to 70 years (average, 55 years) participated in the study. Eight of the subjects had noncontributing past medical histories, one patient had hypertension, aortic aneurysm, and angina, and another had diabetes and arthritis. Previous dental conditions included nine patients with missing teeth, eight patients with moderate to advanced periodontal disease, one with a severe class II malocclusion, and one with failing overdenture abutments.

Natural teeth with a poor or hopeless prognosis were extracted and Brånemark implants (Nobelpharma USA, Inc., Westmont, IL) immediately placed in 9 of 10 mandibles. Four patients exhibited signs of a parafunctional habit (bruxism before or during treatment), and two patients were smokers. The inclusion criteria included healthy patients in need of a full arch mandibular implant reconstruction with adequate bone for placement of at least 7 mm long implants in the posterior mandible.

A total of 130 implants were placed, with a minimum of 10 implants in each patient's mandible (range, 10 to 15; average, 13), between December

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1993 and December 1994 (Table 1). Abutments were connected to four implants, two on each side of the arch, for each patient. The implants were spread out as far as possible, with unloaded implants anterior and posterior to each loaded implant (Fig. 1).

The implants with abutments were immediately loaded at first-stage surgery with acrylic fixed transitional implant-supported prostheses (conversion prostheses)¹² (Fig. 2). Radiographs were taken the day of implant placement, at 1-week intervals, and finally at 1-month intervals. Ninety implants were not immediately loaded and were allowed to heal in the conventional manner.

Sutures were removed 7 to 10 days after first-stage surgery, and a final plaster impression was made of the four loaded implants for fabrication of a master cast. A titanium framework (Procera; Nobelpharma USA, Inc., Westmont IL) was constructed on the master cast (Fig. 3).

The Procera framework replaced the acrylic conversion prosthesis (Fig. 4) approximately 6 weeks later. The remaining implants were uncovered 3 months after first-stage surgery (between March 1994 and April 1995). All implants were checked clinically for mobility. Osseous response and marginal bone loss was monitored using panoramic and periapical radiographs. Abutments were connected on all clinically immobile implants. The original conversion prosthesis was modified to include all of the remaining implants.

Immediately loaded implants with no mobility or pain and exhibiting radiographic evidence of integration were considered successful and preserved at the time of second-stage surgery along with the standard protocol implants. Immediately loaded implants that were clinically mobile, elicited pain or discomfort on pressure, or showed signs of radiographic failure (excessive bone loss or radiopacity surrounding the implant) were recorded as failures and removed before making the plaster final impression. When mobility was noted before second-stage surgery, the implant

was retained until uncovering if it did not appear to jeopardize any additional adjacent implants; otherwise, it was removed. The final mandibular metal reinforced acrylic implant prostheses were delivered approximately 6 weeks after second-stage surgery (between October 1994 and July 1995) (Figs. 5 and 6).

RESULTS

All 10 patients reached second-stage surgery and experienced a prosthesis survival rate of 100 percent; implant survival was less. Mobile implants in two patients were closely observed during the healing period to maintain survival of the provisional fixed prostheses. An implant was removed in two cases, resulting in a modified prosthesis with only three implants for support.

Immediately Loaded Implants

Thirty two of the 40 loaded implants were not mobile at second-stage surgery, for a survival rate of 80 percent. Five of the remaining eight implants were mobile before second-stage surgery, whereas three implants were mobile for the first time at second-stage surgery. Three of four immediately loaded implants failed in a patient with bruxism and a past medical history of diabetes and arthritis, and three additional immediately loaded implants failed in patients who also exhibited signs of bruxism; the two remaining implants failed in a patient who smoked. No relationship was observed between implant failure and size. All four loaded implants survived in 6 of 10 patients. One of these six patients was a smoker and another a bruxer. No additional immediately loaded implants failed after second-stage surgery.

Unloaded Implants

The survival rate of the unloaded implants at second-stage surgery was 98 percent (2 failures out of 90). Two additional unloaded implants failed after

Table 1. Overview of Study Participants

Patient	Bone Quality	Bone Quantity	Immediately Loaded Failures	Standard Protocol Failures	Additional Comments
1	2	B	0/4	1/10	Poor oral hygiene
2	2	C	0/4	0/9	Smoker
3	2 anterior 3 posterior	C	1/4	0/9	Bruxer
4	3 anterior 4 posterior	B	3/4	1/11	Arthritic, diabetic, bruxer
5	3	A	2/4	1/10	Bruxer
6	3	B anterior C posterior	0/4	0/11	
7	3 (17-19) 2 (21-32)	B	0/4	1/6	
8	3	B	2/4	0/8	Smoker
9	2	C	0/4	0/10	Bruxer
10	2	B anterior C posterior	0/4	0/6	

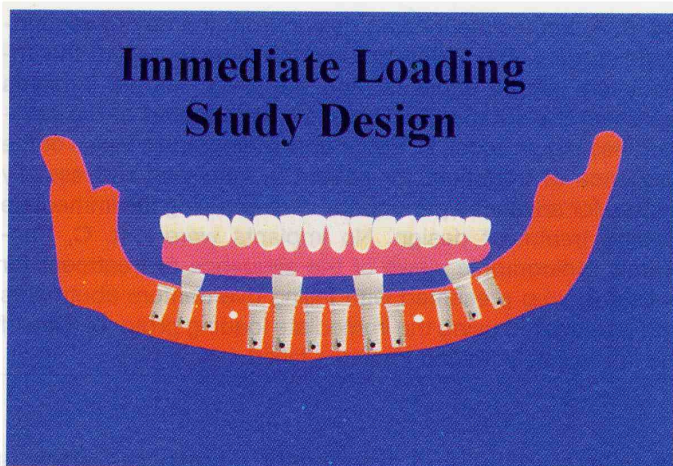


Fig. 1. Immediate loading study design used from the day of first-stage surgery to second-stage surgery involving four immediately loaded implants supporting a fixed prosthesis with the remaining implants submerged for healing in the conventional manner.

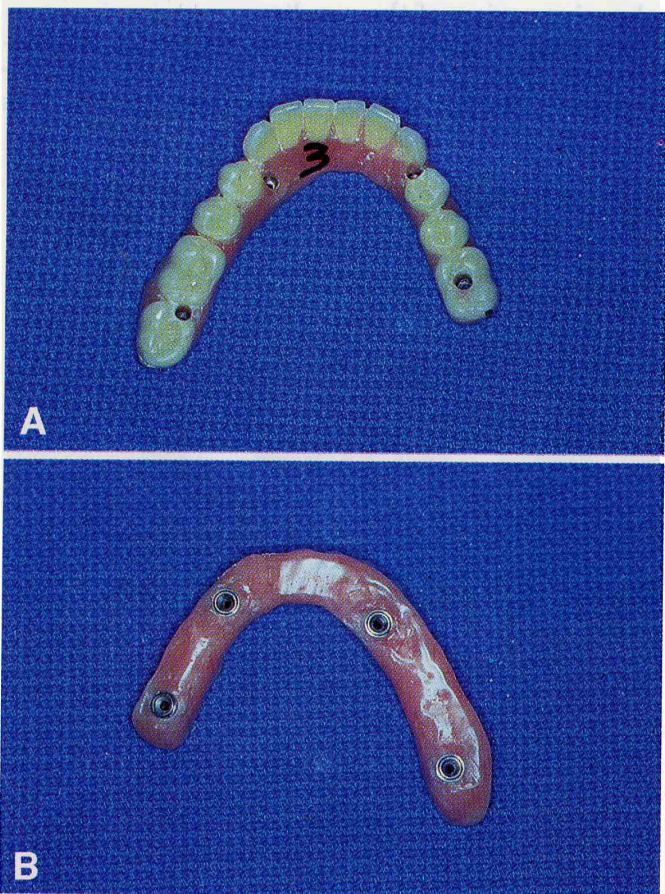


Fig. 2. All acrylic conversion prosthesis for use on the four immediately loaded implants. A, Occlusal view. B, Tissue view.

second-stage surgery, one at 4.5 months and one at 10 months, for a survival rate of 96 percent (4 failures out of 90) (Table 2). One implant exfoliated before second-stage surgery for no apparent reason, two implants had probable reasons for failure, and the re-

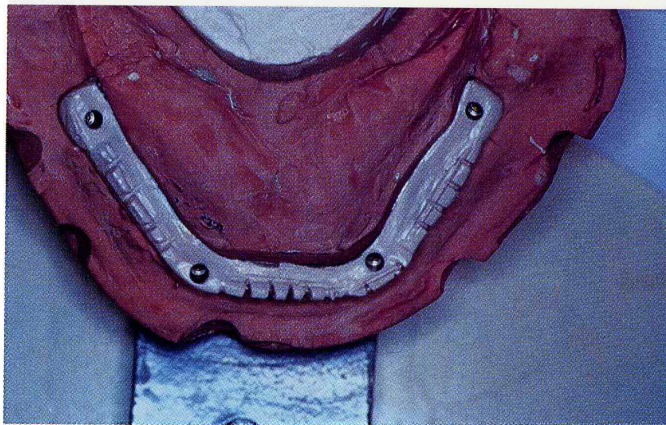


Fig. 3. Occlusal view of opaquet Procera framework designed for four implants.

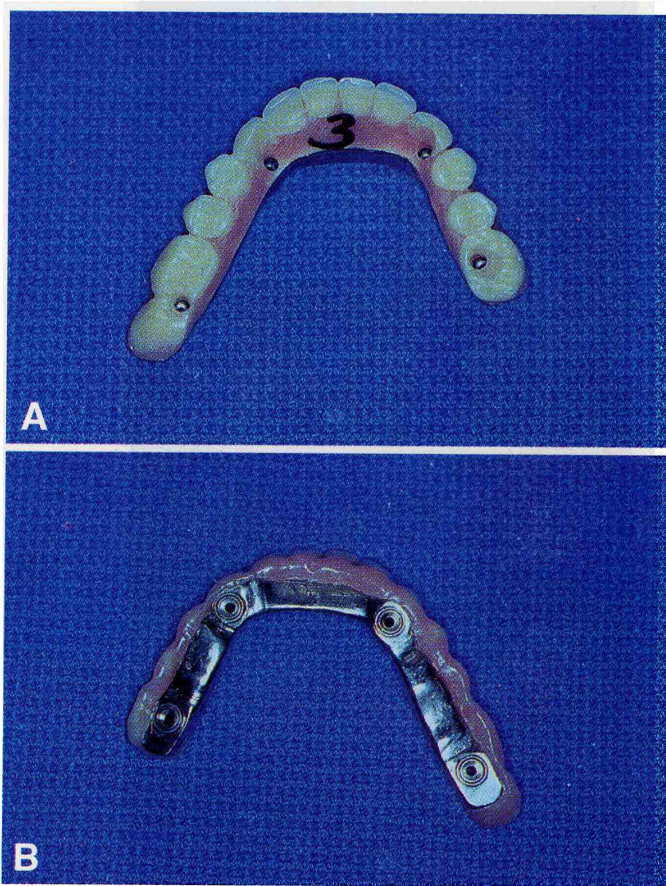


Fig. 4. Procera framework-supported transitional restoration for use on four immediately loaded implants. A, Occlusal view. B, Tissue view.

maining implant was in an immediate extraction site. Failures of immediately loaded and standard protocol implants in relationship to bone quality and quantity are listed in Table 3. An analysis of immediately loaded as compared with standard protocol implants in imme-

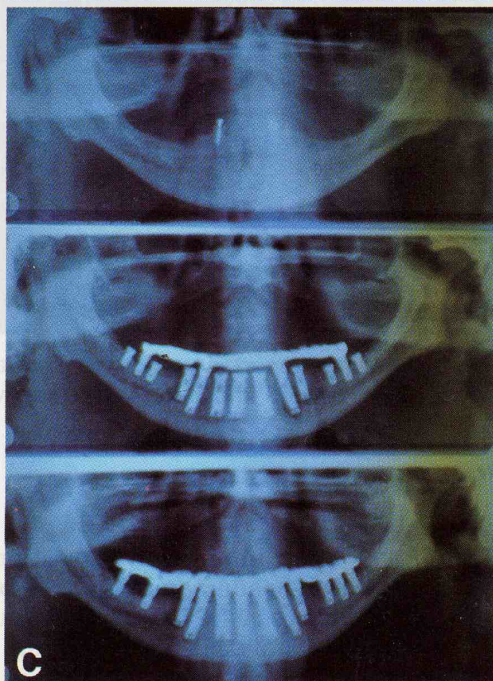
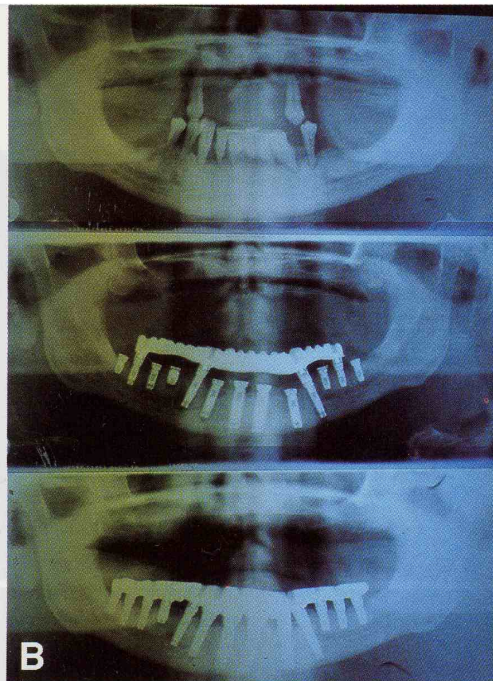
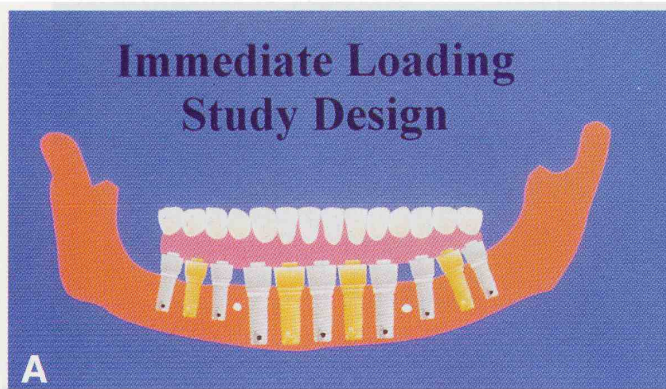


Fig. 5. A, Immediate loading design from the day of second-stage surgery. The yellow colored implants represent the immediately loaded implants, and the silver colored implants represent the submerged implants that adhered to the standard healing protocol. B, Panoramic radiographic views of the sequence of treatment for patient 2, who was successfully treated for advanced periodontal disease using the immediate loading treatment design. No implants were lost. C, Panoramic radiographic views of the sequence of treatment for patient 3, who presented with failing overdenture abutments and was treated using the immediate loading protocol. One of the immediately loaded implants failed.

mediate extraction and previously edentulous sites is presented in Table 4.

DISCUSSION

Because the data presented in this preliminary report are limited, a statistical analysis is not warranted. Preliminary conclusions are based on a comprehensive review of the results.

This study suggests that premature loading of dental implants will adversely affect the survival rate for integration (96 percent for the standard protocol as

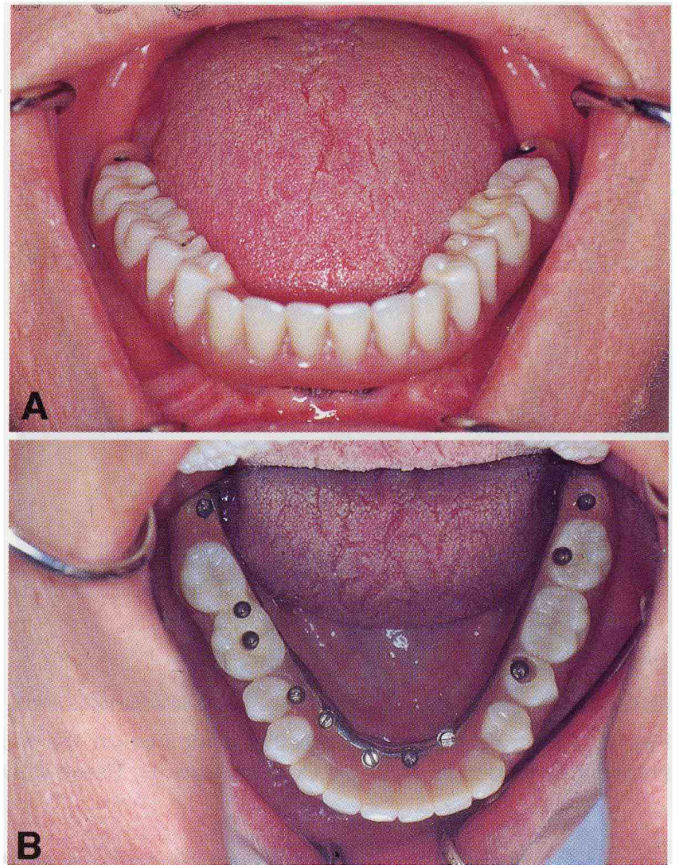


Fig. 6. Definitive mandibular fixed implant restoration consisting of a Procera titanium framework supporting acrylic denture teeth on the remaining 11 nonmobile implants. A, Facial view. B, Occlusal view.

Table 2. Implant Survival Rates (Percent)

	Immediately Loaded Implants	Standard Protocol Implants
Before second-stage surgery	95 (38 of 40 implants)*	99 (89 of 90 implants)
At second-stage surgery	80 (32 of 40 implants)	98 (88 of 90 implants)
After second-stage surgery	80 (32 of 40 implants)	96 (86 of 90 implants)

* Three additional implants with mobility were noted before second-stage surgery but were maintained.

Table 3. Bone Quality (Type) and Quantity (Shape) of Sites of Inserted and Lost Implants

Bone Quality (Type)	1	2	3	4
Immediately loaded implants inserted	0	18	20	2
Immediately loaded implants lost	0	0	6	2
Standard protocol implants inserted	0	39	43	8
Standard protocol implants lost	0	2	1	1
Bone Quantity (Shape)*	A	B	C	
Immediately loaded implants inserted	4	20	16	
Immediately loaded implants lost	2	5	1	
Standard protocol implants inserted	10	43	37	
Standard protocol implants lost	1	3	0	

* No implants were inserted in D or E bone.

Table 4. Survival Rates of Implants at Immediate Extraction Sites as Compared with Previously Edentulous Sites (Percent)

	Immediately Loaded Implants	Standard Protocol Implants
Immediate extraction sites	71 (12 of 17 implants)	98 (40 of 41 implants)
Edentulous sites	87 (20 of 23 implants)	94 (46 of 49 implants)

compared with 80 percent for the immediate loading protocol). The reduction in survival rate is encouraging because it is not prohibitive.

Use of a removable prosthesis between first- and second-stage surgery can be avoided by immediate insertion of an implant-supported fixed prosthesis. This procedure seems to be predictable in the mandible where bone quality is good and bone quantity permits the placement of at least 7 mm long implants posteriorly. The authors' results in a similar study with immediately loaded implants in the maxilla of four patients were not as favorable.

Sufficient implants must be placed and widely distributed to allow reconstruction of a fixed prosthesis should all of the prematurely loaded implants fail. This design eliminates the need for a second surgical procedure for implant placement.

Many variables make an analysis of the results difficult. Bone grafting with autogenous bone, freeze-dried laminar bone, Grafton (Musculoskeletal Transplant Foundation, Holmdel, NJ), and HTR (Biopant

Inc., New York, NY) and immediate extraction procedures were used for both loaded and unloaded implants. Implant length and width, bone quality and quantity, placement site, and opposing occlusion were recorded for all patients.

No relationship could be identified between implant failure and bone quantity, implant site, implant position, or opposing occlusion. Bone quality, however, seems to be an important factor in the success of immediately loaded implants: none were lost in type II bone.

Study patients included two who smoked, one with diabetes, and four with bruxism. Signs of bruxism were determined by repeated fractures of the all-acrylic fixed implant prostheses despite careful occlusal adjustments. Three of the four patients with bruxism had immediately loaded implant failures for a failure rate of 37 percent (6 of 16 implants). One of these patients also had diabetes, which may have been a contributing factor. For the same four patients, the standard protocol implants experienced fewer failures (2 of 40, for a 5 percent failure rate). It has been reported that bruxism reduces the success rate of implant therapy.¹³ Two of the four immediately loaded implants failed in one smoker, and none failed in the other smoker. Although better results may have occurred if bruxers and smokers were screened from the investigation, study patients would then not have been representative of the normal patient pool.

One patient underwent restoration with a gold framework instead of a Procra titanium framework, a variable that should have little effect on the results. The length of time a patient is in a particular stage of treatment is a variable that occurs in the normal patient population.

When an immediately loaded implant failed, it was usually apparent before second-stage surgery (five of eight failed implants were mobile before uncovering). Initial signs of failure were sensitivity to pressure, which was noted as early as 1 week after placement (three cases), and/or mobility of the implant.

The four-implant design used in this study seems to be effective. Length, width, and location may be important factors for the survival of immediately loaded implants. This was not shown to be a factor, perhaps because of the limited number of cases.

Screw-type implants seem to be good for achieving primary stability. Screw-type implants that achieve bicortical stabilization and are placed in good quality bone should prove to be predictable. If primary stability is obtained, limited micromotion should occur between the surface of the immediately loaded implant and bone. Primary implant stability is necessary to prevent the formation of a fibrous interface and subsequent implant failure. Integration may be possible in immediately loaded implants in immediate extraction sites if good primary stability is achieved. The 71 percent survival rate of immediately loaded implants in immediate extraction sites achieved to date is most encouraging.

Patient compliance may be an important contributing factor for success. Patients who adhere to a soft

diet and avoid excessive masticatory force should have more favorable results. Parafunctional habits such as bruxism or clenching may be destructive and should be considered a contraindication for this technique.

The use of a fixed implant-supported prosthesis during the healing phase may provide an additional benefit to the unloaded implants in that the prosthesis forms a protective shield over the soft tissue area and direct implant contact is avoided.

Disadvantages of this technique include increased cost and chair time. The increase in cost is not excessive and may be of little consideration for patients who will not use a removable prosthesis. One study patient functioned with the acrylic conversion prosthesis for the entire 3-month healing period, and all four immediately loaded implants survived. Perhaps the metal-reinforced framework is an unnecessary step and the acrylic conversion prosthesis is rigid enough for patients with immediately loaded implants. A laboratory study comparing all acrylic prostheses with metal-supported acrylic prostheses found little difference in mechanical stiffness between the two types.¹⁴ The only additional cost may be for the four immediately loaded implants, which in this preliminary study experienced an 80 percent survival rate.

The additional chair time may not be a major factor. Although the first-stage surgery appointment is longer, the second-stage visit is slightly shorter. Patients must determine the value of the procedure on an individual basis. Some individuals may only proceed with implant treatment if there is no interim removable prosthesis involved. Although this procedure may not be indicated for all patients or situations, it does provide an option for consideration.

Although clinical immobility of prematurely loaded implants does not imply immediate osseointegration, implant stability after 12 to 18 months of functional loading with negligible osseous changes in this study suggests the probability of long-term success. Periapical and panoramic radiographs, mobility, pain, and infection will be evaluated at 1-year intervals for the next 5 years to determine the success of the immediately loaded implants. Further research using a larger patient base and followed over a longer time period is necessary to validate this treatment modality for use in clinical dentistry.

CONCLUSION

Results of this preliminary report suggest that Brånemark implants can support an immediate fixed implant-supported prosthesis at the time of first-stage surgery without adversely affecting the overall long-term treatment plan. The mandibular arches of 10 patients were successfully restored with osseointegrated implant-supported prostheses that eliminated the need for interim removable prostheses.

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