

Immediate Loading of 2 Interforaminal Dental Implants Supporting an Overdenture: Clinical and Radiographic Results After 24 Months

Andres Stricker, MD, DDS¹/Ralf Gutwald, MD, DDS²/Rainer Schmelzeisen, MD, DDS, PhD³/
Nils G. Gellrich, DDS, MD, PhD²

Purpose: In this study, preliminary results of immediate loading of ITI sandblasted, large-grit, acid-etched (SLA) implants with a bar-connected overdenture in the edentulous mandible are presented. **Materials and Methods:** Ten edentulous patients between 48 and 74 years old were included in this study. All patients received 2 SLA-surfaced ITI solid-screw dental implants in the interforaminal region, which were loaded with a bar connector and an overdenture 1 day after implant placement. Marginal bone resorption was evaluated using periapical radiographs. Gingival health (ie, Bleeding Index) and patient satisfaction (measured using a visual analog scale) were evaluated. Follow-up time was 24 to 36 months (mean time 29.8 months) after implant loading. **Results:** Twenty-four months after placement, none of the 20 implants had failed. Marginal bone resorption around all implants after 12 months averaged 0.71 mm, and 92% of the sites had a Bleeding Index of 0. Between 12 and 24 months, average bone resorption was an additional 0.08 mm. All patients demonstrated an improved quality of life. **Discussion:** The amount of bone resorption was comparable to amounts reported in studies with standard loading times. The low rate of inflammation of the peri-implant soft tissue and the high level of patient satisfaction in this study demonstrate encouraging short-term results. **Conclusion:** The results suggest that immediate loading of 2 dental implants can be successful and further support the use of a rough implant surface in residual bone. INT J ORAL MAXILLOFAC IMPLANTS 2004;19:868–872

Key words: edentulous mandible, endosseous implants, immediate loading, oral rehabilitation

The use of 2 or 4 dental implants with delayed loading for oral rehabilitation of the edentulous mandible has become routine.^{1–3} After loss of teeth, bone resorption, especially in the edentulous anterior mandible, leads to inadequate retention and stability of the conventional complete denture. Different treatment options, such as vestibuloplasties or augmentation of the alveolar ridge, have proven to be inferior to implant therapy.⁴ The use of nonsubmerged implants has been well documented.^{5–10}

The average recommended time between the placement and functional loading of dental implants in the mandible has been 12 weeks.¹¹ Recent studies have recommended a healing time of 6 weeks.^{12,13}

Immediate loading of dental implants was first proposed by Ledermann in 1979, when 4 titanium plasma-sprayed surfaced dental implants (Straumann, Waldenburg, Switzerland) were placed in the interforaminal area and loaded immediately with a bar-supported overdenture.¹⁴ Data from 20 years of clinical experience indicated the predictability of the procedure.¹⁵ A number of studies have concluded that overall implant success had not been adversely affected by immediate loading.^{16–18}

In 1 study, edentulous patients whose Brånemark System implants (Nobel Biocare, Göteborg, Sweden) were loaded early (ie, within 20 days of placement) showed no implant losses after 18 months. Bone resorption was higher in the immediate-loading group than in the control group, patients whose implants were loaded after 4 months.¹⁹ Introducing the concept of rigid connection of 3 immediately loaded implants, Brånemark and coworkers²⁰

¹Assistant Professor, Department of Oral and Maxillofacial Surgery, University Hospital of Freiburg, Germany.

²Associate Professor, Department of Oral and Maxillofacial Surgery, University Hospital of Freiburg, Germany.

³Head, Department of Oral and Maxillofacial Surgery, University Hospital of Freiburg, Germany.

Correspondence to: Dr Dr Andres Stricker, Department of Oral and Maxillofacial Surgery, University Hospital of Freiburg, Hugstetter Strasse 55, D-79106 Freiburg, Germany. E-mail: Stricker@ZMK2.ukl.uni-freiburg.de



Fig 1 Clinical perspective after implant placement.



Fig 2 Seating of the bar 1 day after implant placement.

reported a survival rate of 98% after up to 3 years of loading. The purpose of this prospective study was to evaluate the clinical outcome of immediate loading of 2 ITI (Straumann) bar-connected dental implants used to support an overdenture in the edentulous mandible.

MATERIALS AND METHODS

A total of 20 sandblasted, large-grit, acid-etched (SLA)-surfaced ITI dental implants were placed in 10 patients with an average age of 66 years (range 48 to 74 years). The study sample consisted of 9 female patients and 1 male patient. All patients fulfilling the inclusion criteria were judged to be healthy, with no systemic disorders. Patients suffering from heart disease, systemic disorders, drug abuse, or mental illness were excluded from the study. Preoperative clinical and radiographic examinations were performed, and patients were informed precisely of the risks of the procedure.

Preoperative examination included a panoramic radiograph taken with a positioning guide demonstrating the proposed implant position. Implant placement was performed through a mediocrestal flap of limited size with 2 releasing incisions in the middle of the keratinized tissue on the alveolar ridge crest. After the mucoperiosteal flap was reflected, the mental nerve was identified and protected during the operation.

All implants were placed according to the manufacturer's instructions using a surgical template. After pretapping and implant placement, clinical evaluation of primary stability was performed. Implants had a diameter of 4.1 mm and a length of 10 or 12 mm depending on the remaining ridge bone height. After the implants were connected with a sterilized impression coping (Fig 1), wound closure was performed with a resorbable material (Monocryl 4-0, Ethicon, Somerville, NJ). The sur-



Fig 3 The same bar 2 years after implant placement.

gical template was widened in the area of the placed implants and then positioned on the alveolar crest. Thereafter, impression copings were connected with a polymer (GC Pattern, GC Corporation, Tokyo, Japan). After the impression was made, 2 healing caps 4.5 mm in height were screwed on top of the implants. A panoramic radiograph was taken postoperatively. An analgesic (paracetamol) and rinsing irrigation (chlorhexidine) were administered. One day after implant surgery, the laser-welded bar was placed on top of the implants and tightened with 35 Ncm torque (Fig 2). To verify the superstructure fit, a panoramic radiograph was taken.

A relin impression was made to fix the bar connection to the denture. After 7 days, while removing the sutures, the newly polymerized denture was seated on the bar. Patients were advised to maintain a soft diet with the implant-supported denture for 6 weeks. Clinical and radiographic follow-up examinations were performed every 2 weeks for the first 3 months and every 4 weeks thereafter. After 6 months, the interval between follow-ups was lengthened to 8 weeks, and after 1 year, to 3 months (Fig 3).

Four sites on each implant were evaluated using the Bleeding Index (BI) of Muehleman and Son²¹

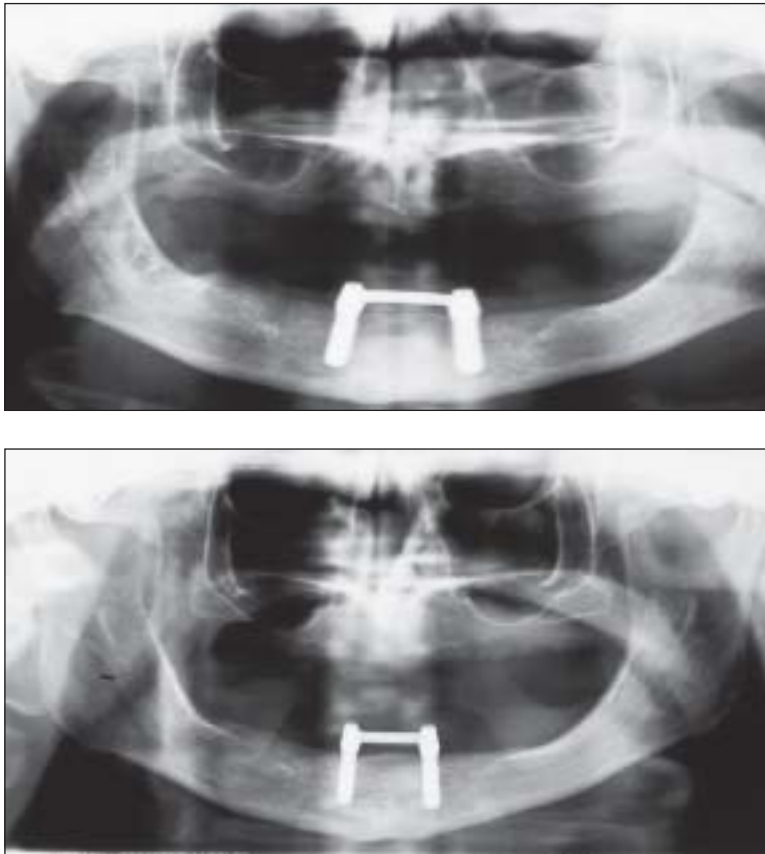


Fig 4 Panoramic radiographs of the patient demonstrating bone resorption after 24 months. (Above) Radiograph taken at baseline. (Below) Radiograph taken at 24 months.

and periapical radiographs were taken at each follow-up investigation. Patient satisfaction with the implant treatment was recorded after 1 year using a visual analog scale (VAS) from 1 (very bad) to 10 (excellent). All surgical procedures and follow-up recordings were done by the same surgeon. Radiographs were evaluated on the mesial and distal aspect of each implant with magnification glasses by a dental radiologist.

Evaluation of success was based on the factors established by Albrektsson and associates.²² For statistical evaluation, the rate of bone resorption over time was calculated for each implant by means of a saturation function curve.

Statistical evaluation of implant success by life table analysis was not performed because of the success rate was 100%.

RESULTS

All implants appeared to be osseointegrated during loading, and no implant was lost during the follow-

up period. Implants were followed for an average of 29.8 months (24 to 36 months) (Fig 4).

After 1 year of loading, marginal peri-implant bone resorption ranged from 0.1 to 1.1 mm (mean 0.71 mm, SD 0.67). After 2 years, average additional bone resorption was 0.08 mm for 9 patients (mean 0.79 mm, SD 0.66) (Fig 5).

BI was 0 in 92% of all measured sites and 1 in 8% after a year; it was the same after 2 years (Fig 6). At that time there were no BI scores of 3 or 4.

Between the 6th and the 12th week after implant loading, 1 patient developed gingival inflammation related to poor oral hygiene. After wound revision, administration of antibiotics (1.2 mega-units of penicillin V for 3 days), and additional oral hygiene instruction, the patient's Gingival Index score increased from 3 to 1.

For improved fit of the denture, relining was performed in 3 patients after 6 months. The denture of 1 patient was fractured and was repaired.

After 1 year, 8 patients rated their satisfaction as a 10 on the VAS (Fig 7). After 2 years, all patients stated they would undergo the same treatment again.

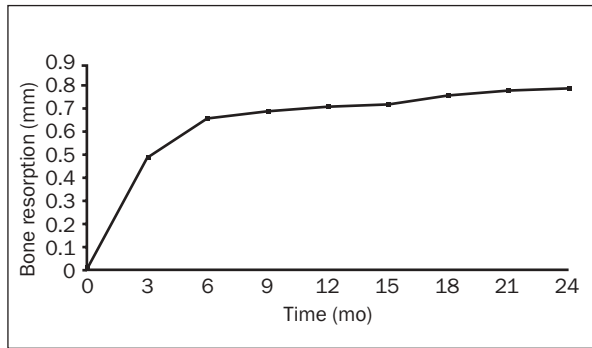


Fig 5 Mean bone resorption (mm), as determined by measuring single-tooth radiographs.

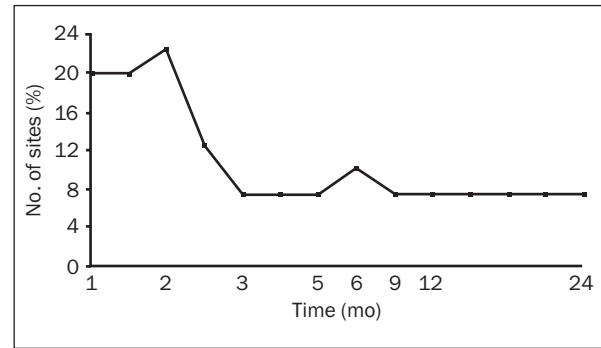


Fig 6 Evaluation of bleeding on probing.

DISCUSSION

The purpose of the present study was to evaluate the outcome of immediate loading of 2 SLA-surfaced bar-connected ITI implants supporting an overdenture for treatment of the edentulous mandible. Several other studies have demonstrated that implant placement can lead to significant improvements in patient life quality, including better function, speech, and comfort.^{23,24}

Studies have demonstrated the reliability of interforaminal implant placement with a time interval between implant placement and loading of 6 to 12 weeks in the mandible.^{5,12} The immediate loading of 4 implants in the interforaminal area has been described.¹⁴

A recent study by Brånemark and coworkers of implants immediately loaded with a fixed prosthesis demonstrated a success rate of 98% after 1 year of loading.²⁰ These studies^{12,14,20} demonstrated successful loading of implants with a quadrangular or triangular implant distribution. In the present study, implant survival in 10 patients with immediate loading of 2 interforaminal implants for up to 36 months was 100%.

Marginal bone resorption was evaluated using periapical radiographs at intervals between 2 weeks and 3 months. Panoramic radiographs were obtained on the day of loading and at the 1- and 2-year follow-up examinations.²⁵ The amount of bone resorption was comparable with the data reported for other studies.^{2,3,12,19} The BI score indicated a lack of inflammatory reaction in 92% of sites probed. The VAS scores demonstrated a high level of patient satisfaction. This study demonstrated that immediate loading of 2 SLA-surfaced implants in the interforaminal area of the edentulous mandible can lead to short-term results comparable to those

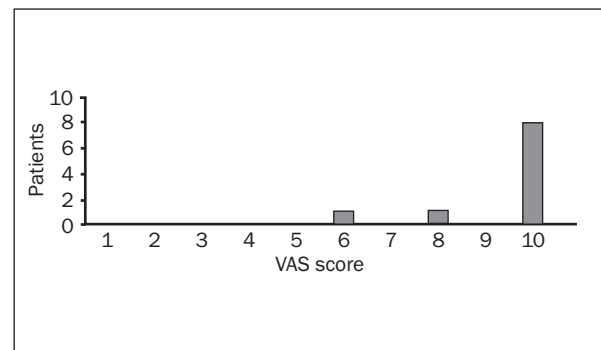


Fig 7 Evaluation of patient satisfaction using a VAS from 1 (very bad) to 10 (excellent).

achieved with immediate loading of 4 interforaminal implants or late loading of 2 implants in the interforaminal area.^{15,26,27}

CONCLUSION

This clinical investigation demonstrated that the immediate loading of 2 bar-splinted solid screw SLA-surfaced dental implants can be successful in the interforaminal area of an edentulous mandible.

ACKNOWLEDGMENT

The authors are grateful to Professor Schulte Monting, Institute of Medical Biometry, University of Freiburg, for his statistical assistance with this report.

REFERENCES

1. Henry P, Rosenberg I. Single-stage surgery for rehabilitation of the edentulous mandible: Preliminary results. *Pract Periodontics Aesthet Dent* 1994;6:15–22.
2. Buser D, Weber HP, Bragger U, Balsiger C. Tissue integration of one-stage ITI implants: 3-year results of a longitudinal study with hollow-cylinder and hollow-screw implants. *Int J Oral Maxillofac Implants* 1991;6:405–412.
3. Roynesdal AK, Ambjornsen E, Stovne S, Haanaes HR. A comparative clinical study of three different endosseous implants in edentulous mandibles. *Int J Oral Maxillofac Implants* 1998;13:500–505.
4. Burns DR, Unger JW, Elswick RK Jr, Beck DA. Prospective clinical evaluation of mandibular implant overdentures: Part 1—Retention, stability, and tissue response. *J Prosthet Dent* 1995;73:354–363.
5. Roynesdal AK, Ambjornsen E, Haanaes HR. A comparison of 3 different endosseous nonsubmerged implants in edentulous mandibles: A clinical report. *Int J Oral Maxillofac Implants* 1999;14:543–548.
6. Wismeijer D, Van Waas MA, Vermeeren JI, Mulder J, Kalk W. Patient satisfaction with implant-supported mandibular overdentures. A comparison of three treatment strategies with ITI dental implants. *Int J Oral Maxillofac Surg* 1997; 21:263–267.
7. Deporter DA, Watson PA, Booker D. Simplifying the treatment of edentulism: A new type of implant. *J Am Dent Assoc* 1996;127:1343–1349.
8. Piattelli A, Emanuelli M, Scarano A, Trisi P. A histologic study of nonsubmerged titanium plasma-sprayed screw implants retrieved from a patient: A case report. *Int J Periodontics Restorative Dent* 1996;16:138–147.
9. Ericsson I, Randow K, Glantz PO, Lindhe J, Nilner K. Clinical and radiographical features of submerged and non-submerged titanium implants. *Clin Oral Implants Res* 1994; 5:185–189.
10. Hellem S, Karlsson U, Almfeldt I, Brunell G, Hamp SE, Astrand P. Nonsubmerged implants in the treatment of the edentulous lower jaw: A 5-year prospective longitudinal study of ITI hollow screws. *Clin Implant Dent Relat Res* 2001;3:20–29.
11. Adell R, Lekholm U, Brånemark P-I. Surgical procedures. In: Brånemark P-I, Zarb GA, Albrektsson T (eds). *Tissue-Integrated Prostheses: Osseointegration in Clinical Dentistry*. Chicago: Quintessence, 1985:211–240.
12. Buser D, von Arx T, ten Bruggenkate C, Weingart D. Basic surgical principles with ITI implants. *Clin Oral Implants Res* 2000;11(suppl 1):59–68.
13. Bornstein MM, Lussi A, Schmid B, Belsler UC, Buser D. Early loading of nonsubmerged titanium implants with a sandblasted and acid-etched (SAL) surface: 3-year results of a prospective study in partially edentulous patients. *Int J Oral Maxillofac Implants* 2003;18:659–666.
14. Ledermann PD. Die Stegprothetische Versorgung des zahnlosen Unterkiefers mit Hilfe von Plasmabeschichteten Titanschraubenimplantaten. *Dtsch Zahnarztl Z* 1979;34: 907–908.
15. Ledermann PD. Über 20 jährige Erfahrung mit der sofortigen funktionellen Belastung von Implantatstegen in der Regio interforaminalis. *Z Zahnarztl Implantol* 1996;12:123–136.
16. Gatti C, Haefliger W, Chiapasco M. Implant-retained mandibular overdentures with immediate loading: A prospective study of ITI implants. *Int J Oral Maxillofac Implants* 2000;15:383–388.
17. Chiapasco M, Gatti C, Rossi E, Haefliger W, Markwalder TH. Implant-retained mandibular overdentures with immediate loading. A retrospective multicenter study on 226 consecutive cases. *Clin Oral Implants Res* 1997;8:48–57.
18. Schmitman PA, Wohrle PS, Rubenstein JE, DaSilva JD, Wang NH. Ten-year results for Brånemark implants immediately loaded with fixed prostheses at implant placement. *Int J Oral Maxillofac Implants* 1997;12:495–503.
19. Randow K, Ericsson I, Nilner K, Petersson A, Glantz PO. Immediate functional loading of Brånemark dental implants. An 18-month clinical follow-up study. *Clin Oral Implants Res* 1999;10:8–15.
20. Brånemark P-I, Engstrand P, Ohnell LO, et al. Brånemark Novum: A new treatment concept for rehabilitation of the edentulous mandible. Preliminary results from a prospective clinical follow-up study. *Clin Implant Dent Relat Res* 1999; 1:2–16.
21. Muehleemann HR, Son S. Gingival sulcus bleeding—A leading symptom in initial gingivitis. *Helv Odontol Acta* 1971; 15:107–113.
22. Albrektsson T, Zarb G, Worthington P, Eriksson AR. The long-term efficacy of currently used dental implants: A review and proposed criteria of success. *Int J Oral Maxillofac Implants* 1986;1:11–25.
23. Meijer HJ, Raghoebar GM, Van 't Hof MA. Comparison of implant-retained mandibular overdentures and conventional complete dentures: A 10-year prospective study of clinical aspects and patient satisfaction. *Int J Oral Maxillofac Implants* 2003;18:879–885.
24. Allen PF, McMillan AS. A longitudinal study of quality of life outcomes in older adults requesting implant prostheses and complete removable dentures. *Clin Oral Implants Res* 2003;14:173–179.
25. Truhlar RS, Morris HF, Ochi S. A review of panoramic radiography and its potential use in implant dentistry. *Implant Dent* 1993;22:122–130.
26. Gatti C, Chiapasco M. Immediate loading of Brånemark implants. A 24-month follow-up of a comparative prospective pilot study between mandibular overdentures supported by Conical transmucosal and standard MK II implants. *Clin Oral Implant Dent Relat Res* 2002;4:190–199.
27. Batenburg RH, Meijer HJ, Raghoebar GM, Van Oort RP, Boering G. Mandibular overdentures supported by two Brånemark, IMZ, or ITI implants. A prospective comparative preliminary study: One-year results. *Clin Oral Implants Res* 1998;9:374–383.