Clinical Outcome of Narrow Diameter Implants: A Retrospective Study of 510 Implants

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Background: Narrow diameter implants ([NDIs]; diameter <3.75 mm) are a potential solution for specific clinical situations such as reduced interradicular bone, thin alveolar crest, and replacement of teeth with small cervical diameter. NDIs have been available in clinical practice since the 1990s, but only a few studies have analyzed their clinical outcome.

Methods: From November 1996 to February 2004, 237 patients were selected, and 510 NDIs were inserted. Implant diameter ranged from 3.0 to 3.5 mm, multiple implant systems were used, and 255 implants were restored immediately without loading (IRWL). No statistical differences were detected among the studied variables. Consequently, marginal bone loss (MBL) was considered an indicator of the success rate (SCR) to evaluate the effect of several host-, surgery-, and implant-related factors. A general linear model (GLM) was used to detect those variables statistically associated with MBL.

Results: Only three of 510 implants were lost (survival rate [SRR] = 99.4%), and no differences were detected among the studied variables. On the contrary, the GLM showed that delayed loading and longer (>13 mm) and larger (3.4 and 3.5 mm) NDIs reduced MBL.

Conclusions: NDIs have a high SRR and SCR, similar to those reported in previous studies of regular diameter implants. Moreover, IRWL of NDIs is a reliable procedure, although a slightly higher bone resorption is reported compared to delayed loading. No implant fractures were detected in the present series. *J Periodontol 2008;79:49-54.*

KEY WORDS

Dental implants; linear model.

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The concept of osseointegration, i.e., the direct anchorage of endosseous implants made of commercially pure or titanium alloy to the bone, was a breakthrough in oral rehabilitation.[1] Experimental and clinical experience led to the establishment of clinical guidelines for the predictable achievement of osseointegration.[2,3] The identification of factors for the long-term survival rate ([SRR]; total implants still in place at the end of the follow-up) and success rate ([SCR]; good clinical, radiologic, and esthetic outcome) is the main goal of the recent literature.[4-19] Several variables can influence the final result; however, in general, they can be grouped as surgery-, host-, implant-, and occlusion-related factors.[4] The surgery-related factors consist of several variables, such as an excess of surgical trauma, e.g., thermal injury,[5] bone preparation, drill sharpness, and design.[6] Bone quality and quantity are the most important host-related factors,[6,7] whereas length[8] and design,[9-11] surface coating,[12] and diameter[13-17] are the strongest implant-related factors. Finally, quality and quantity of force[18] and prosthetic design[19] are the variables of interest among the occlusion-related factors. All of these variables are of interest in scientific investigations because they may affect the clinical outcome.

The choice of implant diameter depends on the type of edentulism, the volume of the residual bone, the amount of

doi: 10.1902/jop.2008.070248

space available for the prosthetic reconstruction, the emergence profile, and the type of occlusion. Narrow diameter implants (NDIs; diameter <3.75 mm) have specific clinical indications, e.g., where there is reduced interradicular bone or a thin alveolar crest, and for the replacement of teeth with a small cervical diameter. In general, it seems that guidelines developed for the surgical placement and prosthetic restoration of regular size implants (RDIs; diameter = 3.75 mm) can be applied to NDIs; however, although NDIs have been available since the 1990s, few studies[13-17] have analyzed the clinical outcome of such implants. These reports showed good medium- and long-term results with two-stage surgical procedures.

In 2000, Vigolo and Givani[13] presented a 5-year retrospective study on 52 mini-implants for single-tooth restorations. The NDIs[§] had a diameter ranging from 2.9 to 3.25 mm. Three implants were lost, with a total implant survival rate ([SRR]; total implants still in place at the end of the follow-up) of 94.2%. In a subsequent report, Vigolo et al.[16] studied 192 NDIs for single-tooth or partial prostheses placed in 165 patients with a 7-year follow-up: the total implant SRR was 95.3%. Two-stage surgery was performed in both studies. The investigators concluded that NDIs have an SRR similar to those reported in previous studies of RDIs and suggested that NDIs can be included successfully in implant treatment.

Zinsli et al.[15] reported on 298 3.3-mm implants[‖] inserted in 149 partially or completely edentulous patients evaluated over a 10-year period. After a standard healing period (3 to 6 months), the implants were restored with fixed restoration, such as single crowns, fixed partial or complete prosthesis, or overdentures. Complete prostheses or overdentures in the edentulous jaw were the predominant types of restoration. The cumulative 5-year implant survival rate was 98.7%; after 6 years, it was 96.6%. The investigators concluded that the success of the 3.3-mm implants seemed to be predictable if clinical guidelines were followed and appropriate prosthetic restorations were provided, failures of NDIs were infrequent, and prosthetic complications were not dependent on the use of NDIs. However, fatigue fractures could occur after a long period of loading.

In 2005, Comfort et al.[17] reported a 5-year prospective study on NDIs (diameter = 3.3 mm). Twenty-three implants were placed with an SRR of 96%.

Although the above-mentioned studies reported a good clinical outcome, only two studies[15,16] analyzed a large series, and none focused specifically on the effect of immediate loading on NDIs. Immediate loading means placing the final or provisional prosthetic restoration immediately or within 48 hours of the surgical procedure.[20-23] It is referred to appropriately as immediate loading when the prosthetic restoration is in occlusal contact; otherwise, it is known as immediate restoration without loading (IRWL).[20]

In addition, concerns may arise from the fact that reduced diameter means a reduction in the contact surface between the implant and the bone, and one might ask if, in this condition, osseointegration is sufficient to withstand the loading forces. Decreasing the diameter also means increasing the risk for implant fracture due to reduced mechanical stability and increasing the risk for overload.[13-17]

In implant dentistry, the use of RDIs generally is recommended to ensure adequate bone-to-implant contact. Occasionally, the space available may be insufficient for the placement of an RDI; in these cases, an NDI can be an acceptable solution.[14] NDIs are used in areas where ridge dimension is narrow or space is limited. These conditions are found frequently in the maxilla, especially in situations where teeth are congenitally missing. Lack of sufficient space for an RDI also is common in the mandibular incisor, maxillary premolar, and canine regions. Furthermore, the placement of an NDI can be an alternative to bone-augmentation surgery in patients with thin posterior mandibular ridges. Under these conditions, NDIs have been used successfully in delayed-loading conditions.[13-17]

For the above-mentioned reasons, it was decided to perform a retrospective study on a large series of 510 NDIs to evaluate the clinical outcome with special attention to IRWL implants.

MATERIALS AND METHODS

Data were collected as in previous studies.[21-23] All implants had a diameter <3.75 mm (NDI).

Patients

During the period from November 1996 to February 2004, 237 patients (91 males and 146 females; median age, 50 years; range, 18 to 80 years) were selected. Informed written consent, approved by the Ethics Committee of the University of Chieti-Pescara, was obtained from patients to use their data for research purposes. The patients were followed for a median of 20 months (range, 3 to 96 months) after loading.

Subjects were enrolled in the study according to the following inclusion criteria: controlled oral hygiene (overall plaque score <20%[24]), the absence of any lesions in the oral cavity, and sufficient residual bone volume to receive implants ≥3.0 mm in diameter and ≥8 mm in length. In addition, the patients agreed to participate in a postoperative control program.

Exclusion criteria were insufficient bone volume to contain implants <3.0 mm in diameter and <8 mm in length; a high degree of bruxism, i.e., a dental erosion

§ 3i/Implant Innovations, Palm Beach Gardens, FL.
‖ ITI Dental Implant System, Straumann, Basel, Switzerland.

with dentin exposure of more than two teeth per jaw; smoking >20 cigarettes/day; excessive consumption of alcohol (~1 l/day of wine); localized radiation therapy of the oral cavity; antineoplastic chemotherapy; liver diseases; blood diseases; kidney diseases; immunosuppression; use of corticosteroids; pregnancy; inflammatory and autoimmune diseases of the oral cavity; and poor oral hygiene (overall plaque score >20%[24]).

Data Collection

Before surgery, periapical radiographs, orthopantomograms, and computed axial tomography scans were taken. Periapical radiographs were used in the follow-up period.

In each patient, peri-implant marginal bone levels were evaluated by calibrated examination of periapical radiographs. Measures were recorded after surgery and at the end of the observation period, i.e., by February 2004. The measurements were made mesially and distally to each implant, calculating the distance between the edge of the implant and the most coronal point of contact between the bone and the implant. The bone level recorded just after the surgical insertion of the implant was the reference point for the subsequent measurements. The measurement was rounded off to the nearest 0.1 mm. A scale loupe[¶] with a magnification of seven times and a scale graduated in 0.1 mm were used. All of the measurements were made by three independent examiners.

SCR was evaluated according to the following criteria: absence of persisting pain or dysesthesia, absence of peri-implant infection with suppuration, and absence of implant mobility tested individually.[25] In addition, we evaluated the absence of persisting peri-implant bone resorption >1.5 mm during the first year of loading and >0.2 mm/year during the subsequent years.

Implants

A total of 510 implants were inserted in 237 patients. There were eight Ankylos,[#] 13 Brånemark,[**] 12 Frialit,[††] nine IMZ,[‡‡] 69 Maestro,[§§] two Maximus,[‖‖] 13 Restore,[¶¶] 345 XiVE,[##] and 39 XiVE TG[***] implants. Implant diameter ranged from 3.0 to 3.5 mm, and implant length ranged from 8 to 18 mm. Table 1 shows a cross tabulation between implant location and mean length/width of the case series. A total of 193 implants were inserted in the maxilla, and 258 were placed in bone with quality ≤D2 (bone quality was defined as indicated by Misch:[26] D1 = thick cortical and dense cancellous bone; D2 = thick cortical and fenestrated cancellous bone; D3 = thin cortical and dense cancellous bone; and D4 = thin cortical and fenestrated cancellous bone). There were 67 immediate postextraction implants, and 443 were placed in healed sites. Half (255) were IRWL implants, and half were delayed-loaded implants. Patients were treated alternately with IRWL or the delayed-loaded protocol.

Table 1.

Demographics of Implant Location, Length, and Width

Location	Cases (N)	Length (mm; mean [range])	Width (mm; mean [range])
Incisor	158	14.5 (10 to 18)	3.3 (3.0 to 3.5)
Canine	33	14.5 (11 to 18)	3.25 (3.0 to 3.5)
Premolar	169	13.3 (9.5 to 18)	3.24 (3.0 to 3.5)
Molar	150	11.4 (8 to 15)	3.3 (3.0 to 3.5)

Surgical and Prosthetic Technique

All patients underwent the same surgical protocol. Antimicrobial prophylaxis consisted of amoxicillin, 500 mg twice daily for 5 days, starting 1 hour before surgery. Local anesthesia was induced by infiltration with articaine/epinephrine, and post-surgical analgesia consisted of nimesulide, 100 mg twice daily for 3 days. Patients ate a soft diet for 4 weeks, and oral hygiene instructions were provided.

After a crestal incision, a mucoperiosteal flap was elevated. Implants were inserted according to the procedures recommended. In the case of immediate loading, a temporary restoration was relined with acrylic, and trimmed, polished, and cemented or screw retained 1 to 2 hours later. Occlusal contact was avoided in centric and lateral excursions, i.e., IRWL. After provisional crown placement, a periapical radiograph was impressed by means of a customized holder device.[†††] This device was necessary to maintain the x-ray cone perpendicular to a film placed parallel to the long axis of the implant. Sutures were removed 14 days after surgery. The provisional crown was removed 24 weeks after the implant insertion, and a final impression of the abutment was made using polyvinylsiloxane impression material. The final restoration was cemented in all cases and was delivered ~32 weeks after implant insertion. All patients were included in a strict hygiene recall.

¶ Peak, Rolyn Optic, Covina, CA.
# Ankylos, DENTSPLY Friadent, Mannheim, Germany.
** Brånemark, Nobel Biocare, Gothenburg, Sweden.
†† Frialit, DENTSPLY Friadent.
‡‡ IMZ, DENTSPLY Friadent.
§§ Maestro, BioHorizons, Birmingham, AL.
‖‖ Maximus, BioHorizons.
¶¶ Restore, Lifecore Biomedical, Chaska, MN.
XiVE, DENTSPLY Friadent.
*** XiVE TG, DENTSPLY Friadent.
††† Rinn, Rinn CP, Densply Rinn, Elgin, IL.

Statistical Analysis

No statistical differences were detected among the studied variables by using the Kaplan-Meier product-limit estimation.[27] No or reduced marginal bone loss (MBL) was considered an indicator of SCR to evaluate the effect of several host-, surgery-, implant-, and occlusion-related factors.

The difference between the implant–abutment junction and the crestal bone level was defined as the insertion abutment junction (IAJ) and was calculated at the time of surgery and during follow-up. Delta IAJ (DIAJ) is the difference between IAJ at the last check-up and IAJ recorded just after the operation. DIAJ medians were stratified according to the variables of interest. A general linear model was used to detect those variables associated with a DIAJ.[28]

RESULTS

Three of the 510 implants were lost during the follow-up period with an SRR of 99.4%.

There was no statistically significant difference in the median DIAJ (MDIAJ that corresponds to MBL and is indicative of SCR) with regard to implant type (Ankylos: –0.45 mm; Brånemark: –1.20 mm; Frialit: –1.20 mm; IMZ: –1.40 mm; Maestro: –1.30 mm; Maximus: –1.15 mm; Restore: –1.20 mm; XiVE: –0.90 mm; and XiVE TG: –0.45 mm), site (maxilla: –1.00 mm and mandible: –1.00 mm), bone quality (≤D2: –0.90 mm and >D2: –1.00 mm), and postextractive site (postextractive: –1.00 mm and healed site: –1.00 mm). Statistically significant differences were detected regarding MDIAJ for type of implant loading (delayed: –0.90 mm and immediate: –1.00 mm), NDI diameter (≤3.3 mm: –0.97 mm and >3.3 mm: –0.81 mm), and implant length (≤13 mm: –1.00 mm and >13 mm: –0.90 mm).

Table 2 shows that wider diameter (3.4 and 3.5 mm), longer length (>13 mm), and delayed loading were related to a lower DIAJ, i.e., reduced MBL, and, thus, a better outcome (or SCR).

The three failed implants are reported in Table 3.

Table 2.

Output of the General Linear Model Reporting Variables Statistically Associated With DIAJ

			95% Confidence Interval	
Parameter	SE	Sig.	Lower Boundary	Upper Boundary
Intercept	0.312	0.000	–3.441	–2.215
Age	0.001	0.004	1.258E–03	6.490E–03
Gender	0.035	0.000	5.908E–02	0.198
Loading	0.039	0.000	0.112	0.266
Diameter	0.096	0.000	0.264	0.642
Length	0.036	0.001	4.677E–02	0.190
Months	0.001	0.000	–1.631E–02	–1.167E–02

Sig. = significance.

DISCUSSION

Although a good clinical outcome was reported in the above-mentioned studies,[13-17] none focused on the effect of immediate loading on NDIs. In the present study, 510 NDIs were evaluated, with only three failures during a mean observation period of 20 months (SRR = 99.4%).

No statistically significant differences were detected among the studied variables by using the SRR. No or reduced MBL was considered an indicator of SCR to evaluate the effect of host-, surgery-, implant-, and occlusion-related factors.

In general, length, surface, and diameter are considered relevant implant-related factors. Tarnow et al.[29] proposed using implants ≥10 mm in the case of immediate loading. In the present series, where IRWL was performed, implant length, diameter, and type were not critical points for SRR. The implants that failed were 13, 15, and 18 mm in length; two implants were 3.4 mm wide, and one was 3.0 mm wide (Table 3). Conversely, a different SCR according to length and diameter was found (Table 3) with a better outcome with regard to reduced MBL over time for longer and wider implants. This fact is related to an overloading of bone around the implant because a reduced diameter means a reduction in the contact surface between the implant and bone. No statistically significant difference was detected with regard to implant type. This could be due to a high number of analyzed implant types (nine types) and to the small number used for some types, i.e., approximately only 10 implants were used of six types. This fact explains the apparent paradox of no detected difference between fixtures with platform switch, e.g., Ankylos, and one-piece fixtures with no abutment connection at the crest level, e.g., XiVE TG. It is well known that the implant–abutment junctions retain bacteria; therefore, it had an impact on the vertical bone loss that we did not detect.

Immediate loading of implants in postextraction sites is one of the current main topics in implant dentistry, but only a few reports[30,31] have focused on this surgery-related factor. In the present study, 255 implants were IRWL, of which 194 were inserted in healed bone, and 61 were inserted in postextraction sockets. No statistically significant differences were observed. Consequently, the IRWL of NDI implants inserted in postextraction sites could be considered a predictable clinical procedure as it is for RDIs.[23]

Table 3.

Description of Three Failed Implants

Patient Age (years)	Gender	Type of Loading	Site	Implant Type	Diameter (mm)	Length (mm)	Bone Quality	Postextractive
63	Female	Immediate	28	Frialit*	3.4	15	D2	Yes
61	Male	Immediate	25	Frialit*	3.4	18	D2	Yes
44	Female	Delayed	18	XiVE†	3.0	13	D2	No

* Frialit, DENTSPLY Friadent.
† XiVE, DENTSPLY Friadent.

Bone quality, a host-related factor, is believed to be the strongest predictor of outcome in immediate loading. Misch[32] reported that most immediately loaded implants are placed in anatomical sites with bone quality of D1 or D2. It is well known that the mandible, in particular the interforaminal region, has better bone quality than the maxilla; this is probably why several reports[33-35] are available regarding immediately loaded implants inserted in the mandible with a high SRR. In the present study, no statistically significant differences were found between the mandible and the maxilla and among different bone qualities. NDIs probably could be used successfully in both jaws and in sites with low-quality bone if careful patient selection and correct procedures are used.

CONCLUSIONS

NDIs can be reliable with a high SRR and SCR. No differences were detected among the several implant types used. Length and diameter seemed to influence MBL, with better results for wider (3.40 mm ≤ diameter <3.75 mm) and longer (>13 mm) NDIs. Immediate restoration of NDIs seems to be a safe procedure, although slightly more bone resorption was found in the present study compared to delayed-loaded NDIs. IRWL of NDIs in postextraction sockets seems possible and seems to have comparable results to those reported in healed sites. Bone quality and sites did not seem to be major limiting variables. Further studies are needed to better define the use and indications of NDIs.

ACKNOWLEDGMENTS

This work was supported, in part, by the National Research Council, Rome, Italy; the Ministry of Education, Universities and Research, Rome, Italy; and the Research Association for Dentistry and Dermatology, Chieti, Italy. The authors report no conflicts of interest related to this study.

REFERENCES

1. Adell R, Lekholm U, Rockler B, Brånemark P-I. A 15-year study of osseointegration implants in the treatment of the edentulous jaw. *Int J Oral Surg* 1981;10: 387-416.
2. Babbush CA, Kent J, Misiek D. Titanium plasma-sprayed (TPS) screw implants for the reconstruction of the edentulous mandible. *J Oral Maxillofac Surg* 1986; 44:274-282.
3. Buser D, Schroeder A, Sutter F, Lang NP. The new concept of ITI hollow-screw implants: Part 2. Clinical aspects, indications, and early clinical results. *Int J Oral Maxillofac Implants* 1988;3:173-181.
4. Gapski R, Wang HL, Mascarenhas P, Lang NP. Critical review of immediate implant loading. *Clin Oral Implants Res* 2003;14:515-527.
5. Satomi K, Akagawa Y, Nikai H, Tsuru H. Bone–implant interface structures after nontapping and tapping insertion of screw-type titanium alloy endosseous implants. *J Prosthet Dent* 1988;59:339-342.
6. Eriksson AR, Albrektsson T, Albrektsson B. Heat caused by drilling cortical bone. Temperature measured in vivo in patients and animals. *Acta Orthop Scand* 1984;55:629-631.
7. Piattelli A, Paolantonio M, Corigliano M, Scarano A. Immediate loading of titanium plasma-sprayed screw-shaped implants in man: A clinical and histological report of two cases. *J Periodontol* 1997;68:591-597.
8. Misch CE. Bone density: A key determinant for clinical success. In: Misch CE, ed. *Contemporary Implant Dentistry*. Chicago: Mosby; 1999:109-118.
9. Skalak R. Aspects of biomechanical considerations. In: Brånemark PI, Zarb G, Albrektsson T, eds. *Tissue-Integrated Prosthesis: Osseointegration in Clinical Dentistry*. Chicago: Quintessence; 1985:117-128.
10. 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.
11. Misch CE. Implant design considerations for the posterior regions of the mouth. In: Misch CE, ed. *Contemporary Implant Dentistry*. Chicago: Mosby; 1999: 376-386.
12. Wennerberg A, Albrektsson T, Andersson B, Krol JJ. A histomorphometric and removal torque study of screw-shaped titanium implants with three different surface topographies. *Clin Oral Implants Res* 1995;6: 24-30.
13. Vigolo P, Givani A. Clinical evaluation of single-tooth mini-implant restorations: A five-year retrospective study. *J Prosthet Dent* 2000;84:50-54.
14. Davarpanah M, Martinez H, Tecucianu JF, Celletti R, Lazzara R. Small-diameter implants: Indications and contraindications. *J Esthet Dent* 2000;12:186-194.
15. Zinsli B, Sagesser T, Mericske E, Mericske-Stern R. Clinical evaluation of small-diameter ITI implants: A

prospective study. *Int J Oral Maxillofac Implants* 2004; 19:92-99.
16. Vigolo P, Givani A, Majzoub Z, Cordioli G. Clinical evaluation of small-diameter implants in single-tooth and multiple-implant restorations: A 7-year retrospective study. *Int J Oral Maxillofac Implants* 2004;19:703-709.
17. Comfort MB, Chu FC, Chai J, Wat PY, Chow TW. A 5-year prospective study on small diameter screw-shaped oral implants. *J Oral Rehabil* 2005;32:341-345.
18. Colomina LE. Immediate loading of implant-fixed mandibular prostheses: A prospective 18-month follow-up clinical study – Preliminary report. *Implant Dent* 2001; 10:23-29.
19. Salama H, Rose LF, Salama M, Betts NJ. Immediate loading of bilaterally splinted titanium root-form implants in fixed prosthodontics – A technique reexamined: Two case reports. *Int J Periodontics Restorative Dent* 1995;15:344-361.
20. Aparicio C, Rangert B, Sennerby L. Immediate/early loading of dental implants: A report from the Sociedad Espanola de Implantes World Congress consensus meeting in Barcelona, Spain, 2002. *Clin Implant Dent Relat Res* 2003;5:57-60.
21. 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.
22. Degidi M, Piattelli A. Comparative analysis study of 702 dental implants subjected to immediate functional loading and immediate nonfunctional loading to traditional healing periods with a follow-up of up to 24 months. *Int J Oral Maxillofac Implants* 2005;20:99-107.
23. Degidi M, Piattelli A, Felice P, Carinci F. Immediate functional loading of edentulous maxilla: A 5-year retrospective study of 388 titanium implants. *J Periodontol* 2005;76:1016-1024.
24. Axelsson P, Nystrom B, Lindhe J. The long-term effect of a plaque control program on tooth mortality, caries and periodontal disease in adults. Results after 30 years of maintenance. *J Clin Periodontol* 2004;31: 749-757.
25. 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.
26. Misch CE. Density of bone: Effect on treatment plans, surgical approach, healing, and progressive loading. *Int J Oral Implantol* 1990;6:23-31.
27. Dawson-Saunders B, Trapp RG. *Basic and Clinic Biostatistics*. Norwalk, NY: Appleton & Lange; 1994: 51-62.
28. Dobson AJ. *An Introduction to Generalized Linear Models*. New York: Chapman and Hall; 1990:27-42.
29. Tarnow DP, Emtiaz S, Classi A. Immediate loading of threaded implants at stage 1 surgery in edentulous arches: Ten consecutive case reports with 1- to 5-year data. *Int J Oral Maxillofac Implants* 1997;12:319-324.
30. Villa R, Rangert B. Early loading of interforaminal implants immediately installed after extraction of teeth presenting endodontic and periodontal lesions. *Clin Implant Dent Relat Res* 2005;7(Suppl. 1):S28-S35.
31. Vanden Bogaerde L, Rangert B, Wendelhag I. Immediate/early function of Brånemark System TiUnite implants in fresh extraction sockets in maxillae and posterior mandibles: An 18-month prospective clinical study. *Clin Implant Dent Relat Res* 2005;7(Suppl. 1): S121-S130.
32. Misch CE. Non-functional immediate teeth in partially edentulous patients: A pilot study of 10 consecutive cases using the Maestro Dental Implant System. *Compendium* 1998;19:25-36.
33. Balshi TJ, Wolfinger GJ. Immediate loading of Brånemark implants in edentulous mandibles: A preliminary report. *Implant Dent* 1997;6:83-88.
34. 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.
35. Chow J, Hui E, Liu J, et al. The Hong Kong Bridge Protocol. Immediate loading of mandibular Brånemark fixtures using a fixed provisional prosthesis: Preliminary results. *Clin Implant Dent Relat Res* 2001;3: 166-174.

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Submitted May 2, 2007; accepted for publication July 17, 2007.