

Provisional Implants: A Clinical Prospective Study in 45 Patients, from Implant Placement to Delivery of the Final Bridge

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ABSTRACT

Background: Protocols for submerged healing of dental implants often require the patient to have no teeth until suture removal and to wear a removable prosthesis during the remaining healing period. This may be inconvenient for the patient, and healing may be influenced negatively by the removable prosthesis.

Purpose: The aim of the present prospective clinical study was to evaluate the use of provisional implants (PIs) to provide patients with a provisional fixed bridge during the healing of permanent implants.

Materials and Methods: Twenty female and 25 male patients were consecutively included in the study. The 45 patients were treated for either partial (16 patients) or total (29 patients) edentulism in the maxilla. The permanent implants were placed first; as many PIs as possible were then installed between the permanent implants. After suturing, impressions from which to manufacture provisional bridges (to be cemented to the PIs) were taken. The patients were monitored with clinical and radiographic follow-up from implant placement to delivery of the final prosthesis.

Results: Five (2.2%) of the 230 permanent Brånemark System® implants (Nobel Biocare AB, Gothenburg, Sweden) did not integrate. None of the failures could be related to the presence of PIs between the permanent implants. Seven PIs failed during the observation period. In addition, 17 (9%) of the 192 PIs showed mobility at the second-stage surgery although they had supported the provisional bridges without clinical symptoms. Forty-four of 45 patients showed stable PI bridges at the time of second-stage surgery.

Conclusion: Based on our experiences we concluded that provisional implants can be successfully used to provide patients with a fixed provisional bridge during the healing of permanent implants.

KEY WORDS: clinical study, dental implants, immediate loading, provisional implants

Titanium dental implants are routinely and successfully used as abutments for fixed partial dentures (FPDs) in edentulous¹⁻⁸ as well as partially dentate jaws.⁹⁻¹⁴ Relevant studies have been based on the use of the traditional two-stage surgical protocol, implying connection of the abutment at a second surgical session 3 to 6 months following the placement of the fixtures in a submerged position.

The use of screw-shaped titanium implants (ad modum Brånemark System®, Nobel Biocare AB, Gothenburg, Sweden) is looked upon as the "gold standard" because of the extensive documentation and the good results reported. The good results achieved with the original two-stage surgical protocol for implant installation has resulted in the reevaluation and further development of the technique.

Schroeder and colleagues¹⁵⁻¹⁷ demonstrated the possibility of achieving osseointegration without submerging the fixtures. Several research teams¹⁸⁻²¹ have reported experimental data on the use of one-piece implant pillars, confirming the observations presented by Schroeder and colleagues. Similar observations from a dog model using the two-piece implants placed in a one-stage surgical procedure have been reported.^{21,22} Furthermore, during the last decade there have been

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published reports demonstrating successful clinical treatment results with the one-stage surgical protocol with Brånemark System fixtures.²³⁻²⁹

The degree of micromotion at the bone-implant interface has been argued to influence the implant integration process. According to some authors it is the absence of micromotion at the bone-implant interface during the initial healing phase that is of great importance for osseointegration rather than the early loading as such.³⁰⁻³³ Cameron and colleagues³⁴ found that micromotion amounting to about 200 μm at the bone-implant interface results in the formation of fibrous tissue, thus preventing osseointegration. The implant's surface characteristics are also of importance. According to Søballe and colleagues³⁵ the tolerated micromotion for roughened implant surfaces is 50 to 150 μm . Brunski³⁶ proposed that a 100 μm micromotion is the threshold level for the turned surface. According to Glantz and colleagues^{37,38} favorable loading conditions are achieved via a rigid FPD. Therefore it could be argued that good treatment results can be reached provided that a rigid FPD is connected to the implants as soon as possible after fixture placement. In other words, the implants will be rigidly splinted to each other via the FPD, thus decreasing the micromotion at the bone-implant interface, which in turn will facilitate proper osseointegration.

Provisional or temporary implants can be used to provide patients with a fixed temporary reconstruction during the healing period of the submerged fixtures. As early as 1970 a provisional implant in the form of the Lew Screw was introduced.³⁹ Some years later other types of provisional implants were described, such as the Sendax Mini Dental Implant® (IMTEC Corporation, Ardmore, OK, USA) and the Dentatus implant system (Dentatus AB, Stockholm, Sweden).⁴⁰ Different clinical techniques using temporary implants have been presented mainly in case reports at courses and conferences. The use of temporary implants is short term; the lack of follow-up studies is easy to understand. However, the classic study in this respect is the study presented by Schnitman and colleagues,^{41,42} who used ordinary "extra" implants to support a provisional FPD during the healing period of the submerged fixtures. The survival rate of these "additional" implants was reported to be about 85%.

The introduction of the Immediate Provisional Implant® system (Nobel Biocare AB) has reawakened

interest in provisional and temporary implants. Also, the knowledge obtained during the last decade regarding the immediate and early function of implants has increased interest in provisional and temporary implants and their use. The surgical and prosthetic technique has been described by Schuppan⁴³ and Babbush.⁴⁰ Schuppan claims that "the use of temporary implants has no adverse effects on the host implants" and concludes that "based on 550 patients treated with temporary implants, the significant advantages of this treatment modality are clearly evident."⁴³ Babbush presents 12 cases with a total of 53 provisional implants; only one PI had to be removed before planned.⁴⁰

The aim of the present prospective clinical study was to evaluate the use of provisional implants (PIs) to provide patients with a provisional fixed bridge during the healing of permanent implants.

MATERIALS AND METHODS

Twenty female and 25 male patients were included in the study. The 45 patients were treated either for partial (19 patients) or totally (26 patients) edentulous maxillas. The age and gender distribution of the patients is presented in Table 1. The presurgical evaluation included clinical and radiographic (periapical radiography as well as orthopantomography) examinations. All 45 patients were informed about the study design and consented to participate.

Surgery and Implants

About 1 hour prior to surgery, the patients were given 3 g of amoxicillin (Amimox®, Tika Läkemedel AB, Lund, Sweden) and diazepam (Stesolid®, Alpharma, Stockholm, Sweden) (0.3 mg/kg body weight) orally. Infiltration anesthesia (Xylocaine®-Adrenaline, AstraZeneca, Södertälje, Sweden) was used.

TABLE 1 Patient Age* and Gender Distribution

Age	Male	Female	Total
41-50	1	1	2
51-60	7	5	12
61-70	8	6	14
71-80	8	7	15
81-	1	1	2
Total	25	20	45

*Average age, 67.1 years; range, 45 to 91 years.

The alveolar process was exposed by elevating the mucoperiosteal flaps. In edentulous maxillas five to seven Brånemark System implants were placed; in partially edentulous situations two to four implants were placed. The fixtures had either turned or TiUnite™ (Nobel Biocare AB) surfaces. The main part of the permanent implants that were installed was 13 mm or longer and of regular platform (RP) type (Tables 2 and 3). The quality and quantity of the bone were classified according to the Lekholm and Zarb classification⁴⁴ (Table 4). After placement of the permanent implants, PIs (Nobel Biocare AB) were placed between the permanent implants (Figure 1). In brief, the PI is a one-piece implant with a bendable neck to which a provisional bridge can be cemented (Figure 2). The diameter is 2.8 mm; the threaded part is 14 mm long and is supplied with a turned surface. The site is prepared with a 1.5 mm twist drill, and the self-tapping PI is placed. In the present study as many PIs as possible were placed at a distance of 2 to 3 mm to the permanent implants (Figure 3). A special effort was made to find dense bone. In types I and II bone⁴⁴ the full length of the twist drill was used whereas in bone of quality levels 3 to 4,⁴⁴ only a 5- to 7 mm-deep entrance was prepared. The PIs were then inserted to full depth. Before adaptation and suturing of the flaps, the angulation of the PIs was checked, and necessary adjustments were performed by bending (Figure 4). The total number of permanent implants placed was 145; the corresponding figure for the PIs was 121. The most common condition found was C3 bone. The minimum number of permanent implants placed was 2, and the maximum number was 7. The corresponding respective figures for PIs were 2 and 8.

Prosthetic Procedures and Follow-Up Examinations

After the surgical session and after suturing, copings were placed on the PIs (Figure 5), and a quick-setting high-viscosity polyvinyl siloxane (Dimension™ Penta™ H Quick, 3M ESPE, St. Paul, MN, USA) impression was

TABLE 2 Surface of the Permanent Implants

Implant, Surface	NP	RP	WP	Total
Mk III, turned	8	31	1	40
Mk IV, turned	—	22	—	22
Mk III, TiUnite	19	147	2	168

NP = narrow platform; RP = regular platform; WP = wide platform.

TABLE 3 Length and Platform of Permanent Implants

Length (mm)	NP	RP	WP	Total
10.0	2	3	—	5
11.5	—	2	2	4
13.0	8	22	1	31
15.0	17	112	—	129
18.0	—	61	—	61
Total	27	200	3	230

NP = narrow platform; RP = regular platform; WP = wide platform.

taken of the upper jaw, with the copings embedded in the impression. Bite registration (with any suitable material) was performed, and a traditional impression of the opposing jaw was taken.

The provisional FPD was most commonly fabricated with an indirect technique, that is, the existing removable denture was rebuilt in such a way that it could be cemented to the PIs or to the tooth or teeth included as abutments in the provisional fixed bridge (Figures 6–9). No cantilever units exceeding 5 mm were accepted. The first choice of cement was a temporary one (eg, ImProve™, Nobel Biocare AB). (In Figures 7 to 9 some patients are presented wearing the provisional FPD.)

All patients participating in the study agreed to be enrolled in a strict and individually designed maintenance care program focusing on the following:

1. Oral hygiene instructions
2. Stability of the provisional FPD
3. Condition of the soft tissues
4. Careful examinations focusing on probable complications and how to remedy them without jeopardizing the permanent implants

TABLE 4 Bone Quality and Quantity Distribution*

Bone Quality	Bone Quantity				Total
	A	B	C	D	
1	—	—	—	—	0
2	—	3	1	3	7
3	1	10	15	—	26
4	1	8	1	2	12
Total	2	21	17	5	45

*Adapted from Lekholm and Zarb.⁴⁴

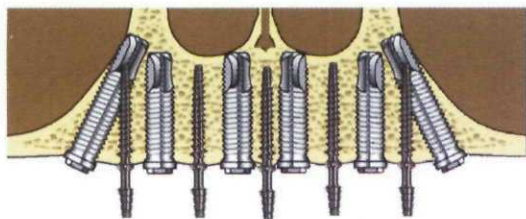


Figure 1 Following placement of the permanent implants, provisional implants are placed between them.

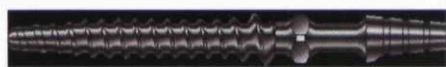


Figure 2 The Immediate Provisional Implant is a one-piece implant with a bendable neck.

Second-Stage Surgery

Six months after initial implant placement, mucoperiosteal flaps were raised to enable proper abutment connection according to the original protocol. At the same session, all or some of the PIs were removed by rotating them anticlockwise with the insertion tool mounted on the torque device (Figure 10). In situations when not all PIs were removed, the remaining ones served as abutments for the provisional FPD during the fabrication of the permanent FPD. At the latest, the remaining PIs were removed when it was time to connect the permanent FPD to the permanent implants.

RESULTS

Five (2.2%) of the 230 permanent Brånemark implants placed did not integrate and were subsequently removed at the second-stage surgery. Seven (3.6%) PIs failed owing to infection or pain during the observation period and were removed. Seventeen (9%) of 192 PIs placed showed mobility at the second-stage surgery

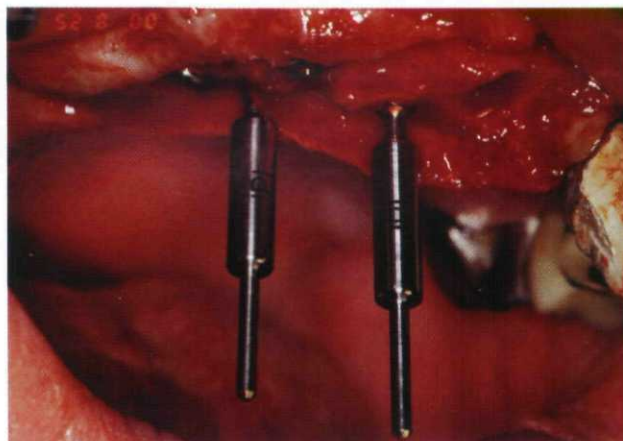


Figure 4 Before adaptation and suturing of the flaps, the angulations of the PIs are adjusted by bending.

although they had served as support for the provisional bridge without clinical symptoms. All the mobile PIs had been placed in bone of qualities 3 and 4. Forty-seven PIs were removed at the second-stage surgery, and 138 were removed at permanent bridge delivery.

Forty-four of 45 patients had stable provisional fixed bridges at the time of the second-stage surgery. In one patient the provisional fixed bridge was removed after 10 weeks because of pain and mobility. In this case the permanent implants were loaded with a fixed temporary bridge during the remaining 3-month period until fabrication of the permanent bridge. One provisional fixed bridge was fractured during the observation interval; it was mended and functioned well throughout the observation period.

DISCUSSION

The present clinical study clearly demonstrated that PIs can be successfully used to provide patients with a fixed

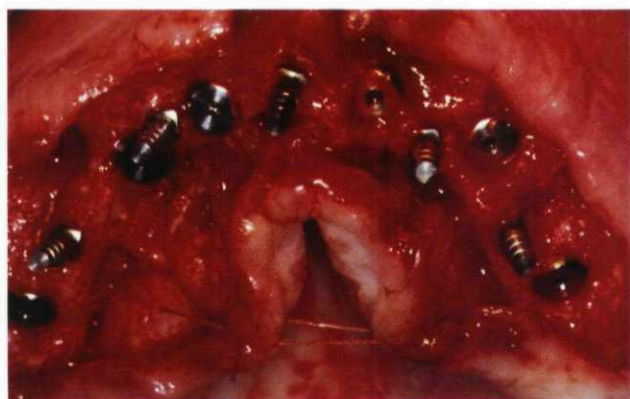


Figure 3 Clinical photograph taken after installation of permanent and provisional implants. The space between the different implants should be 2 to 3 mm.

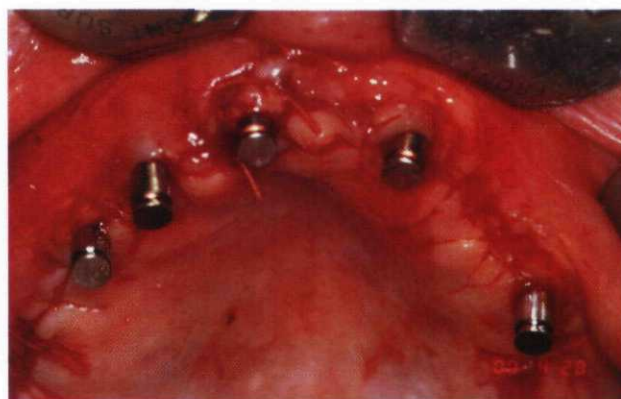


Figure 5 Impression copings mounted in the temporary implants. The same copings are used as retention elements in the final provisional implant bridge.



Figure 6 Two views of a removable denture rebuilt by the dental laboratory in such a way that it can be cemented to the provisional implants. The copings are embedded in the acrylic as retention elements.

provisional bridge during the healing of permanent implants. Forty-four of 45 FPDs supported by PIs maintained their stability during the healing phase of at least 6 months. Both partially and totally dentate jaws were included. In the partially dentate situations some of the neighboring teeth were sometimes used. The integration of teeth in the provisional FPDs not only increased the number of abutments but also protected the provisional FPD from lateral forces.

The failure cases were (1) a partially dentate patient with soft bone (types 3 and 4) who showed signs of bruxism and (2) a totally dentate patient with severe bruxism (she was provided with a nightguard but never used it). Bruxism is most likely one of the contraindications for applying temporary occlusal rehabilitation by means of PIs.

The five permanent implants that did not integrate had machined (turned) surfaces and had been placed in type 3 and 4 bone. Soft bone will most likely result in a lesser initial implant stability. This has been pointed out as a main reason for implant failure.⁴⁵⁻⁴⁷

Jaffin and Berman⁴⁵ reported a failure rate of 44% for implants placed in type 4 bone. The corresponding figure for implants placed in bone of types 1, 2, and 3 was only 3.6%. The TiUnite surface seems, at least in type 4 bone, to be more beneficial than the machined one.^{48,49} This observation is in agreement with previously reported experimental data.⁵⁰ Zechner and colleagues⁵⁰ compared bone-to-implant contact at three different implant surfaces on "Brånemark bodies" in minipigs. The authors reported a bone-to-implant contact of about 20% at the machined surface. The corresponding figure for the TiUnite surface was 43%. Furthermore, the survival rate (97.8%) of the permanent implants in the present study is in line with short-term data reported earlier.⁵¹ No clinical signs could be observed, indicating that the implant failures were related to the use of PIs.

Only 7 of 192 PIs were lost during the observation period, but 17 were not stable at the time for second-stage surgery. Nevertheless these unstable PIs had obviously contributed to the support of the provi-



Figure 7 A rebuilt removable denture fitted in a patient. The provisional implant bridge has an extension from 15 to 25 and is supported by five provisional implants.

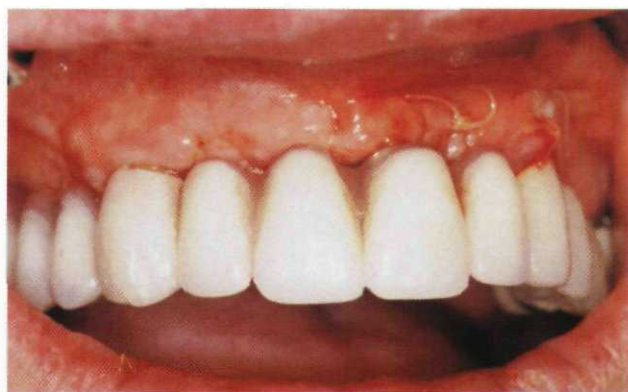


Figure 8 A partial denture rebuilt to a provisional implant bridge. Tooth 13 is integrated in the construction. Extension is from 13 to 25; support is by three provisional implants.



Figure 9 A provisional implant bridge made by composite: a mixture of provisional implants (15 to 21) and teeth (22 to 25).

sional FPD. Krennmair and colleagues⁵² reported a failure rate of 36.2% for maxillary temporary implants. However, in their study the temporary implants were loaded with an overdenture and were not splinted with a fixed bridge. An advantage of using PIs in combination with fixed temporary bridges is that the load meeting the permanent submerged implants will be minimized, thus perhaps increasing the success rate of these implants. A side observation made at the second-stage surgery was the excellent condition of the covering mucosa, namely, thin (nonhyperplastic) and with minimal signs of irritation. Whether this condition can be related to the fact that no removable provisional dentures were used is only to be speculated upon. Controlled clinical trials are needed to confirm such a hypothesis.

CONCLUSIONS

Within the limitations of the present clinical study, the following conclusions could be postulated:



Figure 10 The provisional implants were removed by rotating them anticlockwise with the insertion tool mounted on the torque device.

1. PIs can predictably be used to provide patients with a fixed provisional bridge during healing of permanent implants.
2. No interference with the osseointegration process of the permanent submerged implants owing to the placement of PIs could be observed.
3. Although some PIs were found to be mobile at abutment connection, they had supported the provisional bridge asymptotically.

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