A Three-Year Follow-Up Report of a Comparative Study of ITI Dental Implants® and Brånemark System® Implants in the Treatment of the Partially Edentulous Maxilla

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ABSTRACT

Background: Many longitudinal studies of different implant systems have been published but few controlled randomized investigations have been reported. A 1-year report of a comparative study of ITI Dental Implant System® implants (Straumann AG, Waldenburg, Switzerland) and Brånemark System® implants (Nobel Biocare AB, Gothenburg, Sweden) has been published by the present authors. This paper is a 3-year follow-up of that randomized study.

Purpose: The aim of the study was to compare the outcome of fixed partial prostheses supported by ITI or Brånemark implants. The outcome was evaluated primarily in terms of survival rates and changes in marginal bone level.

Material and Methods: The study group comprised 28 patients with anterior residual dentition in the maxilla. The patients were provided with two to four implants on each side of the dentition and were randomly allocated to Brånemark implants or ITI implants; 77 ITI implants and 73 Brånemark implants were inserted. After 6 months abutment connections were made to both ITI and Brånemark implants. All patients were provided with fixed partial prostheses of gold-ceramic. The patients were followed up annually with clinical and radiographic examinations for 3 years.

Results: Two Brånemark implants and two ITI implants were lost. The Brånemark implants were lost before loading whereas the ITI implants were lost because of periimplantitis. The survival rate for both groups was 97.3%. The mean marginal bone level of the Brånemark implants was situated 1.8 mm from the reference point at both the baseline and the 3-year examinations. The corresponding values for the ITI implants were 1.4 mm at baseline and 1.3 mm after 3 years. There was no significant difference between the implant systems with regard to bone level or bone level change. A steady state of the marginal bone level was calculated to have been reached after 3 years for 95.5% of the Brånemark implants and 87.1% of the ITI implants. Periimplantitis (infection including pus and bone loss) was observed with seven ITI implants but with none of the Brånemark implants. This difference was statistically significant.

Conclusions: No statistically significant differences were found between the implants studied, except for the frequency of periimplantitis, which was higher for the ITI implants. The survival rates were high, and the marginal bone loss was small for both systems.

KEY WORDS: Brånemark System® implants, comparative study, ITI dental implants, randomized study, marginal bone change

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Today there are an increasing number of dental implant systems on the market. The treatment results of several systems have been documented in longitudinal studies (for an overview, see the reports of Esposito and colleagues[1,2] and Berglundh and colleagues[3]), and these studies are of great value in the evaluation of individual implant systems. However, it is often difficult or impossible to compare implant systems when they are reported on in separate studies. Comparative studies between implant systems are scarce, but a number have been published. Some of these studies compared patient groups from different clinics and/or were conducted by different therapists.[4–7] In such studies the indications for the treatment and its technical performance may vary.

A more reliable comparison between implant systems is achieved by using the systems to be compared in the same patient group, with the same therapeutic team and with randomization between the implant systems.

The first randomized comparison was published by Kwakman and colleagues,[8] who compared a transmandibular implant system with IMZ® implants.

Kemppainen and colleagues[9] reported a study of single-tooth implants, comparing Astra Tech Dental Implant System® implants with ITI implants. Batenburg and colleagues[10] studied implants in the edentulous mandible treated with overdentures, using ITI, IMZ, or Brånemark (Brånemark System®, Nobel Biocare AB, Gothenburg, Sweden) systems. A comparison between Astra Tech implants and Brånemark implants in edentulous jaws has been reported,[11] and van Steenberghe and colleagues[12] compared the same two systems in a split-mouth study in partially edentulous mandibles.

The two implant systems most frequently used today are the ITI Dental Implant System and the Brånemark System. Comparative studies of these two systems were made in edentulous jaws[13] and (by Åstrand and colleagues[14]) on partially edentulous jaws. The report on the latter was a 1-year report of a split-mouth study; the present article is a follow-up report after a 3-year observation period. At the time the study began, the ITI implants were designed for a 1-stage procedure and had a titanium plasma–sprayed (TPS) surface. The Brånemark System implants were primarily designed for the two-stage technique and had a turned surface. New surfaces have since been developed for both systems.

The aim of the study was to compare the outcomes of fixed partial prostheses supported by ITI or Brånemark implants in a split-mouth design. The outcome was evaluated primarily in terms of survival rate and changes in marginal bone level but also with regard to other clinical variables, such as frequency of periimplantitis and aesthetic results.

MATERIALS AND METHODS

Patients

Details on the patient group have been presented in the 1-year report.[14] The group comprised 28 patients (mean age, 61.7 years; range, 36–76 years) with a residual anterior dentition in the maxilla. In the opposing jaw they had a natural dentition or bridges (tooth or implant supported).

A sample size calculation regarding the variable change in bone level was performed. On the basis of data from previous studies, it was considered possible to detect a difference between the tested implants of 0.2 mm with 90% power and at the 5% level of significance with 50 patients. For different reasons the number of participating patients had to be reduced to 28, which should have allowed the detection of differences of 0.3 mm or more.

The study was performed as a multicenter study with five centers. All patients were examined after 1 year; two patients died, for reasons unrelated to the study, between the 1-year and 3-year examinations.

Pre-treatment Examination

All patients were examined by an oral surgeon and a prosthodontist. The patients were mainly healthy; but patient histories revealed two cases of diabetes and one case of osteoporosis. Heavy smokers (> 20 cigarettes per day) were not included in the study, but seven patients had smoking habits (< 20 cigarettes per day).

Jaw relations were normal in 27 cases and prenormal in 1 case. The number of residual anterior teeth varied between two and six.

The radiographic examination included panoramic examination, intraoral radiography, and tomography (if required). Bone quantity and quality, as defined by Lekholm and Zarb,[15] were assessed radiographically and by the findings at surgery (Table 1).

Following the clinical and radiographic examinations, the patients were informed of the treatment possibilities and the design of the study, and their consent to participate in the study was obtained.

TABLE 1 Bone Quality and Quantity*

Brånemark Implants Quantity					ITI Implants Quantity				
A	B	C	D	E	A	B	C	D	E
1	14	11	2	0	1	12	12	3	0
Quality					Quality				
1	2	3	4		1	2	3	4	
1	14	12	1		1	12	14	1	

*Adapted from Lekholm and Zarb.[15]

Overall Study Design

The study was performed in the maxilla as a split-mouth study; the Brånemark implants were used on one side, and the ITI implants were used on the contralateral side of the residual dentition according to a randomization procedure. At this procedure, a blocking size of four was used, giving an equal probability of the patient's receiving ITI or Brånemark implants in the right or left side of the jaw.

The patients were not enrolled in the study until immediately before surgery, after verification that they met the inclusion criteria, and after informed consent was obtained.

Surgical Procedure

The surgical procedures followed the guidelines given respectively for the Brånemark and ITI implant systems.[16,17] This means that the Brånemark implants were inserted with a submerged technique and ITI implants with a nonsubmerged technique. However, a divergence from the guidelines was made regarding the healing periods. For practical reasons abutments were connected 6 months after insertion of both ITI and Brånemark implants rather than at the recommended 3 to 4 months recommended for ITI implants.

The patients were provided with 2 to 4 implants on each side of the dentition to support fixed bridges on both sides. Altogether 150 implants were inserted, 77 ITI implants and 73 Brånemark implants (Table 2).

Brånemark implants of 3.75 mm diameter and ITI implants of 4.1 mm diameter were the first choice of treatment. In cases of reduced bone volume, 3.3 mm implants were used. The implants were positioned to permit placement of the crown margin slightly subgingivally. This required the use of ITI Esthetic Plus® implants in some cases. One implant per tooth unit was the recommendation.

All ITI implants exhibited a TPS surface, and all Brånemark implants had a turned surface.

All patients were given prophylactic antibiotics for 10 days (penicillin V 2 g twice daily, or in case of penicillin allergy, clindamycin 300 mg twice daily).

Postoperative Care

Sutures were removed after 7 to 10 days. During this period no brushing was allowed at the operated sites. Adequate oral hygiene was maintained as described earlier.[14]

The removable partial denture was not used during the first 14 days after implant insertion. It was then relieved in the areas of the implant sites and relined with a tissue conditioner.

Prosthetic Procedure

Abutment connection of the Brånemark implants was performed after 6 months. Healing abutments were used, and two weeks later permanent abutments were connected to both systems. For the Brånemark implants Mirus cone or angulated abutments were used whereas the ITI implants were provided with the octa-type abutments. In two cases, however, an ITI abutment with a transversal screw was used.

Prosthetic treatment with both implant systems was performed at the same time and on one and the same impression and jaw relation registration, according to the guidelines for each implant system. All patients were provided with fixed partial bridges of gold-ceramic. Following analysis in each patient, the goal was to achieve occluding contacts that were evenly distributed over the fixed prosthesis and residual dentition, with special focus on the cantilever loading.

TABLE 2 Lengths and Types of Implants

Brånemark		ITI*	
Length (mm)	Number	Length (mm)	Number
8.5	1	8.0	8
10.0	10	10.0	12
13.0	18	12.0	48
15.0	43	14.0	9
18.0	1	—	—
Total	73	Total	77

*Of the ITI implants, 31 were of the Esthetic Plus type.

The suprastructure was connected 6 to 8 weeks after abutment connection for the Brånemark implants, which means that loading of the implants (both ITI and Brånemark) took place about 7 months after implant insertion. The restorations were all screw retained to allow removal at follow-ups. All superstructures were constructed to allow the patient to carry out satisfactory oral hygiene after instruction by dental hygienists.

Follow-Up

Evaluations. At implant insertion, data regarding the following variables were recorded: (1) bone quality and quantity for the right and the left side (as classified by Lekholm and Zarb[15]), (2) implant positions and dimensions, (3) primary stability of the implants (clinical assessment), (4) bone fenestrations or marginal dehiscences, and (5) complications.

During the healing period, data regarding the adaptation of the flaps to the implants (ITI) and regarding complications were recorded.

At the prosthesis installation (baseline, visit number "0") and at recall visits after 1 year and after 3 years, data on the following variables were recorded: (1) bridge stability (clinical assessment); (2) implant stability (clinical assessment, with the supraconstructions removed at the 3-year examination); (3) plaque and bleeding on probing; (4) hyperplasia of the periimplant mucosa; (5) radiographic examination results (at visits "0," 1, and 3); and (6) location of the crown margin buccally.

The radiographic examination included intraoral radiography performed with a modified Eggen holder.

To evaluate the marginal bone level, the distance from a reference point at the implant to the most coronal point where the marginal bone meets the implant was measured in 0.1 mm increments. Measurements were made mesially and distally of each implant. The mean value of these measurements was used in the computations. For the Brånemark implants, the fixture-abutment junction was used as the reference point (Figure 1). The ITI implants were inserted with the border between the rough and polished surface level with the alveolar crest. This border was situated 2.8 mm from the top of the implants (1.8 mm for the Esthetic Plus implants). As this border was not discernible on radiographs, the measurements on ITI implants were referenced to the top of the implant, and the figures were reduced by 2.8 and 1.8 mm, respectively. An adjusted reference point at the border between the surfaces was thus found (see Figure 1).

According to Albrektsson and colleagues,[18] steady state of the marginal bone level may be defined as a demonstrated bone loss of ≤ 0.2 mm per year after the first year of function. We have calculated the frequency of implants showing a bone loss of ≤ 0.4 mm between 1 and 3 years, indicating that they have reached a steady state.

Marginal bone level was measured with a scale loupe with a magnifying factor of 7×. The measurements were taken by two of the investigators working independently. In cases with a difference of ≤ 0.5 mm between the measurements, the mean value was used. In cases of differences of > 0.5 mm, the radiographs were reexamined by both investigators and consensus was sought.

Survival Rates. The survival rates were calculated by using a modification of the success criteria suggested by Albrektsson and colleagues.[18]

1. The implant is in function in a clinically stable bridge.
2. The implant is clinically stable (as tested with the suprastructure removed).
3. There is no pain from the implant.
4. The periimplant soft tissues are healthy or have only a mild degree of inflammation.

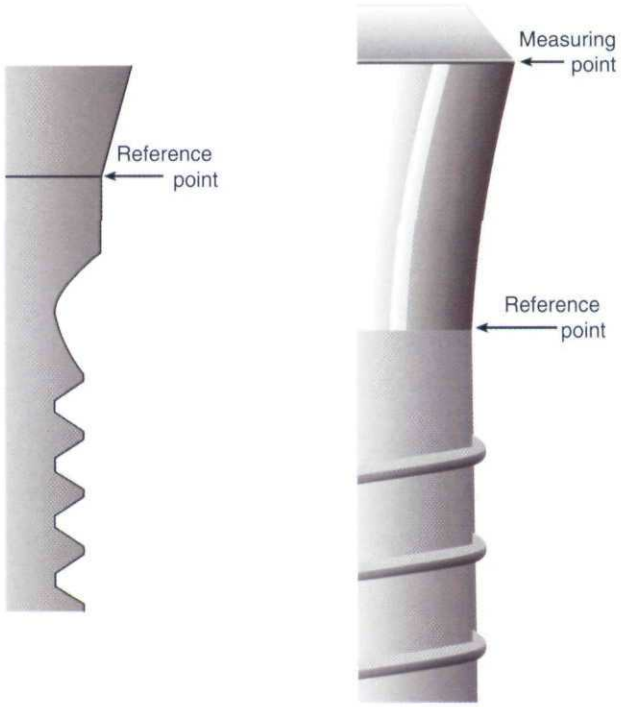

Figure 1 Reference points used in measurements of marginal bone level.

5. Radiographs may demonstrate a variation in marginal bone loss but no signs of total loss of osseointegration.

Data Collection and Statistical Considerations. The results of all examinations were registered on a case record form and entered into an electronic database. Before entering the data into the computer, the patient's identity information was removed.

Change in bone level (the primary response variable) was analyzed with analysis of variance. For the remaining variables nonparametric techniques were used.

The statistical computations were based on the implant-supported bridge as the unit. p Values of < 0.05 on two-tailed testing were considered statistically significant. (A detailed description of the statistical methods used can be found in the 1-year report.)[14]

Ethics. The protocol of the study was approved by the Research Ethics Committee at the University Hospital, Linköping, Sweden.

RESULTS

Clinical Experience

No system-related difficulties were encountered upon insertion of the implants. However, in a number of cases the alveolar process was narrow and 3.3 mm implants were used. Of the 150 implants included in the study, 77 were ITI implants (29 of them 3.3 mm) and 73 were Brånemark implants (16 of them 3.3 mm) (see Table 2). Thirty-one of the ITI implants were of the Esthetic Plus type.

Two implants were used to support the bridges in 8 of the ITI sites and 12 of the Brånemark sites while 3 implants were used in 19 of the ITI sites and 15 of the Brånemark sites (Figure 2). In one case of each implant system, four implants were used. Most implants were inserted in the premolar regions.

The extension and design of the 56 bridges are presented in Table 3; the distribution of bridges with cantilevers was equal between the implant systems.

The screw access holes were situated on the palatal side of all bridges supported by Brånemark implants. On the ITI constructions the access holes were situated on the buccal side in nine cases.

Survival Rates

Four implants were removed within the 3-year observation period. In one patient two Brånemark implants were considered to have reduced primary stability at fixture insertion, and these were lost before loading. One ITI implant was lost about 1 year after loading; at insertion a slight marginal dehiscence was noted, but good primary stability was achieved. Crater-form bone loss was seen at the baseline examination, and periimplantitis developed during the first year until the implant was removed. Another ITI implant had to be removed at the 3-year follow-up because of periimplantitis.

One ITI implant had an adjacent radiolucency along most of its surface. However, the implant was stable, and compared to the 1-year examination, the radiolucent area was smaller. At another ITI bridge, two implants were diagnosed with periimplantitis and advanced bone loss. The status of these implants is questionable, but they are stable, and there is no radiographic sign of total loss of osseointegration. Thus there were two ITI failures and two Brånemark failures. All the failed ITI implants were in bridges in smoking patients. With these failures, the survival rate after 3 years was 97.3% for both the ITI implants and the Brånemark implants.

Marginal Bone Levels

The Brånemark implants were inserted with the reference point at about the same level as the surrounding bone. The ITI implants were inserted with the border between the rough and the smooth surfaces at the marginal bone level.

At baseline (at which the first radiographic examination was performed) the bone levels of the two implant systems demonstrated great variation (Figure 3). Five ITI implants had a bone level more than 4 mm apical to the reference point while none of the Brånemark implants had such a location. At baseline the mean marginal bone level of the Brånemark implants was situated 1.8 mm from the reference point, 2.0 mm from the reference point after 1 year, and 1.8 mm from that level at 3 years (Table 4 and Figure 4). The mean marginal bone level at the ITI implants at baseline was situated 1.4 mm from the reference point, 1.6 mm from the reference at the 1-year follow-up, and 1.3 mm from that point at 3 years (Figure 5; see also Table 4). The number of implants with different bone levels at the 3-year examination is shown in Figure 6.

Between baseline and the 1-year examination (Table 5), the mean bone change was -0.2 ± 0.09 mm at the Brånemark implants and -0.2 ± 0.16 mm at the

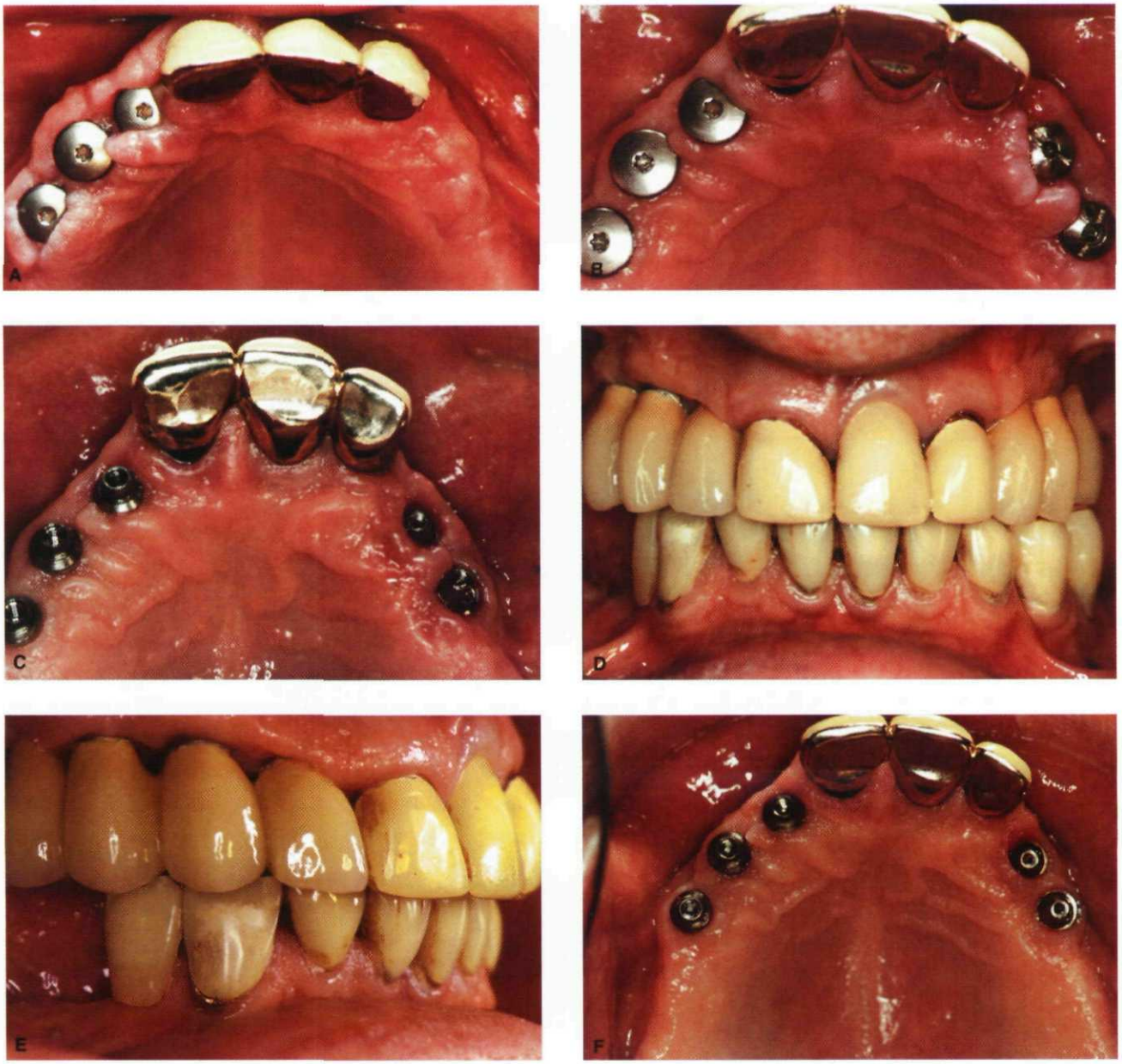

Figure 2 Photographs of patients treated. *A*, ITI implants inserted with a one-stage technique on the right side, and Brånemark implants inserted with a two-stage technique on the left side. *B*, Healing abutments connected to the Brånemark implants. *C*, Final abutments inserted at both ITI and Brånemark implants. *D*, Bridges connected (baseline). *E*, Implant bridges in situ after 3 years. *F*, After removal of implant bridges for examination of implant stability at the 3-year examination.

ITI implants. Between baseline and the 3-year examinations, the corresponding figures were 0.1 ± 0.09 mm and 0.2 ± 0.25 mm. There was thus no significant difference between baseline and the follow-ups at 1 and 3 years (see Table 5) for either of the implant systems, and there was no difference between the two implant systems.

The distribution of bone level changes is presented in Table 6. Calculation of the steady-state marginal bone level (Tables 7 and 8) as described under "Materials and Methods" shows that at the 3-year examination 95.5% of the Brånemark implants and 87.1% of the ITI implants exhibited a loss of ≤ 0.4 mm. The corresponding figures for bridges as assemblies were 96.2% for the Brånemark bridges and 88.5% for the ITI bridges.

Soft Tissue Reactions

Bleeding on probing at baseline examination was found at 2.1% of the Brånemark implant surfaces (four sites per implant were recorded) and at 3.9% of the ITI implants. At the 1-year follow-up the corresponding

TABLE 3 Distribution of Implants by Bridges and Type of Bridge Design

Implant Design	ITI Bridges	Brånemark Bridges
2 Implants	3	7
2 Implants with cantilevers	4	5
2 Implants with pontic and cantilevers	1	0
3 Implants	11	7
3 Implants with pontic	1	1
3 Implants with cantilevers	7	7
4 Implants with cantilevers	1	1
Total	28	28

figures were 11.3% and 10.1%, respectively. At the final examination after 3 years, bleeding on probing was found at 7.9% of the Brånemark implants and at 9.1% of the ITI implants. The difference between the implant systems was not statistically significant.

Plaque was recorded at baseline on 0.4% of the Brånemark implants and 1.6% of the ITI implants. At the 3-year follow-up the corresponding figures were 11.9% and 7.5%, respectively.

Pain was not recorded in connection with any implant.

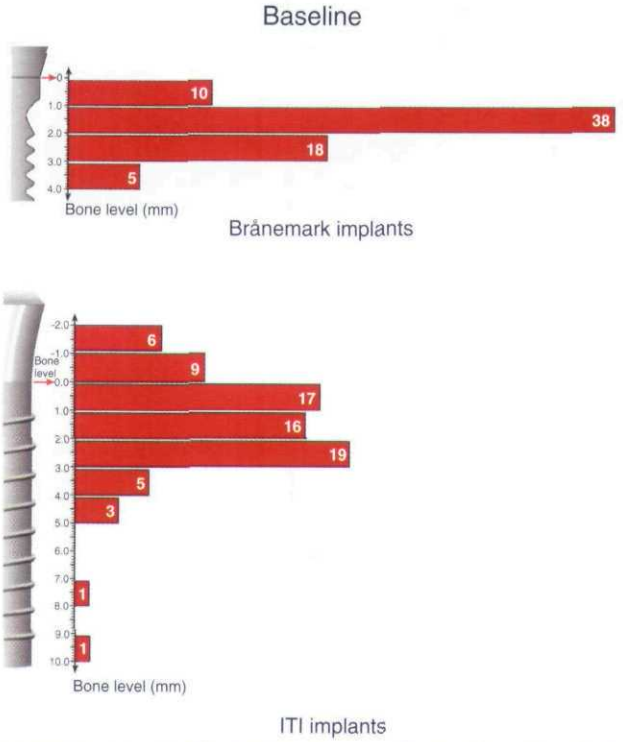

Figure 3 Graphic illustration showing the number of implants with different bone levels at baseline.

TABLE 4 Mean Marginal Bone Level* at Baseline and at 1 and 3 Years

Implant	Baseline	1-Year Examination	3-Year Examination
Brånemark	1.8 ± 0.11 mm	2.0 ± 0.23 mm	1.8 ± 0.13 mm
	$n = 28$	$n = 28$	$n = 26$
ITI	1.4 ± 0.33 mm	1.6 ± 0.30 mm	1.3 ± 0.27 mm
	$n = 28$	$n = 28$	$n = 26$

The patient (bridge) is used as the unit.
n = number of observations.
*Mean ± standard error of the mean.

Complications

Besides the implant failures described above, some component complications with loose bridge and abutment screws occurred. In the superstructure, ceramic fractures occurred at two ITI bridges and at one Brånemark bridge during the 3 years of function.

Statistically significant differences between the implant systems were found with regard to periimplantitis (infection including purulent discharge and bone loss). Periimplantitis was seen at seven ITI implants but at none of the Brånemark implants.

Three patients with small anterior dentitions lost their residual teeth during the healing period, and full fixed bridges had to be made on the osseointegrated implants.

DISCUSSION

Clinical Outcome

This article is a 3-year report of a previously published intra-individual prospective randomized comparative

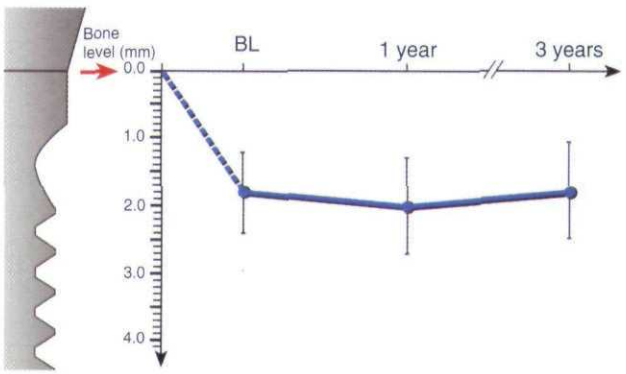

Figure 4 Mean bone level and standard deviation of the Brånemark implants at baseline (BL) and at the 1-year and 3-year follow-ups. The dotted line indicates the change from the surgically intended insertion depth from fixture installation to the first radiographic examination at baseline (6 months after fixture insertion).

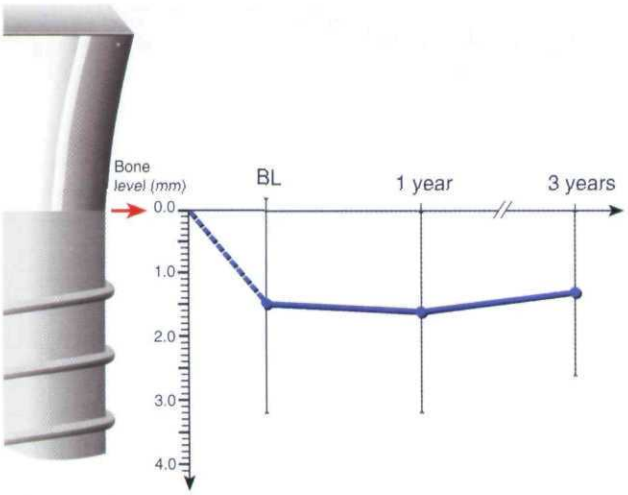

Figure 5 Mean bone level and standard deviation of the ITI implants at baseline and at the 1-year and 3-year follow-ups. The dotted line indicates the change from the surgically intended insertion depth from fixture installation to the first radiographic examination at baseline (6 months after fixture insertion).

multicenter study of two dental implant systems. Consecutive patients fulfilling the inclusion criteria were enrolled in the study. All patients were treated by experienced oral and maxillofacial surgeons and prosthodontists. All but two participating patients could be observed during the whole period (these two patients died after the 1-year examination).

The ITI and Brånemark implants are both solid screw titanium implants but are different in regard to surface texture, thread and neck design, and surgical techniques. The Brånemark implants used in the study had a turned surface and were used with a two-stage procedure. The ITI implants had a TPS surface and were installed in a one-step surgical procedure. The aim of the study was to investigate whether these differences influenced the clinical outcome in terms of survival rates, hard and soft tissue reactions, and prosthetic results.

Survival rates for the two systems have been individually reported in many earlier studies.[19–24] The long-term results reported for each system are good, with high survival and success rates. Comparative studies of the systems have also been reported.[10,13,25] These studies have shown high survival rates (96.8–98.3%) and no difference between the systems. Like the present study, these studies compared TPS and turned surfaces. The results of the present study are similar with regard to survival rates.

Although the ITI implants were inserted with a one-stage procedure, and the Brånemark implants with a two-stage procedure, both types of implants were inserted during the same operation in each patient. The abutment connections were also made at the same time, following abutment operations on the Brånemark implants after 6 months. During the healing period all patients used a removable partial denture that was prepared before surgery and was relieved and relined about 2 weeks after implant installation. The dentures thus covered the submerged Brånemark implants and the nonsubmerged ITI implants during the 6 months of healing. The influence of loading the implants during that period is not fully known. The greater variation in baseline bone level among the ITI implants (see Figure 3) may have been influenced by this extended provisional loading time.

Four implants, two Brånemark and two ITI implants, have been classified as failures, which has resulted in a survival rate of 97.3% for both systems. Owing to our definition of surviving implants, some implants with considerable bone loss and a questionable prognosis (Figures 7 and 8) were nevertheless not included among the failures.

Figure 6 Graphic illustration showing the number of implants with different bone levels at the 3-year follow-up.

TABLE 5 Changes in Marginal Bone Levels from Baseline to 3-Year Examination

Implant	Baseline to 1-Yr Exam (n = 28)	Baseline to 3-Yr Exam (n = 26)	1-Yr Exam to 3-Yr Exam (n = 26)
Brånemark	–0.2 ± 0.09 mm	0.1 ± 0.09 mm	0.28 ± 0.08 mm
ITI	–0.2 ± 0.16 mm	0.2 ± 0.25 mm	0.29 ± 0.19 mm

Marginal bone reactions around 1- and 2-stage implants have been investigated in many studies. Mean marginal bone resorption between baseline and 1 year showed the same small changes in most studies.

Although the mean changes of marginal bone level in this study were as small as in other studies, it may be of interest, for future outcome, to determine whether the bone reactions around separate implants have reached a steady state. It has been proposed[18] that an annual bone loss of 0.2 mm after the first year of function is acceptable. On that basis a situation with bone loss of < 0.2 mm per year during the following years could be called biologically stable. After 3 years a bone loss of ≤ 0.4 mm should thus indicate a steady state. Considering the mean values presented in Figures 4 and 5, it seems that such a steady state was reached for both implant systems. However, taking the individual implants as the unit, a steady state was reached by only 95.5% of the Brånemark implants and 87.1% of the ITI implants. The corresponding figures with the bridge as the unit were 96.2% for Brånemark and 88.5% for the ITI cases.

In a longitudinal study of Astra Tech and Brånemark System implants,[26] steady state for the implants in the upper jaw was attained by 80.4% of the Astra Tech implants and 88.9% of the Brånemark implants. We suggest that evaluation of the frequency of implants' reaching steady state may be a useful parameter in the longitudinal evaluation of implant treatment results.

The appearance of the marginal bone changes is also interesting. The number of ITI implants with crater-form bone loss was the same as at the 1-year examination. However, two of the affected implants had been lost.

Periimplantitis with ITI implants with a TPS surface was reported earlier.[24,27,28] In the study by Åstrand and colleagues,[24] the prevalence of periimplantitis including crater-form marginal radiolucencies was 7.2%. In the present study similar results were observed; both clinical and radiographic signs of periimplantitis were seen for 7 (9.1%) of the 77 ITI implants at the 3-year follow-up. No periimplantitis occurred at the Brånemark implants. The difference in the frequency of periimplantitis between the systems was statistically significant.

In an article by Karoussis and colleagues,[29] a higher incidence of periimplantitis was found among patients with a history of chronic periodontitis when compared to patients without such a history. In the present study eight patients had a history of periodontal disease, and six of the implants demonstrating periimplantitis belonged to these patients. However, none of these patients had signs of periimplantitis in the contralateral part of the jaw provided with Brånemark implants.

The greater prevalence of periimplantitis among the ITI implants may be an effect of the TPS surface[30] but may also derive from the denture covering the exposed implants during healing. Earlier loading of the implants (6–8 weeks) with a fixed prosthesis is now recommended by the manufacturer, and ITI implants are now available with another surface (SLA®, Straumann AG).

TABLE 6 Distribution of Mean Change in Bone Level between Baseline and 1 Year and between Baseline and 3 Years, with Bridge as Unit

	Baseline to 1 Year		Baseline to 3 Years	
Mean Change	Brånemark	ITI	Brånemark	ITI
> +0.5 mm	1	3	5	8
+0.5 to –0.5 mm	23	21	20	13
–0.6 to –1.5 mm	4	3	1	4
–1.6 to –2.5 mm	—	1	—	1

TABLE 7 Number of Implants with Bone Loss between 1 and 3 Years and Frequency of Steady State

	Bone Loss		
Implant	≤ 0.4 mm	≥ 0.5 mm	Frequency (%)
Brånemark	63	3	95.5
ITI	61	9	87.1

TABLE 8 Number of Bridges with a Mean Bone Loss between 1 and 3 Years and Frequency of Steady State

	Mean Bone Loss		
	≤ 0.4 mm	≥ 0.5 mm	Frequency (%)
Brånemark	25	1	96.2
ITI	23	3	88.5

Functional and Aesthetic Outcomes

An equal distribution of occlusal contacts was achieved with both systems. Plaque and bleeding did not differ during follow-up. The aesthetic outcome was assessed by the location of screw access holes and visible crown margins.

Unfavorable inclination of implants often results in a facial access to the bridge screw and can generally be solved with different abutments. The availability and simplicity of these components will influence the choice made by the prosthodontist. In nine ITI crowns this problem resulted in access holes on the buccal side. Angulated abutments were used on 18 Brånemark implants, and transversal screws were used on two ITI crowns.

In aesthetic positions in the upper jaw, submucosal crown margins are often desired. In that respect there is a difference between one-piece and two-piece implants for one-step versus two-step surgery. In the two-step technique, abutment lengths can be chosen according to the depth of the implant and the thickness of the mucosa after healing. In the one-step technique with one-piece implants, the surgeon must determine which implant to use and the appropriate insertion depth at installation. In 31 ITI cases in this study, the Esthetic Plus implant was used, which has (for aesthetic reasons) a mucosa-penetrating part of 1.8 mm instead of the standard 2.8 mm. Visible crown margins on the buccal side were seen at both Brånemark and ITI implants; their frequency, however, may be due to the different experiences of the surgeons using the two systems.

The fact that three patients lost their residual teeth and a full-arch bridge had to be made indicates that it may be unwise to retain small residual dentitions. Often a better choice is to plan for a full-arch bridge.

CONCLUSIONS

The following conclusions were drawn from the study's results:

1. Periimplantitis occurred at 9.1% of the TPS-surfaced ITI implants but at none of the Brånemark implants; the difference was statistically significant.
2. No other significant differences were found between the implants studied.
3. Survival rates for the two studied implant systems were high.

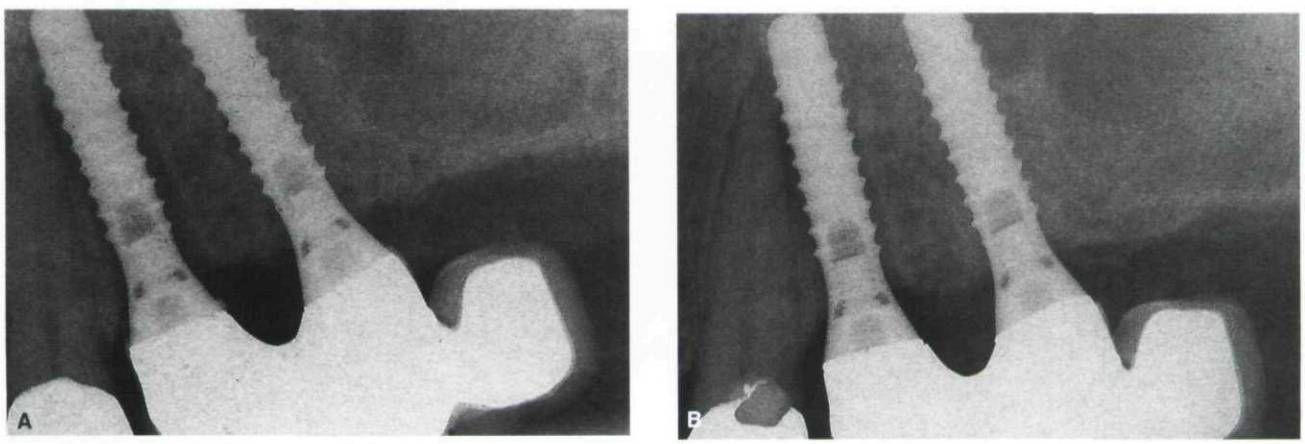

Figure 7 ITI implant had considerable bone loss at both the baseline (A) and 3-year (B) examinations, but being clinically stable, was included among surviving implants.

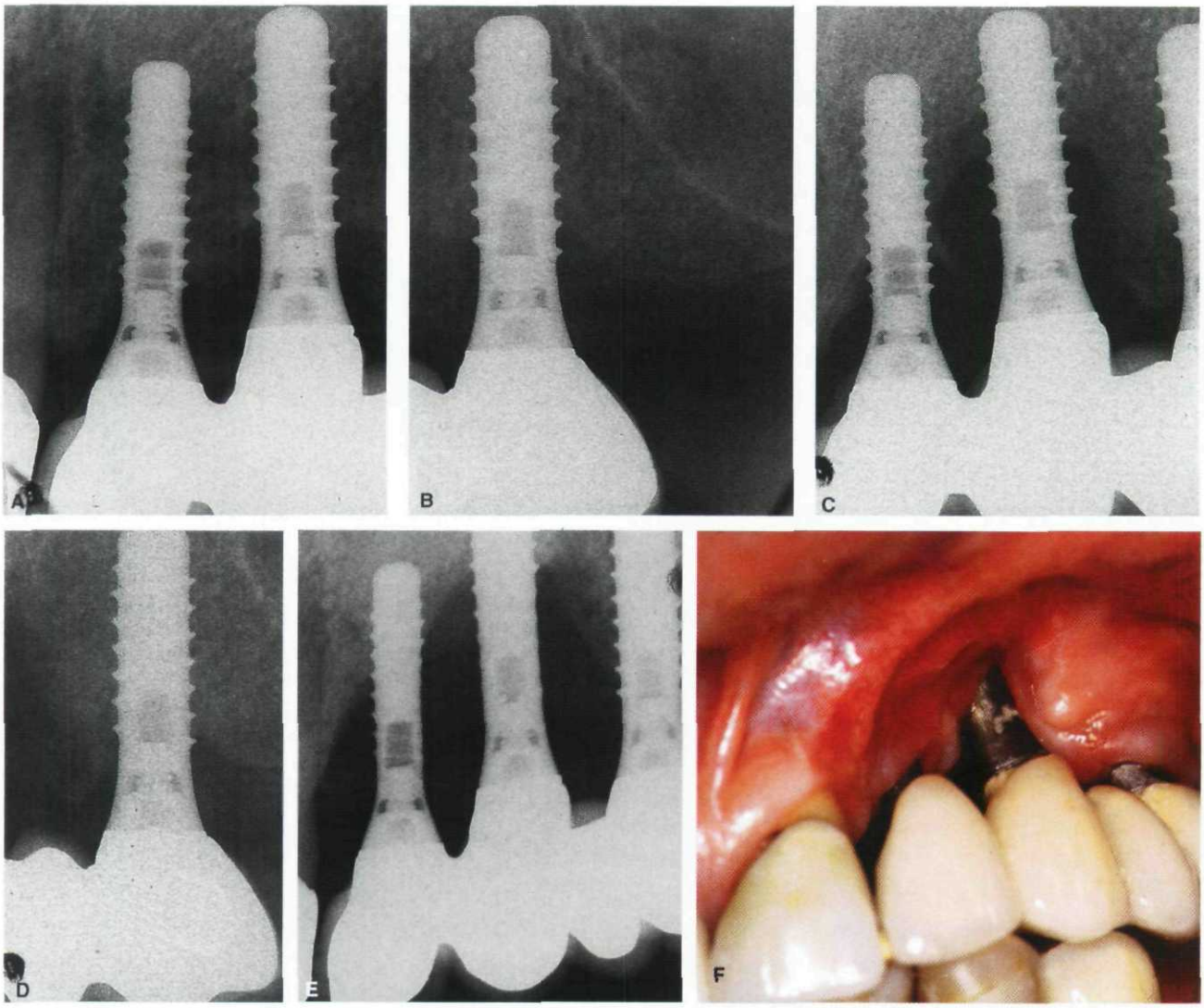

Figure 8 *A* and *B*, Radiographs from a patient with beginning bone loss at ITI implants in positions 22 and 23 at baseline. *C* and *D*, At the 3-year examination the bone loss has increased despite surgical intervention. *E* and *F*, After 4 years radiographic and clinical examinations revealed considerable bone loss.

4. Mean marginal bone resorption after loading was low.
5. A steady state of marginal bone level was reached after 3 years with 95.5% of the Brånemark implants and 87.1% of the ITI implants.

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