Astra Tech and Brånemark System Implants: A Prospective 5-Year Comparative Study. Results after One Year

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ABSTRACT

Background: Endosseous dental implants are used frequently, and many implant systems are available. The scientific documentation of the implant system presents a great variation, and it is often difficult to compare studies of different systems.

Purpose: The aim of this study was to compare two Swedish implant systems (Astra Tech and Brånemark System® implants), in a prospective randomized study.

Materials and Methods: Sixty-six patients were equally distributed between the two implant systems; 184 Astra Tech and 187 Brånemark System implants were used. The patients have been followed annually with clinical and radiographic examinations. The results after 1 year are reported.

Results: The abutment procedure was found to be easier and less time-consuming with Astra Tech than with Brånemark implants. The operation times in minutes (mean ± SEM) were for the respective implant 35 ± 4.0 and 51 ± 4.8 in the maxilla and 32 ± 3.8 and 43 ± 2.4 in the mandible. The differences in both cases were significant: $p < .02$ and $p < .05$, respectively. The failure rate for Astra Tech implants was 0.5% and for Brånemark implants 4.3%. The difference was significant ($p < .05$); however, taking into account that five of the eight implant losses in the Brånemark implant group occurred in one patient, an intraindividual correlation cannot be excluded. Therefore, this result should be interpreted with caution. The marginal bone level changes were examined already from the fixture installation. The major bone loss was found between fixture installation and baseline. This bone loss was several times greater than the bone loss between the baseline and the 1-year follow-up. The total bone loss during the observation period did not differ significantly between the systems, but they had different resorption patterns. The bone loss in the upper jaw between baseline and 1-year follow-up was 0.22 ± 0.14 and 0.03 ± 0.09 mm for the Astra Tech and Brånemark implants, respectively. In the lower jaw, the loss was –0.31 for both systems. The frequency of plaque accumulation and bleeding on probing did not differ between the implant systems.

Conclusions: Abutment connection with Astra Tech implants was simpler than the corresponding surgery with Brånemark System implants and the survival rate of Astra Tech implants was higher than that of Brånemark system implants.

KEY WORDS: Astra Tech implant, Brånemark System, endosseous implants, marginal bone level, survival rate, comparative study

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Endosseous implants are frequently used for the replacement of missing teeth. The long-term results depend mainly on preservation of the bone support. Maintenance of osseointegration and limited changes in the marginal bone level adjacent to the implants are therefore imperative.

Many investigators have studied changes of the marginal bone level around Brånemark implants over time. An early study comprising a large number of implants was published by Adell et al.[1] The authors described a healing phase, covering the period from implant inser-

tion to abutment connection, and a remodeling phase, covering 12 months after loading. The largest bone loss occurred during the healing phase, 0.7 to 1.3 mm in the maxilla and 0.3 to 0.7 mm in the mandible. The total mean bone loss during the healing and remodeling phases was, on average, 1.2 mm. During the next follow-up periods, the mean marginal bone loss was 0.1 mm per year. Similar results were found by Ahlquist et al,[2] whereas other authors,[3–5] investigating Brånemark implants, have demonstrated even less marginal bone loss.

Changes in marginal bone level also have been studied in relation to other implant systems. The first report on Astra Tech (Astra Tech AB, Mölndal, Sweden) implants was published in 1992.[6] In that study, comprising mandibular implants, the marginal bone level changes during the first year ranged from –0.4 to +1.0 mm, with a median value of 0.0 mm. Corresponding figures for the first 3 years were –1.1 to +1.0 mm (median value 0.0 mm).

In a study[7] of Astra Tech implants inserted in the maxilla, the marginal bone loss during the first year in function was found to be 0.1 mm, and the additional bone loss after 3 and 5 years was less than 0.1 mm.

Considering the differences in bone loss during the first year reported in the literature, the present authors found it interesting to compare Astra Tech and Brånemark System implants from that aspect when all patients were treated by the same team.

The aim of this investigation was to compare the treatment results of Astra Tech implants and Brånemark System implants, during 5 years, primarily in terms of changes in marginal bone support but also with regard to survival rates and other clinical parameters of interest. This report presents the results after 1 year.

MATERIALS AND METHODS

All patients with edentulous jaws applying for implant treatment during the period August 1993 to December 1995 were considered for inclusion in the study. Those who met the inclusion criteria and gave their informed consent to inclusion in the study were consecutively included.

According to a sample size analysis, 68 patients were included. Two randomization schedules were generated: one for implant installation in the mandible and one for the maxilla. The patients were randomized in blocks with an equal probability of receiving Astra Tech or Brånemark implants.

In accordance with the inclusion criteria, the patients were aged 25 to 75 years and were generally healthy; however, 13 patients suffered from hypertension and 5 had controlled diabetes. Eighteen of the patients were smokers (12 in the Astra Tech group and 6 in the Brånemark group), but none of them smoked more than 10 cigarettes per day. All surgical procedures were performed by the same two oral surgeons and all prosthetic procedures by three prosthodontists.

At the fixture installation, two patients were found not to meet the inclusion criteria (insufficient bone volume with need of bone graft or guided tissue regeneration treatment). Thus, the study population consisted of 66 patients, 28 males and 38 females (Table 1). The mean age was 60 years (range, 35–74 yr).

Bone quantity and quality were assessed at surgery according to Lekholm and Zarb.[8] Most jaws had a resorption degree corresponding to score B and a bone quality score of 2 (Table 2). Five patients had a slightly pre- or postnormal jaw relation.

The implants used in the study were of two types:

1. **Astra Tech implants** (Astra Tech AB, Mölndal, Sweden) with TiOblast surface and with lengths ranging from 9 to 19 mm (Figure 1 and Table 3). Implants with a diameter of 3.5 mm were used except for a few cases in which the primary stability was doubtful and the 3.5-mm implant was changed to a 4.0-mm implant. Eight maxillary implants still had a slightly reduced primary stability. Altogether 184 Astra implants were installed, 104 in the maxilla and 80 in the mandible.
2. **Brånemark System® implants** (Nobel Biocare, Göteborg, Sweden) of the Mark II type and with lengths ranging from 10 to 18 mm (see Figure 1 and Table 3). The implants had a diameter of 3.75 mm. In a few cases, 4.0-mm implants were used to improve the primary stability. Eight maxillary implants and one mandibular implant still had a slightly reduced primary stability. Altogether 187 Brånemark implants were installed, 107 in the maxilla and 80 in the mandible.

The use of implants with different lengths was similar for Astra Tech implants and Brånemark implants (see Table 3).

Surgical Procedure

The surgical procedures followed the manufacturer's instructions for each system. The patients were given prophylactic antibiotic treatment with 2 g of phenoxymethyl penicillin before the operation and 2 g twice

TABLE 1. Patient Distribution between the Implant System Groups

	Sex	
Number of Patients in System Group (n = 66)	**Males (n = 28)**	**Females (n = 38)**
Astra Tech		
Upper jaw (n = 17)	**10**	**7**
Lower jaw (n = 16)	**7**	**9**
Brånemark		
Upper jaw (n = 17)	**4**	**13**
Lower jaw (n = 16)	**7**	**19**

Figure 1. Astra Tech (*left*) and Brånemark System (*right*) implants used in the study.

daily for 10 days. In cases of penicillin allergy, clindamycin was used. The patients also received 600 mg ibuprofen and, in most cases, a sedative (diazepam).

In most cases a crestal incision was used in both the jaws. However, in the mandible a vestibular incision were used in eight Astra Tech and seven Brånemark cases. In most cases, six implants were inserted in the maxilla and five in the mandible. After fixture installation, the flaps were closed with continuous sutures (Vicryl, Ethicon, Johnson & Johnson Inc., Brussels, Belgium). The patients were recommended a soft diet and mouth rinsing with chlorhexidine solution (0.1%).

The operation time was measured at both the fixture and the abutment procedures. The operation time was defined as the time from the start of the incision to the completion of the sutures. The sutures were removed after 7 to 10 days, and a few days later, the dentures were adjusted and relined with a conditioner (Viscogel, Dentsply de Trey, Zurich, Switzerland). Abutment surgery was performed according to the manufacturer's instructions for each implant system. The interval between fixture insertion and abutment connection was, on average, 6.2 months (Astra Tech) and 6.7 months (Brånemark System) in the maxilla and 3.8 months (Astra Tech) and 4.0 months (Brånemark) in the mandible.

Prosthetic Procedure

The prosthetic treatment followed the protocol for each implant system. The interval between abutment connection and delivery of the bridge ranged between 42 and 111 days, with a mean of 73 days for Astra Tech implants and 76 days for Brånemark implants.

At the second-stage operation, healing abutments were used. Suitable final abutments were then connected after about 7 to 10 days. The height of the abutments was chosen to give a slightly sub- or supragingival connection of the suprastructure, to meet local hygienic and esthetic demands. Angled abutments were used in six patients (Brånemark System, maxillary cases).

The framework of the suprastructures was made of gold in 57 cases and of titanium in 9 cases. The occlusal surfaces were made of acrylic or porcelain, depending mainly on the patient's demands and the state of the opposing dentition. An impeccable fit of the framework to the implants was imperative. Contacts with the opposite jaw were built-up with cuspid protection or group function, depending on jaw relations and dentition. The occlusal contacts were evenly distributed over the arch, with only light contacts on cantilevers. All patients were carefully informed and instructed in hygienic care with interdental brushes and flossing technique.

TABLE 2. Bone Quality and Quantity Scores in Jaws of Study Patients

		Quantity			
Implant System	**Quality**	**A**	**B**	**C**	**D**
Astra Tech	**1 (n = 3)**			**3**	
	2 (n = 22)	**2**	**12**	**7**	**1**
	3 (n = 7)		**4**	**3**	
	4 (n = 1)		**1**		
Astra Tech total	**(n = 33)**	**2**	**17**	**13**	**1**
Brånemark	**1 (n = 1)**			**1**	
	2 (n = 14)	**1**	**10**	**3**	
	3 (n = 10)	**2**	**6**	**2**	
	4 (n = 8)		**5**	**2**	**1**
Brånemark total	**(n = 33)**	**3**	**21**	**8**	**1**

Lekholm and Zarb[8]

TABLE 3. Number of Implant Fixtures Installed by Length of Implant

	Fixture Type	
Length (mm)	Astra Tech (n = 184)	Brånemark (n = 187)
9	4	
10		17
11	9	
13	25	33
15	65	83
17	79	
18		54
19	2	

FOLLOW-UP

Data from the surgical and prosthetic procedures were continuously collected in case record forms (CRF). Corresponding forms also were used at the baseline examination (delivery of the prosthetic construction) and at the annual follow-up appointments.

Clinical Examinations

The clinical variables recorded were

1. Pain from implant regions,
2. Implant stability (tested with the suprastructure removed),
3. Plaque accumulation (yes or no, four surfaces),
4. Bleeding on probing of the peri-implant mucosa (yes or no, four surfaces), and
5. Suprastructure complications.

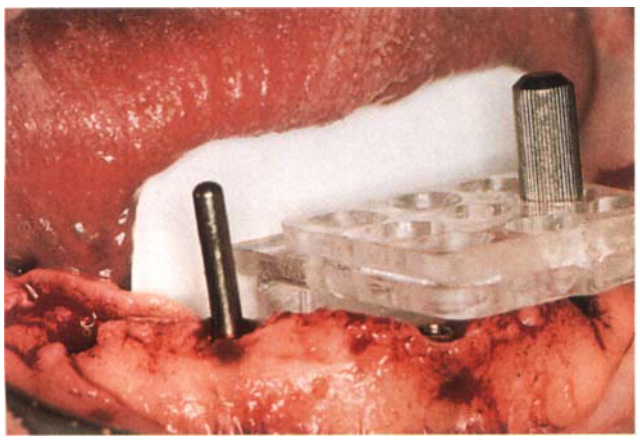

Figure 2. The radiographic examination during the fixture insertion and abutment connection was performed with a plastic filmholder connected to the fixture by a threaded direction indicator.

Radiographic Examination and Evaluation

Intraoral radiographic examinations were performed at baseline and at the 1-year follow-up, using a paralleling technique. Care was taken to get a clear image of the threads on both sides of the implant.[9] Kodak Ektaspeed Plus film (Eastman Kodak Co., Rochester, New York) was used. Further examinations are scheduled at the 3- and 5-year follow-up appointments.

In each patient, additional, intraoral radiographs of two of the implants were obtained at implant insertion (mostly the two distal implants on the left side of the jaw), followed by radiographs of the same two implants at abutment connection (Figure 2). This examination aimed to evaluate the marginal bone level changes in the early healing period. The examination was restricted to one exposure at each operation.

A specialist in oral radiology, who did not take part in the clinical treatment, performed the radiographic evaluation. For each implant, the radiographs were evaluated regarding marginal bone height and its change over time, and with respect to the bone–implant interface zone for changes indicating loss of osseointegration. The marginal bone level was assessed at the mesial and distal implant surfaces by measuring the distance between a reference point of the implant and the bone level, using a magnifying lens (×7) with a measuring scale divided in 0.1 mm. The reference point of the Astra Tech implants was the uppermost point of the vertical

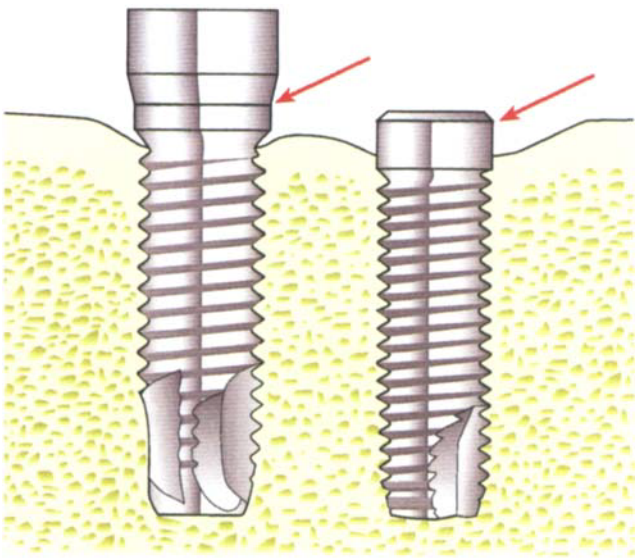

Figure 3. The measurements of marginal bone level were performed in relation to a reference point at the implant. The reference point at the Astra Tech implants was the most coronal point of the vertical part of the fixture and at the Brånemark System implants the abutment–fixture junction.

coronal part of the implant (Figure 3). For the Brånemark implants, the fixture–abutment junction was used.

Statistical Evaluation

The analysis of data addressed the following questions:

1. Did the tested implant systems differ from each other with respect to changes in bone level (primary response variable)?
2. Were there any differences between the tested systems in success rates or in frequency of adverse events?
3. Were there any differences between the two systems regarding installation, measured as time in surgery?
4. Were there any differences between the two implants as to the other measured variables?

Statistical computations were based on the patient as the unit, as a rule. The only exception was for the rate of implant losses, where the difference was calculated both with the implant as a unit and with the patient as a unit. The differences in frequency of implant losses were analyzed using Fisher's exact probability test. The analyses of change in bone level and time of surgery employed one-way analysis of variance (ANOVA). In case of significant outcome, Student-Newman-Keuls test was used to locate the differences. For these two variables, a significance test for interaction between implant system and type of jaw also was performed,[10] which in no case was significant. The within-group differences in bone loss were analyzed using paired t-tests. Differences in frequency of bleeding on probing and plaque were analyzed using Kruskal-Wallis ANOVA.

All statistical comparisons were carried out as two-sided tests, and statistical significance was declared if the p-value was less than or equal to .05.

Sample Size Calculation. Change in bone level was chosen as the primary response variable to judge the clinical outcome of the tested implants. Based upon data from previous studies on implants in the lower jaw, it was considered possible to detect a true difference of 0.4 mm, which was considered to be of clinical importance, between the tested systems with 90% power and 15 patients. This estimate was based upon a two-tailed test conducted at the 5% level of significance. It was assumed that the variation in the upper jaw is not larger than in the lower jaw. To compensate for drop-outs, the sample size was adjusted to 17 patients per tested implant and jaw.

RESULTS

Clinical Experiences and Operation Time

The surgical procedures could be safely performed with both implant systems. The fixture insertion time was about the same for Astra Tech and Brånemark implants (94 vs. 102 minutes in the maxilla and 89 minutes for both systems in the mandible). At the abutment connection, both surgeons found the procedure with Astra Tech implants easier to perform and to necessitate less flap exposure than with the Brånemark System implants. This situation was reflected in the abutment connection time, which was shorter with Astra Tech implants than with Brånemark System implants (Table 4). The difference was statistically significant in both the maxilla ($p < .02$) and the mandible ($p < .05$).

At the prosthetic procedure, the change from healing abutments to the final choice was easily performed with both systems. Suitably angled abutments were more easily found and connected to the Brånemark System. This fact more often resulted in screw access holes through the facings with Astra Tech implants, due to the inclination of the fixtures in the upper jaw. Impression procedures and connection of the suprastructure to the implants were largely the same for both systems.

Implant Survival

Nine implants were lost, eight of which were maxillary implants. Six of them were early failures, detected at abutment connection or during the prosthetic proce-

TABLE 4. Operation Time in Minutes (Mean ± SEM) at Fixture Insertion and Abutment Connection

	Operation Time (min)			
	Maxilla		Mandible	
Implant System	Fixture*	Abutment†	Fixture*	Abutment‡
Astra Tech	102 ± 7.5	35 ± 4.0	89 ± 4.6	32 ± 3.8
Brånemark	94 ± 3.7	51 ± 4.8	89 ± 6.6	43 ± 2.4

Significance level: *NS; † $p < .02$; ‡ $p < .05$.

dure. Three failures were found at the 1-year follow-up. Eight of the failures were Brånemark System implants and one was an Astra Tech implant. The failure rate of Astra Tech implants (0.5%) was significantly lower than that of Brånemark System implants (4.3%) ($p < .05$). However, it is important to observe that five of the eight Brånemark implant failures belonged to one patient, indicating a within-patient correlation.

If the number of patients with implant failures is compared, there was no significant difference between the implant systems. Only one of the implant losses occurred in a patient who smoked.

At fixture insertion, 17 implants were judged to have less stability than the remaining 354 implants which had good primary stability. Two of the failures belonged to the group with reduced stability.

No pain was demonstrated in connection with any of the implants in function.

Bridge Survival

None of the bridges supported by Astra Tech implants were lost. The patient who lost five Brånemark implants had her bridge removed. Re-operation with new implant insertion is planned.

Soft Tissue Reactions

The frequency of plaque accumulation and bleeding on probing did not differ between the implant systems. The frequency of plaque accumulation on the implant surfaces ranged between 0 and 10% (medians) at the baseline examination. At the 1-year follow-up, the corresponding figures were between 0 and 25%. The frequency of bleeding on probing was 0% at baseline and between 0 and 5% at the 1-year follow-up.

Marginal Bone Changes

To include the early marginal bone changes, the patients were examined on four occasions: at fixture insertion, at abutment connection, at baseline, and at the 1-year follow-up (Figure 4). The mean marginal bone levels at the four different examinations are presented in Figure 5, A to D, and the differences between the examinations in Table 5.

To elucidate possible differences in the pattern of marginal bone changes between the two implant systems, mean values of the upper and lower jaws are presented in Figure 5, E and F. The diagrams demonstrate some interesting differences.

At fixture insertion, the mean marginal bone level was located 0.1 mm below the reference point for both systems. At abutment connection the bone level was 0.7 mm below the reference point at the Astra Tech implants and 0.3 mm at the Brånemark implants. However, at the baseline examination there was an inverse relation between the systems and the corresponding figures were 1.4 mm for Astra Tech and 1.8 mm for Brånemark. At the 1-year examination the distance was 1.6 mm at the Astra Tech implants and 1.9 mm at the Brånemark implants. From the diagrams, Brånemark system implants seem to have a smaller bone loss after fixture insertion but a greater bone loss after the abutment connection.

The examination on all four occasions was restricted to only two of the implants, owing to radiation protection aspects. However, the baseline and 1-year examinations were made on all implants. In one patient, however, radiographs could not be obtained at the baseline examination. Overall, the changes in marginal bone level during this period were small (Table 6). A significant change between the baseline and 1-year examinations was found only for Brånemark mandibular implants ($p < .01$). In the maxilla, the marginal bone level at Astra Tech implants changed between –1.6 and +0.9 mm, with a mean change of –0.22 mm. At the Brånemark System implants, the corresponding figures were –0.8 and +0.5 mm with a mean change of –0.03 mm (see Table 6).

In the mandible, the marginal bone level at Astra Tech implants changed between –1.6 and +0.7 mm, with a mean change of –0.31 mm (see Table 6). For the Brånemark System implants, the corresponding figures were –1.2 to +0.2 mm with a mean of –0.31 mm.

There was no significant difference in bone changes between Astra Tech and Brånemark System implants either in the maxilla or in the mandible. The number of patients with different bone level changes is presented in Table 7.

Complications

Besides the implant failures described above, suprastructure complications with veneer fractures occurred in a few cases.

DISCUSSION

Few studies comparing different implant systems have been published. A prerequisite for such studies is that the patients are treated by the same team and are randomized to the systems being compared. In this study,

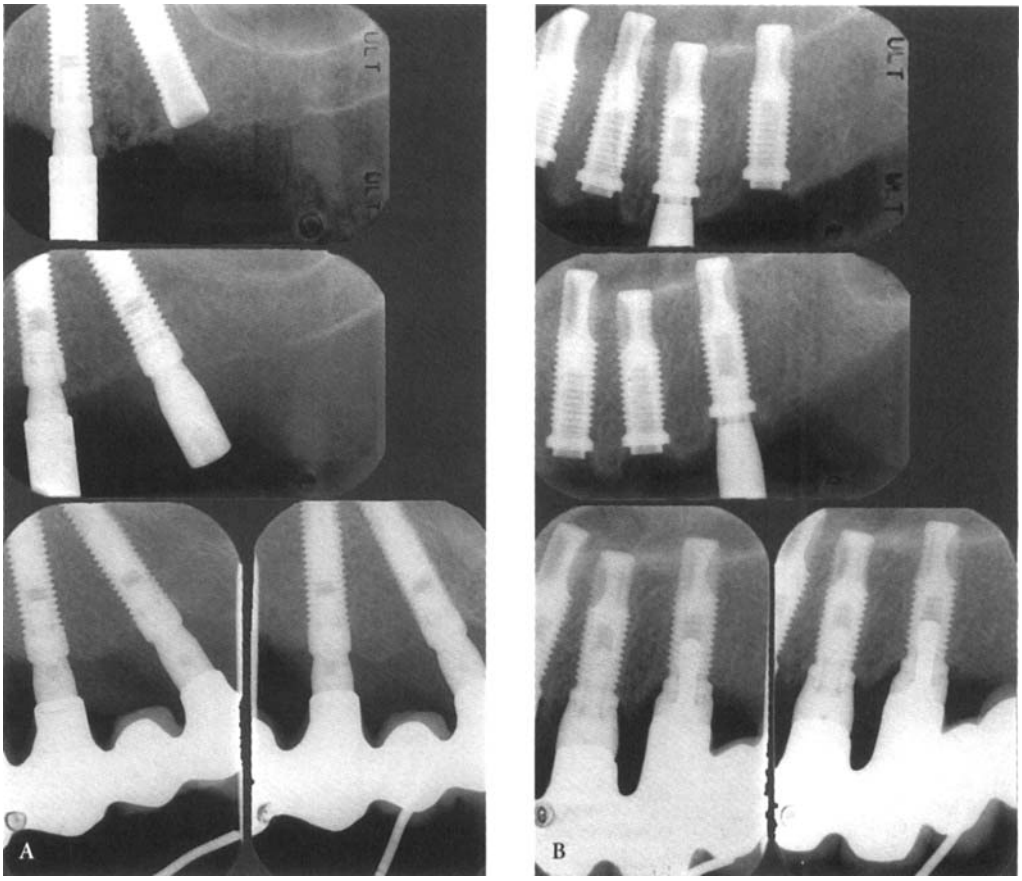

Figure 4. Radiographs of Astra Tech implants (*A*) and Brånemark System implants (*B*) from examinations made at fixture installation (*top*), abutment connection (*middle*), baseline (*bottom left*), and 1-year examination (*bottom right*).

two different Swedish implant systems were studied and compared under these circumstances. Astra Tech and Brånemark System implants both are made of commercially purity titanium but have a number of differences with regard to the macro and micro design: Brånemark System implants are threaded with a machined surface and a flat-to-flat connection of the abutments, whereas Astra Tech implants are threaded with a titanium t-oxide blasted surface and a conical connection of the abutments. The aim of this study was to determine whether the differences between the systems could have an effect on the long-term treatment results.

There is little difference in the surgical and prosthetic procedures of the two systems. The abutment connection time was shorter for the Astra Tech implants, owing to the conical connection, which facilitates the procedure (see Table 4). In general, the operation times described in this study are a little longer than could be

TABLE 5. Bone Level Differences between Examinations (Mean ± SEM)

Position and Type of Implant	Fixture–Abutment (mm)	Abutment–Baseline (mm)	Fixture–Baseline (mm)	Fixture–1 Year (mm)
Maxilla				
Astra Tech	−0.70 ± 0.33*	−0.82 ± 0.18†	−1.52 ± 0.43*	−1.72 ± 0.34†
Brånemark	−0.25 ± 0.12 (NS)	−1.58 ± 0.22†	−1.83 ± 0.23†	−1.97 ± 0.18†
Mandible				
Astra Tech	−0.55 ± 0.22 (NS)	−0.48 ± 0.16*	−0.99 ± 0.22†	−1.24 ± 0.21±
Brånemark	−0.20 ± 0.15 (NS)	−1.23 ± 0.15†	−1.44 ± 0.22†	−1.74 ± 0.20†

NS = $p < .05$; *$p < .01$; †$p < .001$.

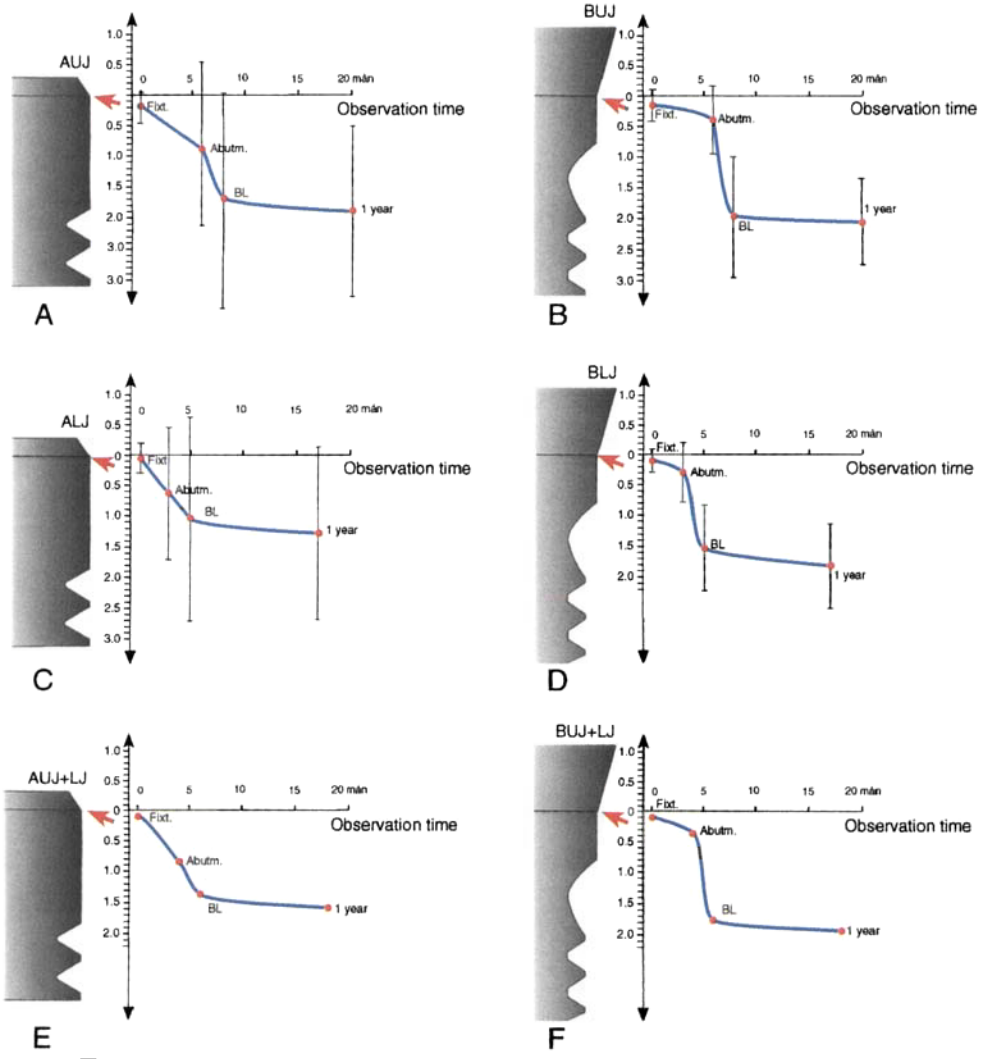

Figure 5. Diagrams illustrating the mean bone level in relation to the implants at fixture insertion (Fixt), at the abutment connection (Abutm), at the baseline examination (BL), and at the 1-year follow-up (1 year). *A–D*, The bone levels for the four different treatment groups (ALJ = Astra lower jaw, AUJ = Astra upper jaw, BLJ = Brånemark lower jaw, BUJ = Brånemark upper jaw). *E* and *F*, The mean marginal bone level values at the maxillary and mandibular implants for Astra Tech (*E*) and Brånemark implants (*F*).

expected. This is attributable to the performance of a radiographic examination during the procedures. Owing to the lack of useable angled abutments for the Astra Tech implants, in some cases, the esthetic results were affected by access holes through the facings.

The failure rate was lower for Astra Tech than for Brånemark System implants when using the implant as a unit. It is important to observe that one patient lost five Brånemark implants. This situation might indicate a patient-related problem, and there was no significant dif-

TABLE 6. Marginal Bone Level Changes between Baseline and the 1-Year Follow-Up

	Maxilla		Mandible	
Implant System	Mean ± SEM (mm)	Number of Observations	Mean ± SEM (mm)	Number of Observations
Astra	–0.22 ± 0.14	17	–0.31 ± 0.16	15
Brånemark	–0.03 ± 0.09	17	–0.31 ± 0.09	16

TABLE 7. Number of Patients with Different Mean Bone Level Changes between Baseline and 1-year Examinations

System and Position of Implant (n = 65)	Bone Level Change (mm)			
	+0.6 to +1.5 (n = 2)	−0.5 to +0.5 (n = 49)	−0.6 to −1.5 (n = 12)	−1.6 to −2.5 (n = 2)
Astra Tech				
Mandible (n = 15)	1	10	3	1
Maxillary (n = 17)	1	12	3	1
Brånemark				
Mandible (n = 16)	0	12	4	0
Maxillary (n = 17)	0	15	2	0

ference between the implant systems in the number of patients with implant losses. The sample size in this study is too small to demonstrate a difference in the low failure rates of the tested systems with the patient as a unit. The implant survival rates of this study are of the same magnitude as those reported in earlier studies.[1,2,5–7,11]

The results regarding plaque accumulation and bleeding on probing did not indicate any difference between the implant systems, and such differences were not to be expected after only 1 year of follow-up. The results might be more interesting at the coming 3- and 5-year examinations.

The first study of Astra Tech implants showed little marginal bone loss.[6] Considering those results and results published on Brånemark System implants,[1,2] less bone loss was to be expected at the Astra Tech than at Brånemark implants. However, no significant differences between the systems could be found. The magnitude of the marginal bone changes at the Astra Tech implants was in accordance with results reported in other studies.[11–13] Generally, there was little bone loss in the present study, and the majority of patients had an unchanged bone level (± 0.5 mm) or a slight bone loss (0.6–1.5 mm) (see Table 7).

Most reports on marginal bone changes at implants have the delivery of the bridge and loading of the implants as the starting-point for the follow-up. In this study, radiographic examinations also were made at fixture installation and at abutment connection, to evaluate the early bone changes. It is interesting to observe that the bone loss between fixture insertion and abutment connection was mostly greater than between baseline and 1-year follow-up (see Tables 5 and 6). Between fixture insertion and baseline, bone loss was several times greater than was found between baseline and 1-year examination. The Brånemark System implants appeared to have slightly less bone loss immediately after fixture insertion but a larger bone loss after abutment connection (see Figure 5). This might reflect the differences in the abutment systems. It is likely that the more extensive flap exposure for the Brånemark System implants accelerates the resorption temporarily. However, at the 1-year control it was stabilized, and the resorption degree was similar for both systems.

CONCLUSIONS

- The survival rate of Astra Tech implants was higher than that of Brånemark System implants.
- No difference in the number of patients with failures could be demonstrated between the two systems.
- There was no difference in marginal bone loss between the systems. However, the remodeling pattern was different.
- Abutment connection with Astra Tech implants was simpler and required significantly less time than the corresponding surgery with Brånemark System implants.

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