Fixed Implant-Supported Prostheses in Elderly Patients: A 5-Year Retrospective Comparison between Partially and Completely Edentulous Patients Aged 80 Years or Older at Implant Surgery

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ABSTRACT

Background: Knowledge on implant treatment in the partially edentulous patient is low for elderly patients aged 80 years or older at inclusion.

Purpose: The objective of this study was to report and compare the clinical and radiological performance of implant treatment in edentulous and partially edentulous elderly patients during 5 years in function.

Material and Methods: Altogether, 192 edentulous (control) and 72 partially edentulous (study) patients, consecutively treated and provided with 1,091 and 265 Brånemark implants, respectively, were included during a period between January 1986 and December 2003, and followed-up for 5 years. Clinical information was retrospectively retrieved from patient files and intraoral radiographs were analyzed for examinations at prosthesis placement and after 1 and 5 years in function.

Results: Altogether, 92 (48%) control and 24 (33%) study patients were lost to follow-up during the 5-year period. In total, 13 (4.9%) and 26 (2.4%) implants were in the study and control groups, respectively, were lost during follow-up, resulting in a comparable 5-year implant cumulative survival rate ranging from 93.9% to 99.3% for upper and lower jaws for study and control groups, respectively. Comparable mean marginal bone loss during 5 years, ranging from 0.4 mm to 0.6 mm, was also observed in the groups. The most common complications for patients in both study and control group were soft tissue inflammation (mucositis). Patients included in the first years of the inclusion (1986–1991) period showed comparable results as patient included at the last part of the inclusion period (1998–2003).

Conclusions: Implant treatment in the partially edentulous elderly patients showed comparable clinical and radiographic results as elderly patients treated in the edentulous jaw.

KEY WORDS: bone loss, clinical experience, complications, edentulism, edentulous, elderly, failures, fixed prostheses, follow-up, implants, implant surface, partially edentulous, upper jaw

INTRODUCTION

There is an obvious trend in the Western world, showing a continuous increase of persons older than 80 years in the population. In Sweden, it is predicted that this group of the population will increase by 87% from 2005 to 2050.[1] Another observation is that patients in higher age groups have more remaining teeth, and elderly people can be expected to make higher demands on dental

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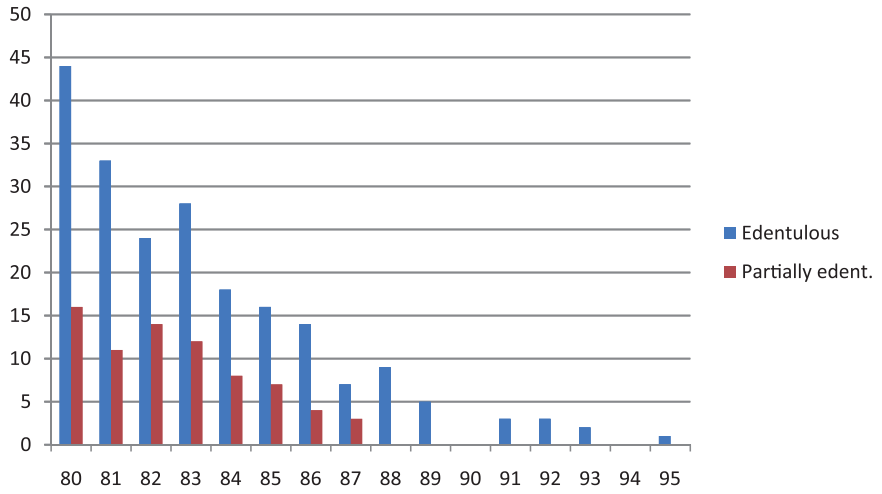

Figure 1 Included patients with regard to age at surgery.

treatment. Accordingly, it could be expected that these elderly patients will ask for more fixed restorations when teeth are lost, both supported by adjacent teeth as well as by implants.

Reports on implant function in elderly patients is contradictory, where Salonen and colleagues[2] suggest that advanced age is a contributing factor to implant failure as also supported by Brocard and colleagues.[3] Furthermore, Sundén Pikner and colleagues[4] reported more bone loss in the older the patient. In contrast to these studies, Bryant and Zarb[5] and Engfors and colleagues[6] have indicated comparable or better results of implant treatment in the elderly patients, compared with younger edentulous individuals. However, because most implant studies on elderly patients have covered the treatment of the edentulous patient, it is still an open question whether the result of implant treatment is comparable for edentulous and partially edentulous elderly patients or not.

The aim of this retrospective study was to examine the clinical and radiographic performances of fixed implant-supported prostheses, placed in partial edentulous patients aged 80 years or more, and compare the results with a similar group of edentulous patients treated with fixed implant-supported prostheses.

MATERIALS AND METHODS

The present publication is a retrospective 5-year follow-up study on elderly patients consecutively treated with fixed implant-supported prostheses at one clinic (The Brånemark Clinic, Public Dental Health Service, Göteborg, Sweden) between January 1986 and December 2003. Patients aged 80 years or older were either treated with implants in the partially (study group) or edentulous (control group) jaw during the inclusion period. Patients treated with implants in combination with major bone grafting procedures were excluded, as well as patients who had only implant surgery at the clinic, but where the prosthetic treatment was performed and followed-up by the referral dentist.

Study Group

Altogether, 1,036 jaws were consecutively treated with 3,568 implants in the partially edentulous jaw during the inclusion period at the clinic. The study group comprised of 72 patients older than 79 years, treated with 265 implants (7.4%) in 76 jaws (7.3%). Forty of the patients were females and 32 were males with a mean age of 82.6 years (standard deviation [SD] 2.11; range 80–88 years) at the time of implant surgery. Distribution of patients with regard to age at first surgery and year at inclusion is given in Figures 1 and 2.

Thirty of the included patients (42%) were taking no medication and reported good general health at the time of implant surgery. Records with regard to smoking habits were available for 41 patients (57%) and indicated that three patients (7%) were smokers.

Altogether, the patients were provided with 265 Brånemark System implants (Nobel Biocare AB, Göteborg, Sweden); 146 implants were placed in the maxilla, and 119 implants were placed in the mandible according to a routine two-stage surgical protocol.[7] Two hundred nineteen and 46 implants, respectively, were provided

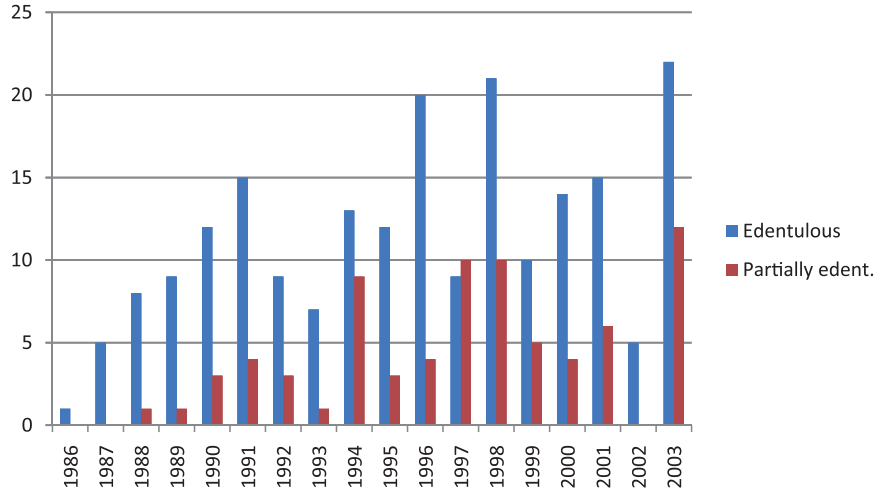

Figure 2 Numbers of patients with regard year of inclusion.

with turned and TiUnite™ surfaces. The TiUnite™ implants were placed in five upper and eight lower jaws.

Thirty-four fixed partial prostheses were placed in the lower jaws and 42 prostheses were placed in the upper jaws after abutment connection surgery. Prosthetic treatment was performed according to standard procedures using gold alloy or titanium frameworks provided with resin teeth or porcelain veneers as accounted for in earlier studies.[8] Four patients were treated with fixed partial prostheses in both jaws.

Control Group

Altogether, 3,867 edentulous jaws were consecutively treated with 20,976 implants during the inclusion period at the clinic. The control group comprised 192 patients, provided with 1,091 implants (5.2%) in 201 jaws (5.2%). One hundred eighteen patients were females and 74 were males with a mean age of 83.2 years (SD 3.06) at first surgery. Age ranged from 80 to 95 years (Figures 1 and 2). Altogether, 62 patients reported good general health and no medication (32%) at time of first implant surgery, and smoking habits was reported in 11% of the patients.

The patients were provided with 447 and 644 straight Brånemark System implants (Nobel Biocare AB, Gothenburg, Sweden) in the upper and lower jaw, respectively. Most implants were provided with turned surfaces (n-983), but 59 and 49 implants with TiUnite surfaces were placed in 11 upper and 10 lower jaws, respectively. All implants in the upper and most implants in the lower jaws were placed according to standard two-stage surgical procedure. Twenty-six edentulous lower jaws (20%) were treated according to a one-stage surgical protocol. For the upper jaws, 3, 8, 43, 7, and 11 patients received four, five, six, seven, and eight implants each, respectively. For the lower jaws, 12, 106, and 11 patients received four, five, and six implants each, respectively.

Altogether, 72 upper and 129 lower edentulous jaws were treated, where nine patients were treated with prostheses in both jaws. Because one patient was withdrawn before prosthesis delivery because of implant failures, only 71 patients received prostheses in the upper jaw.

Registrations

All data were retrospectively retrieved from the patients' records and information on age, gender, medications, general health, smoking habits, time of implant surgery, and number of implants was collected. Information on clinical complications and adjustments related to the treated jaw was also recorded.

Patients were on a routine basis recalled for checkup after 1 and 5 years of function, but also individually recalled for closer checkups if considered indicated. However, all patients were encouraged to contact the clinic whenever they had problems with their prostheses. For the control group, intraoral apical radiographs were taken on routine basis at the radiological specialist clinic (Public Dental Health Service, Göteborg) at the time of prosthesis insertion, and after 1 and 5 years in function, while radiographs were taken on a routine basis at the Brånemark clinic for the study group. The radiographs where analyzed with regard to mechanical and biological complications at the

implants and also with regard to changes of marginal bone levels. The distance between the implant reference point (0.8 mm below the fixture/abutment junction) and the marginal bone level, on both the mesial and distal sides of the implants, was recorded. A mean value between the mesial and distal side of the implant was used for calculations.

Criteria for survival rate are those suggested by Roos and colleagues.[9] Because the prostheses were not removed to determine the stability of individual implant on a routine basis at the termination of the study, the term *survival* is used in regard to implants, and the term *success* is used in regard to prostheses which can be confirmed on an individual level. The criteria for a *successful* prosthesis are used when no complications or other comments are observed in relation to the treatment during follow-up ("no event").

Statistics

Conventional descriptive statistics (mean, SDs) were used for the present material. Cumulative survival rate (CSR) for implants and prostheses was calculated according to life table techniques. Statistical comparisons of distributions between the groups have been tested by means of chi-squared techniques. Comparisons have only been performed on patient levels using the patient/prosthesis or the mean value of the patient as the base, thereby avoiding comparisons on "implant levels", "site levels", or "occation/incidence levels". Statistical significance has been set to 5% in the study.

Statistical tests were used with caution, avoiding to statistically test differences in the material when no clear difference was indicated. Still, several individual statistical tests were performed in the present study (five tests). In order to avoid false positive statistical results because of mass significance and to maintain an overall 5% level of significance in the study, a correction of the p value was performed according to Bonferroni[10] to an nominal level of $p < .01$ for the *individual* test (p value: 0.05/5 (tests) = 0.01 for individual tests).

Each group of patients were arranged into three subgroups with regard to year at inclusion, referred to as "early" (1986 to 1991), "later" (1992 to 1997), and "last" (1998 to 2003) group of patients, to analyze the possible impact of time upon clinical and radiographic parameters during the 5-year follow-up period.

RESULTS

Patients Lost to Follow-Up

Altogether, 24 patients (33%), provided with 90 implants and 26 prostheses, were lost to follow-up in the study group during the follow-up period (Table 1A and 1B). Altogether, in the control group, 92 patients (48%) patients, provided with 92 prostheses and 489 implants were withdrawn from the study (Table 1A and 1B). Most patients were withdrawn after they were deceased or because of severe illness or noncompliance. One patient was withdrawn before prosthesis placement because of economical problems in association to treatment in the lower jaw. Difference in withdrawals between the two groups was not significant ($p > .05$) after correction of the p value according to Bonferroni.[10]

Implant and Prostheses

Seven patients (9.7%) lost one implant each at second surgery in the study group (Table 1A). Thereafter, altogether, six implants were lost in function, observed in four different patients (Table 1A). None of the failing implants were provided with a TiUnite™ surface. One patient lost one implant at second surgery and the two remaining implants during the first year in function, thereby loosing the fixed prosthesis in the upper jaw (Table 1B). The 5-year implant and prosthesis CSR was calculated to 93.9% and 97.6% for the study group in the upper jaw. Corresponding 5-year CSR for the lower jaw was 96.5% and 100%, respectively (Table 1A and 1B).

Altogether, 26 implants were lost in the control group, 23 in the upper and three in the lower edentulous jaw (Table 1B). Ten of these implants were lost before prosthesis placement in six maxillae (8.3%) and one mandible (0.8%), where one patient lost all implants in one upper jaw (n-5). Thereafter, five upper jaw implants were lost during the first year in function, followed by another eight failing implants in the upper and two in the lower jaw during the following 4 years (Table 1A). Out of 26 failing implants, only one failing implant was provided with a TiUnite™ surface, removed after 5 years in function in an edentulous lower jaw.

Three fixed prostheses were lost in the upper edentulous jaw because of implant failures after 8 months, 1, and 3 years in function, respectively. These patients resumed to complete dentures (one patient) or removable overdentures (two patients), supported by remaining implants. The 5-year implant CSR was calculated to

TABLE 1A Life Table Analysis of Implants Placed and Lost during 5 years

	Maxilla				Mandible			
	No. of Implants				No. of Implants			
Time Period	Followed	Failed	Withdrawn	Implant CSR (%)	Followed	Failed	Withdrawn	Implants CSR (%)
Study group								
Placement	146	–	–	100, 0	119	–	–	100, 0
Loading	142	4	–	97, 3	116	3	–	97, 5
1st year	133	5	6	93, 9	113	–	3	97, 5
2nd year	120	–	13	93, 9	100	–	13	97, 5
3rd year	100	–	20	93, 9	86	1	13	96, 5
4th year	97	–	3	93, 9	83	–	3	96, 5
5th year	81	–	16	93, 9	83	–	–	96, 5
Total	81	9	58	93, 9	83	4	32	96, 5
Control group								
Placement	447	–	–	100	644	–	–	100
Loading	435	10	2	97, 8	643	1	–	99, 8
1st year	387	5	43	96, 6	610	–	33	99, 8
2nd year	345	4	38	95, 5	515	1	94	99, 6
3rd year	332	1	12	95, 3	472	–	43	99, 6
4th year	283	3	46	94, 3	369	–	103	99, 6
5th year	253	–	30	94, 3	323	1	45	99, 3
Total	253	23	171	94, 3	323	3	318	99, 3

CSR, cumulative survival rate.

TABLE 1B Life Table Analysis of Prostheses during 5 years

	Maxilla				Mandible			
	No. of Jaws				No. of Jaws			
Time Period	Followed	Failed	Withdrawn	Implant CSR (%)	Followed	Failed	Withdrawn	Implants CSR (%)
Study group								
Placement	42	–	–	100	34	–	–	100
1st year	40	1	2	97, 6	33	–	1	100
2nd year	35	–	5	97, 6	29	–	4	100
3rd year	30	–	5	97, 6	26	–	3	100
4th year	29	–	1	97, 6	25	–	1	100
5th year	25	–	4	97, 6	25	–	0	100
Total	25	1	17	97, 6	25	0	9	100
Control group								
Placement	71*	–	–	100	129	–	–	100
1st year	63	1	7	98, 5	122	–	7	100
2nd year	56	1	6	96, 9	103	–	19	100
3rd year	54	–	2	96, 9	94	–	9	100
4th year	45	1	8	94, 9	73	–	21	100
5th year	41	–	4	94, 9	64	–	9	100
Total	41	3	27	94, 9	64	0	65	100

*One patient withdrawn after implant failure at second surgery, before prosthetic treatment.
CSR, cumulative survival rate.

TABLE 2 Number of Patients with Reported Problems during the 5-Year Follow-Up Period. A Total of 72 and 192 Patients Were Treated in the Test and Control Groups Respectively

	Patients					
	Maxilla		Mandible		Total	
Complication	Study Group	Control Group	Study Group	Control Group	Study Group	Control Group
Implant failures	6	12	4	3	10*	16*
Mucositis	11	13	9	15	20	28
Cheek, lip, tongue biting	–	6	–	10	0*	16*
Resin Veneer/porcelain fracture	3	9	1	7	4*	16*
Implant component fractures	–	–	–	2	0	2
Loose abutment and/or prostheses screws	–	2	–	–	0	2
Patient-related aesthetic problems	–	2	–	2	0	4
Patient-related speech problem	–	6	1	3	1*	9*
Others	6	3	3	19	9	22

*Not statistically significant ($p > .05$) after correction of p value according to Bonferroni.[10]

94.3% and 99.3% for upper and lower jaws in the control group, respectively. Corresponding prosthesis 5-year CSR was 94.9% and 100%, respectively (Table 1A and 1B). Comparable results regarding implant and prosthesis failures were observed in the two groups.

Follow-Up, Maintenance, and Complications

In the study group, altogether, 18 (53%) and 22(52%) of the prostheses were recorded with no complications or other comments in their files ("no events") during follow-up in upper and lower jaws, respectively. The corresponding number of prostheses followed-up for 5 years was 12 (67%) and 10 (45%), respectively. Corresponding results of "no event" for the control group were 42 (52%) and 67(48%) patients, and 17 (40%), 20 patients (30%), respectively.

With regard to noted problems in patients during follow-up, the most frequent problem was related to mucositis followed by implant failures in the study group (Table 2). Mucositis, lip/cheek biting, and speech problems were the most frequently reported problems in the control group (Table 2). Besides significantly more patients reporting problem with cheek/lip biting ($p < .05$), no significant differences in problems were observed between the two groups ($p > .05$).

Radiographic Observations

Mean marginal bone level and mean marginal bone loss at the implants in the study group is shown in Table 3A and 3B. Mean marginal bone levels increased from 0.4 mm (SD 0.61) and 0.3 mm (SD 0.51) to 1.0 mm (SD 0.51) and 0.7 mm (SD 0.60) for upper and lower partially edentulous jaws after 5 years in function, respectively (Table 3A). Bone loss during the 5-year follow-up period reached on an average 0.6 mm (SD 0.47) and 0.4 mm (SD 0.50) for upper and lower jaws, respectively (Table 3B). No implant presented bone loss > 2.4 mm during the follow-up period (Table 3B).

Corresponding mean marginal bone levels for the edentulous patients in the control group increased from 0.5 mm (SD 0.45) and 0.2 mm (SD 0.30) to 0.9 mm (SD 0.47) and 0.6 mm (SD 0.45) for upper and lower jaws, respectively (Table 4A). Average bone loss during the 5 years in function was 0.6 mm (SD 0.46) and 0.6 mm (SD 0.47), respectively. Only five implants presented bone loss > 2.4 mm during the follow-up period (Table 4B). Comparable bone reaction can be noticed in the two groups of patients.

Regarding bone loss at the TiUnite™ implant surfaces, an average of 0.5 (SD 0.66) mm and 0.4 (SD 0.70) mm bone loss was observed during the 5-year follow-up in upper (two patients, six implants) and lower jaws (four patients, 14 implants) in the test group, respectively. Corresponding mean bone loss in the control groups were 0.5 mm (SD 0.37) and 0.7 mm (SD 0.43) for upper and lower jaws, respectively.

Observations Regarding Period of Treatment

After arranging patients into subgroups according to year at inclusion, it was observed that patients

TABLE 3A Mean Marginal Bone Levels in mm in the Partially Edentulous Jaw. Distributions of Implants with Regard to Bone Levels during Different Time Intervals Are Also Given

	Bone Levels for the Test Group					
	Placement		After 1 Year		After 5 Years	
	Maxilla	Mandible	Maxilla	Mandible	Maxilla	Mandible
Patients	42	28	34	31	24	24
Implants	141	93	115	107	78	80
Mean marginal bone level (mm)						
Mean	0.4	0.3	0.9	0.6	1.0	0.7
SD	0.61	0.51	0.64	0.45	0.51	0.60
Distribution of implants with regard to bone levels (%)						
0.0 mm	92 (66)	69 (73)	28 (24)	49 (46)	10 (13)	28 (35)
>0–1.1 mm	36 (26)	21 (23)	57 (50)	49 (46)	45 (58)	36 (45)
>1.1–1.7 mm	7 (5)	2 (2)	20 (17)	8 (8)	16 (21)	11 (14)
>1.7–2.3 mm	3 (2)	1 (1)	6 (5)	1 (1)	4 (5)	3 (4)
>2.3–2.9 mm	1 (1)	1 (1)	4 (4)	0	2 (3)	0
>2.9 mm	2 (1)	0	0	0	1 (1)	2 (3)

SD, standard deviation.

who were included in the "first" group (1986 to 1991) showed comparable frequency of complications and change of bone levels during 5 years of follow-up, as compared with the groups of patients included in the" later" (1992–1997) or the "last" group (1998–2003) of patients, respectively. The only trend that could be observed by time was related to fewer implant failures in the "last" group of patients (1998–2003), when more implants with TiUnite™ surfaces were used.

TABLE 3B Mean Marginal Bone Loss in mm in the Partially Edentulous Test Group Distributions of Implants with Regard to Amount of Bone Loss during Different Time Intervals Are Also Given

	Bone Loss during Follow-Up					
	0 to 1 Year		0 to 5 Years		1 to 5 Years	
	Maxilla	Mandible	Maxilla	Mandible	Maxilla	Mandible
Patients	34	26	24	21	20	23
Implants	115	87	78	69	67	77
Mean	–0.5	–0.3	–0.6	–0.4	–0.2	–0.1
SD	0.51	0.42	0.47	0.50	0.41	0.32
Bone Loss	Distribution of Number of Implants with Regard to "Gain"/Bone Loss (%)					
"Increase"	68 (59)	28 (32)	50 (64)	34 (49)	13 (19)	21 (27)
0.0 mm	45 (39)	57 (66)	24 (30)	30 (44)	51 (76)	48 (62)
0.1–0.6 mm	1 (1)	1 (1)	2 (3)	0	3 (5)	4 (5)
0.7–1.2 mm	0	1 (19	2 (3)	4 (6)	0	4 (5)
1.3–1.8 mm	0	0	0	1 (1)	0	0
1.9–2.4 mm	1 (1)	0	0	0	0	0
>2.4 mm	0	0	0	0	0	0

SD, standard deviation.

TABLE 4A Mean Marginal Bone Levels in mm in the Edentulous Control Group. Distributions of Implants with Regard to Bone Levels during Different Time Intervals Are Also Given

	Bone Levels for the Control Group					
	Placement		After 1 Year		After 5 Years	
	Maxilla	Mandible	Maxilla	Mandible	Maxilla	Mandible
Patients	65	126	60	113	28	46
Implants	387	620	370	563	167	230
Mean marginal bone level in mm						
Mean	0.5	0.2	0.9	0.6	1.1	0.8
SD	0.45	0.30	0.47	0.45	0.52	0.53
Distribution of implants with regard to bone levels (%)						
0.0 mm	198 (51)	432 (70)	98 (26)	198 (35)	38 (23)	67 (29)
>0–1.1 mm	136 (35)	173 (28)	176 (48)	294 (52)	65 (39)	122 (53)
>1.1–1.7 mm	42 (11)	13 (2)	78 (21)	54 (10)	43 (26)	27 (12)
>1.7–2.3 mm	8 (2)	1 (0)	11 (3)	10 (2)	13 (8)	9 (4)
>2.3–2.9 mm	1 (0)	0	4 (1)	6 (1)	4 (2)	4 (2)
>2.9 mm	2 (1)	1 (0)	3 (1)	1 (0)	4 (2)	1 (0)

DISCUSSION

Patients referred to as "older" or "elderly" varies significantly in age in the literature.[11] Accordingly, definition of "the elderly patient" range from an age of 60 years or more,[12,13] 65 years or more,[14,15] to 70 years or more.[16] The present study has used the criteria as used by the official SCB ("Statistics Sweden") in their definition of "older-older" patients, presenting an age of 80 years or more.[1] Similar criteria for "elderly" patients has been used Grant and Kraut[17] and Engfors and colleagues[6]

This group of elderly patients represents about 5.4% of the entire population and 7.1% of the adult

TABLE 4B Mean Marginal Bone Loss in mm in the Edentulous Control Group. Distributions of Implants with Regard to Amount of Bone Loss during Different Time Intervals Are Also Given

	Bone Loss during Follow-Up					
	0 to 1 Year		0 to 5 Years		1 to 5 Years	
	Maxilla	Mandible	Maxilla	Mandible	Maxilla	Mandible
Patients	60	113	27	44	27	40
Implants	371	563	162	219	162	201
Mean	−0.4	−0,4	−0.6	−0.6	−0.2	−0.2
SD	0.44	0.39	0.46	0.47	0.23	0.26
Bone Loss	Distribution of Number of Implants with Regard to "Gain"/Bone Loss (%)					
"Increase"	25 (7)	21 (4)	5 (3)	5 (2)	7 (4)	8 (4)
0.0 mm	187 (50)	264 (47)	64 (40)	81 (37)	100 (62)	139 (69)
0.1–0.6	65 (18)	140 (25)	29 (18)	57 (26)	34 (21)	32 (16)
0.7–1.2	66 (18)	103 (18)	38 (23)	48 (22)	14 (9)	15 (7)
1.3–1.8	21 (6)	26 (5)	16 (10)	20 (9)	5 (3)	7 (3)
1.9–2.4	5 (1)	4 (1)	6 (3)	7 (3)	1 (1)	0
>2.4 mm	2 (1)	5 (1)	4 (2)	1 (0)	1 (1)	0

population (>19 years) in Sweden.[1] The proportion of treated elderly partially (7.3%) and edentulous (5.2%) jaws at the present clinic coincide well with these overall population figures. However, because the proportion of elderly patients is relatively low, a long inclusion period has been necessary to reach representative numbers of the groups. The risk of skewness in the material is then obvious because of such a long inclusion period, but not reaching any significant levels for the parameters used in the present study.

Follow-up studies on elderly patients involve higher levels of lost patients because of their age at inclusion.[6] Thus, higher numbers of patients lost after they have deceased or withdrawn because of severe illness is expected, and will substantially reduce the remaining number of the patients at the termination of the 5-year follow-up study. Accordingly, higher numbers of patients are also needed at inclusion, to allow reasonable numbers of patients at termination of the study. According to population data, a patient at age 80 years have a statistical mean probable remaining life-time of about 7.6 to 9.4 years (year 2006), while a patient at an age of 90 years has only a mean expected remaining life-time of 3 6 to 4.4 years.[18] With these figures in mind, dropout levels of 33% and 47% during the 5 years of follow-up in the present groups of elderly patients can be considered acceptable, even though the figures are higher than reported for other follow-up studies on younger age groups over a 5-year period of time.[19–21] The difference in numbers of dropout patients in the present study did not reach significant levels after correction of p values according to Bonferroni,[10] but still indicates higher dropout levels for edentulous patients in these elderly populations. A possible explanation to this trend could be that older patients were included in the control group, but differences related to longer expected life time in dentate as compared with edentulous patients could not be disregarded as suggested by Österberg and colleagues[22] and Holm-Pedersen and colleagues[23]

Overall, implant treatment in the elderly partially edentulous patient functioned well during the 5 years in accordance with earlier experiences, indicating that implant treatment in the elderly partially edentulous jaw is a predictable clinical protocol in the long-term perspective.[24] The pattern and frequency of lost implants as well as the degree of bone loss were comparable for the two groups, indicating that implant treatment can be expected to function as well in partially edentulous as in edentulous elderly patients. Because the clinical performances of implant treatment was similar for both groups of patients, results seems to be favorable for elderly patients, coinciding well with other reports on implant treatment in younger age groups.[20,25,26] Adaptation problems as lip/cheek biting and diction problems observed in elderly edentulous patients[6] could not be seen in the present study group, probably because of that fewer teeth were replaced in this group.

It can be assumed that elderly patients present a more compromised situation for osseointegration because of compromised general health. However, at present time, there are no data to contraindicate the use of dental implants in osteoporotic patients; however, a proper adjustment of the surgical technique and a longer healing period may be considered in order to achieve osseointegration.[27] Thus, diagnosis of osteoporosis and osteopenia was not reported to contribute to increased risk of implant failure.[28] Also, other studies show that implant therapy in geriatric patients with controlled systemic disease should not be considered to be of particularly high risk.[16] Accordingly, age alone is not a contraindication for implant treatment.[13,29–32]

In conclusion, it can be observed that implant treatment in elderly patients seems to be comparable in partially and edentulous patients, also showing overall 5-year results also comparable with treatment of younger age groups.

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