Immediate and Delayed Implant Placement Into Extraction Sockets: A 5-Year Report

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ABSTRACT

Background: As a complement to the earlier reported 3-year results from a prospective multicenter study of immediate and delayed placement of implants into fresh extraction sockets, the 5-year results are reported.

Purpose: The purpose of this 5-year report was to evaluate the immediate and long-term success of implants placed into fresh extraction sockets, with respect to implant size and type, bone quality and quantity, implant position, initial socket depth, and reason for tooth extraction.

Materials and Methods: This paper presents the 5-year results of the original 12 centers that participated with 143 consecutively included patients. A total of 264 implants were placed either immediately after tooth extraction or after a short soft-tissue healing time (3–5 weeks). The patients were divided into five subgroups, depending on the type of insertion method used.

Results: The outcome demonstrated that the cumulative implant survival rate after 5 years of loading has not changed and remains 92.4% in the maxilla and 94.7% in the mandible. No difference in failure rates can be seen between the groups when relating the failures to insertion method.

Conclusion: This prospective study demonstrated that placing Brånemark implants into fresh extraction sites can be successful over a period of 5 years of loading. One of the outcomes of the study shows that there is a clinical correlation between implant failure and periodontitis as a reason for tooth extraction, even if it is difficult to give it a casual association. It can be hypothesized that periodontitis affected tissues might have a negative local influence because of the presence of infrabony defects that could possibly increase the gap between bone and implant or jeopardize achievement of primary stability.

KEY WORDS: Brånemark System® implants, delayed implant placement, fresh extraction sockets, immediate implant placement, prospective multicenter study

The 3-year results from this prospective multicenter study of immediate and delayed placement of Brånemark System® implants in extraction sockets were reported earlier.[1] The results were similar to those obtained for the placement of implants into ossified extraction sites according to the standard protocol[2,3] and were in agreement with other human studies with the immediate implant placement method.[4–10] The purpose of this 5-year report was to evaluate the immediate and long-term success of implants placed into fresh extraction sockets, with respect to implant type and size, bone quality and quantity, implant position, initial socket depth, and reason for tooth extraction.

The patients were divided into five subgroups, depending on what type of direct insertion method was used. The surgical methods, already described in the previous article, were as follows:

1. The implant was placed immediately when the tooth was extracted (immediate placement).
2. The implant was placed after a 3- to 5-week healing period of the extraction site (delayed placement).
3. Membranes were placed over the extraction sites.

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4. Freeze-dried bone, bone graft, or collagen was used.

Methods 1 and 2 were used alone or in combination with 3 and/or 4.

These different surgical techniques for an immediate or delayed placement of implants have been used for single-tooth replacement, in partial reconstructions, and in full bridges.

MATERIALS AND METHODS

The outline of this prospective multicenter study has previously been reported in detail[1] and will therefore only be mentioned briefly. Originally, 12 centers participated with 143 consecutively included patients, 75 females and 68 males. Two hundred sixty-four implants (Nobel Biocare AB) were placed in 105 maxillae and 43 mandibles. They were placed either immediately after tooth extraction or after a short soft-tissue healing time. The first implant was placed in January 1991 and the last in June 1992.

The reason for tooth extraction was recorded. Bone quality and quantity were classified according to Lekholm and Zarb.[3] Socket depths were recorded as well as implant type, size, and position. One hundred thirty-nine suprastructures (101 in maxillae and 38 in mandibles) were placed in 126 patients. These were 76 single-tooth replacements (66 in maxillae and 10 in mandibles), 40 partial restorations (22 in maxillae and 18 in mandibles), and 23 complete arch prostheses (13 in maxillae and 10 in mandibles).

Clinical parameters (bleeding or not bleeding, pocket depth, implant mobility) were evaluated after 1, 3, and 5 years. Radiographic examinations were performed at the time of prosthesis connection and at the 1- and 5-year follow-ups. The marginal bone levels were examined by an independent radiologist at the University of Göteborg, Sweden. All complications were reported. A successful treatment is defined as a stable implant without any pathologic findings according to Albrektsson et al.[11] Since all suprastructures were not removed to check individual implant stability, this article can only report the implant survival rate.

Statistical Analysis

Cox regression analysis was used to evaluate the influence of bone quality, bone quantity, reason for tooth loss (periodontitis/not periodontitis), implant type (self-tapping/standard), jaw, and type of insertion method (immediate/delayed) on implant failure.[12] When comparing the failure rates between different implant types, reason for tooth loss, methods for placement, and different implant positions, the chi-square test with Yate's correction was used.[12] Spearman's rank correlation test was used to evaluate the correlation between reason for tooth loss and implant failure and between method of placement and implant failure.[13]

One implant in each patient has been used for statistical analysis to avoid dependence. The implants have been randomized by using a table of random numbers.[14] Life table analyses were used to calculate cumulative survival rates for the implants.

RESULTS

Of the originally included 143 patients, 57 were withdrawn from the study. The reasons for patient withdrawals are given in Table 1. All implant failures that occurred before the patients withdrew are included in the total number of failed implants.

Seventeen of the originally inserted 264 implants failed, giving an overall failure rate of 6.4%: 12 of the 165 maxillary implants (7.3%) and 5 of the 99 mandibular implants (5.1%). When the failures were related to implant position, the posterior maxilla showed the

TABLE 1. Reasons for Patient Withdrawals

	Number of Patients							
Time	Deceased	Moved	Fixture Failure	Poor Compliance	Other	Withdrawn Clinic	Unknown	Total
Abutment	1	1	2	7	1	0	1	13
Prostheses	0	0	1	1	1	0	1	4
1 year	0	0	1	0	0	0	0	1
3 years	0	7	1	5	0	0	4	17
5 years	0	1	0	2	0	7	12	22
Total	1	9	5	15	2	7	18	57

TABLE 2. Fixture Losses Related to Insertion Method and Reason for Tooth Extraction

		Immediate Insertion*				After Soft-Tissue Healing (3–5 Wks)†			
		1	1+3	1+4	1+3+4	2	2+3	2+4	2+3+4
Maxillae	Placed	71	45	6	8	23	10	1	1
	Failed 1	5	4	0	0	2	0	0	0
	Failed 2	1	0	0	0	0	0	0	0
Mandibles	Placed	75	9	1	2	11	0	0	1
	Failed 1	2	0	0	0	1	0	0	0
	Failed 2	1	1	0	0	0	0	0	0

Failed 1 = periodontitis was either the only or one of the reasons for extraction; failed 2 = other reasons for tooth extraction.
*1 = immediate insertion, 1+3 = immediate insertion + membranes, 1+4 = immediate insertion + bone graft or freeze-dried bone, 1+3+4 = immediate insertion + freeze-dried bone + membranes.
†2 = soft-tissue healing, 2+3 = soft-tissue healing + membranes, 2+4 = soft-tissue healing + collagen, 2+3+4 = soft-tissue healing + freeze-dried bone + membranes.

highest failure rate with 11.1%, compared to 5.8% for the anterior maxilla, 4.9% for the anterior mandible, and 5.2% for the posterior mandible.

When relating the failures to insertion method and the reason for tooth extraction, there seems to be a correlation between implant failure and immediate insertion in the maxillae where periodontitis was either the only or one of the reasons for tooth extraction (Table 2).

Immediate insertion with or without membranes, freeze-dried bone, bone graft, or collagen was used for 82% of the implants, and only 18% of the extraction sites were left to heal for 3 to 5 weeks before implant placement. No difference in failure rates can be seen between the groups.

Fistula formation was registered for eight patients at abutment connection time. After the 5-year follow-up, one of the fistulas was still present. Soft-tissue penetration was also registered for eight patients at abutment connection time. Two patients had paresthesia at abutment connection time, but this had disappeared at the 1-year follow-up. The gingival situation throughout the 5 years after prosthetic treatment has been stable for all patients (Tables 3 and 4).

TABLE 3. Gingival Status Around the Abutments (%)

	Maxillae				Mandibles			
	Prostheses (n = 386)	1 Year (n = 493)	3 Years (n = 314)	5 Years (n = 145)	Prostheses (n = 190)	1 Year (n = 226)	3 Year (n = 280)	5 Years (n = 132)
No bleeding	76	81	79	75	72	87	84	70
Bleeding	24	19	21	25	28	13	16	30

The above registrations were not given for all sites.

TABLE 4. Pocket Depths Around the Abutments (%)

	Maxillae				Mandibles			
	Prostheses (n = 432)	1 Year (n = 520)	3 Years (n = 422)	5 Years (n = 274)	Prostheses (n = 312)	1 Year (n = 304)	3 Year (n = 276)	5 Years (n = 252)
< 4 mm	82	79	80	73	91	92	95	88
≥ 4 mm	18	21	20	27	9	8	5	12

The above registrations were not given for all sites.

TABLE 5. Marginal Bone Resorption

	Maxillae		Mandibles	
0–5 Years	Mesial	Distal	Mesial	Distal
Number	67	67	52	52
Mean value	1.17	1.19	0.71	0.64
SD	1.37	1.49	1.27	0.43
< 0	1	4	4	5
0	10	11	19	19
0.1–0.5	20	14	7	8
0.6–1.0	11	16	12	9
1.1–2.0	13	10	6	5
> 2	12	12	4	6

The marginal bone loss around implants is presented in Table 5. From the time of implant loading to the 5-year follow-up, the total amount of bone loss was 1.17/1.19 mm (SD = 1.37/1.49) in the maxillae and 0.71/0.64 mm (SD = 1.27/0.43) in the mandibles. These values are well within the limits according to Albrektsson et al.[11]

There has been no implant failure after the 3-year follow-up, and the cumulative survival rate after 5 years of loading is 92.4% in the maxillae and 94.7% in the mandibles (Table 6).

Figures 1 to 4 show a single tooth case, with a radiograph and a clinical view both from the time of the trauma and from the 5-year follow-up.

Statistical Results

No relationship could be found between implant failure and bone quality, bone quantity, reason for tooth loss, implant type, jaw, or type of insertion method ($p > .05$ for all variables). However, there was a tendency of relationship of reason for tooth loss on implant failure ($p \approx .06$). No significant difference ($p > .05$) could be found between failure rate in different implant types, different reasons for tooth loss, different methods for placement, or different implant position. The correlation between reason for tooth loss and implant failure ($p \approx .053$) indicates a tendency toward correlation between the two variables. No correlation could be seen between method of placement and implant failure ($p < .05$).

DISCUSSION

Placing an implant into a fresh extraction socket seems to offer many advantages for the patient and for the clinician (e.g., shorter treatment time and fewer surgical sessions).[15–17]

The first 6 months postextraction are critical because the highest rate of bone resorption occurs in either direction.[18–21] Therefore, the immediate or delayed insertion after extraction can be a realistic opportunity to reduce the postextraction bone loss. This method is an important modification of the traditional surgical protocol, recommending a 12-month healing period between tooth extraction and placement of implants,[2] and, in our opinion, finds special indication in the frontal esthetic regions of the upper jaw.

The anatomic characteristics of the socket after tooth extraction is different from the socket environment after 1 year of healing. Implants placed immediately into fresh extraction sites engage precisely prepared bony walls only in their apex, whereas the coronal space is filled by the end of the healing phase. The main difference occurs during the initial phase of osseointegration. That is why most of the studies focus on this interval to define survival rates.[22]

There are only a few human studies with more than 50 immediately placed screw-type titanium implants published[5,10,23–26] but they all show a high rate of survival, ranging between 93.9% and 100%.

TABLE 6. Life Table Analysis

	Maxillae Fixtures				Mandible Fixtures			
Time Period	Fixtures	Failed	Withdrawn	CSR (%)	Fixtures	Failed	Withdrawn	CSR (%)
Placement to loading	165	7	16	95.8	99	3	10	97.0
Loading to 1 year	142	1	0	95.1	86	1	0	95.8
1–3 years	141	4*	18	92.4	85	1	6	94.7
3–5 years	119	0	31	92.4	78	0	3	94.7
5 years	88	—	—	—	75	—	—	—

*One of these fixtures fractured.

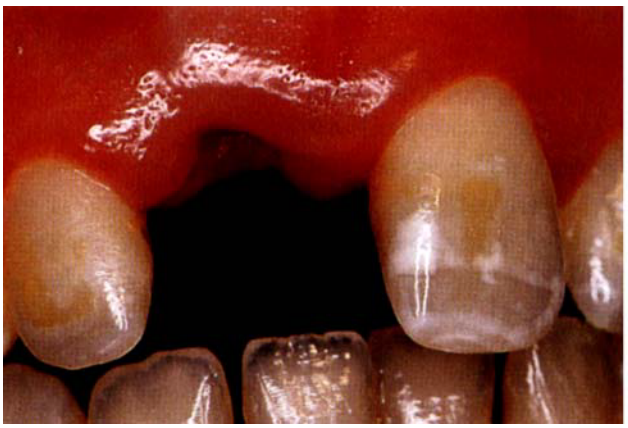

Figure 1. Central incisor lost after trauma.

Figure 3. Clinical view of the restoration after 5 years of loading.

This study, with an overall survival rate of 93.6%, confirms the predictability of this modified surgical protocol. Cumulative survival rates of 92.4% for the maxillae and 94.7% for the mandibles after 5 years of loading are similar to the survival rates described in other studies with delayed or immediate implantation methods.[4–10]

Ten implants (58.8% of the failures) were lost before loading, 2 (11.8%) between 1 month and 1 year of loading and 5 (29.4%) between 1 and 3 years of loading. There were no failures between the 3- and 5-year follow-ups. The high number of failures after loading leads to the speculation that the healing time could have been insufficient to achieve osseointegration.[1]

The higher failure rates for implants in the posterior maxillae[27,28] confirm the results of various other studies.[19–31] This may be related to difficulties in achieving primary stability in a fresh extraction socket in the posterior maxilla. Initial implant mobility is, in fact, an important factor associated with implant integration.[32]

One of the outcomes in this study is the clinical correlation between implant failure and periodontitis as a reason for tooth extraction. In 14 of 17 patients where an implant was lost, periodontitis was the reason or one of the reasons why a tooth had to be extracted. Similar findings were reported by Rosenquist and Grenthe.[9] On the other hand, the vast majority of implants placed in this study were associated with a history of previous

Figure 2. Rx showing fracture of the root of the same incisor. There is optimal indication for an immediate replacement with an implant just after the root extraction.

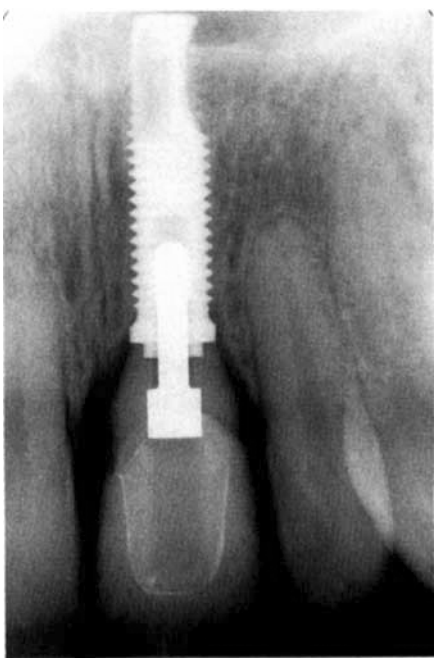

Figure 4. Rx of the same showing good marginal bone response and absence of any residual vertical bone defect.

local attachment loss resulting from periodontal disease. However, we could not observe an increased statistically significant incidence of implant loss comparing immediate and early implant placement when periodontitis was the cause of tooth loss. Therefore, in agreement with some authors,[33–35] it might be difficult to assume a causal association between implant failure and a previous history of periodontal disease. However, it can be speculated that periodontitis-affected tissues might have had a negative local influence also for the presence of infrabony defects; this could increase the gap between bone and implant[36] or jeopardize achievement of primary stability[32] both at immediate and early implant placement. The depth of the extraction socket does not appear to have any influence on the survival rate of implants, which is in agreement with the finding of Nir-Hadar et al.[37] Comparing the results of the different methods used in this study, there was no clinical difference whether an implant was placed immediately after tooth extraction or after allowing soft-tissue healing for a few (3–5) weeks if membranes or different gap filling material was used. These results correlate well with the results published by Mensdorff-Pouilly et al.[6]

The gap's entity seems crucial and inversely correlated with bone-implant contact percentage,[36,38,39] and this fact could be the reason for an increased risk of poor osseointegration.

Regarding the importance of gap-filling materials, the impression obtained from the literature is that autologous bone grafts seem to be the best filler material,[23,40] but implants placed into fresh extraction sites without augmentation or grafting have excellent long-term results.[26] The need for bone augmentation and also for primary flap closure has never been proven.[41]

Although growth factors such as IGF-1, and rhOP-1 have been tested as bone formation promoters in fresh extraction sites, the results are questionable.[42,43] In this study, the use of membranes placed over the extraction site does not demonstrate any advantages. Histologic studies in dogs did not show better bone-implant contact ratios with membranes.[44] On the contrary, several studies have shown that membrane exposure led to complications,[5,7,10] such as bone resorption or even failure of the entire implant procedure.[45]

Therefore, and within the limits of this study, we can conclude that with the simplest method of placing implants into fresh extraction sites, we have obtained a high survival rate. The use of membranes with or without the use of filling material (freeze-dried bone, autogenous bone grafts, collagen, or a combination of the above) does not imply better results.

A multicenter study with 12 different investigating centers is difficult to complete without a great number of withdrawn patients. To be able to verify the safety and the benefit of new surgical protocols within the same implant systems, studies with a higher number of patients and a limited number of parameters are needed.

CONCLUSION

This study demonstrated that treatment with Brånemark implants placed into fresh extraction sites with an immediate or delayed method can be successful over a period of 5 years. No implant failure has occurred after the 3-year follow-up, giving a cumulative survival rate of 92.4% in the maxillae and 94.7% in the mandibles after 5 years of loading, which is comparable to the results of other studies using similar procedures.

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