Immediate Placement of Implants Into Extraction Sockets: Implant Survival

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In 51 patients (21 males and 30 females) aged 16 to 72 years, a total of 109 Nobelpharma implants were placed into extraction sockets immediately following extraction. The follow-up period varied between 1 and 67 months with a mean of 30.5 months. Osseointegration was determined by clinical stability, lack of symptoms, and lack of peri-implant pathology based on radiographic examination. The implant survival rate was 93.6%. Six implants were mobile at the abutment connection stage, and one was lost when function commenced. The success rate was 92.0% for implants replacing teeth extracted because of periodontitis and 95.8% for implants replacing teeth extracted for other reasons. Two other complications occurred: 12 cover screws perforated the gingiva during healing; and infection developed in five cases. The incidence of infection was higher in the periodontitis group. It was found that immediate placement of implants into extraction sockets is a safe and predictable procedure if certain guidelines are followed. (Int J Oral Maxillofac Implants 1996;11:205-209)

Key words: extraction socket, immediate implant, osseointegration, stability

Since Brånemark introduced the osseointegration concept, development has followed three paths. The method has been applied to partially edentulous patients and used to replace single teeth. New donor sites and new techniques to transplant bone have given new groups of patients access to implants. Finally, efforts have been made to reduce the treatment period.

It has been regarded as prerequisite for the osseointegration of implants that they be placed completely surrounded by bone of good quality. A healing period of at least 6 months has therefore been recommended between extraction of a tooth and subsequent implant placement. However, not only does the healing period delay treatment for 6 months, but sometimes the result is jeopardized because resorption may leave the alveolar process too thin for implant placement. In a number of animal studies, successful placement of implants into fresh extraction sockets has been reported.¹-³ These reports have been followed by equally encouraging studies in humans, although the number of subjects has been either small or not specified.⁴-⁸

The aim of the present study was to calculate the success rate of immediate placement of implants into fresh extraction sockets.
Materials and Methods
Fifty-one consecutive patients (21 males and 30 females) in whom immediate implant surgery was performed between March 1989 and April 1994 were included in the study. Mean age at the time of surgery was 32.9 years with a range of 16 to 72 years. A total of 109 Nobelpharma implants (Nobelpharma AB, Göteborg, Sweden) were placed. The types and lengths of implants used are given in Table 1, and the extraction indications are in Table 2.

The surgical technique varied with the diagnosis of the tooth and with the local anatomy. Extraction was performed as gently as possible. In most single-tooth cases, a buccal flap was raised. When several teeth were replaced by implants in a region or when additional implants were placed between the extraction sockets, an incision was made on top of the alveolar ridge crest and both buccal and lingual flaps were raised. In 10 patients, various amounts of bone had to be removed: in five patients, the marginal buccal bone was reduced; and in five, an apical “window” was made in the cortex to facilitate removal of a root with horizontal fracture. When the indication for extraction was periodontitis, careful curettage of the socket was performed. The presence of active suppuration was permitted at the time of extraction.

The implants were normally placed along the lingual wall of the extraction socket in the incisor and canine areas and centrally in the socket in the premolar areas. In all patients, the large twist drill was inserted until it was cutting at least 5 mm into solid bone. All implants were thus initially stabilized by at least 5 mm of bone in their apical portion. The gap between the superior part of the implant and the adjacent bone varied with the size and the anatomy of the socket. Between 0 and 12 mm (mean 1.3 mm) of the implant lacked buccal bone support immediately following placement, usually more in the incisor/canine areas, while between 5 and 18 mm of the implants were completely surrounded by bone. The mean initial length of the total bone support of the implants was larger in patients in whom the extraction indication had been periodontitis (12.6 mm) than in the nonperiodontitis group (10.8 mm). No effort was made to fill the gap between the implant and the surrounding socket gap with a graft. The amount of countersinking varied with the width of the extraction site. The implants were positioned with the superior surface of the cover screw approximately 1 mm below the level of the cementoenamel junctions of the adjacent teeth. In all but a few premolar cases, this was possible without countersinking.

The soft tissue sealing of the socket was obtained in various ways; for single implant placement the technique generally used was a Rehrmanplasty. In five patients, expanded polytetrafluoroethylene (e-PTFE) membranes (Gore-Tex GT6, WL Gore, Flagstaff, AZ) were used. They were secured by the cover screws and removed at the abutment connection stage. In some patients, the implant socket was sealed by a free mucosal graft or by a pedicled flap. When both buccal and lingual
flaps had been raised in multiple extraction cases, the flaps were closed with the papillaes in a zipperlike fashion. All patients were given antibiotics (Phenoximethylpenicillin, Calciopen, Astra läkemed AB) preoperatively and for 10 days postoperatively. Abutment connection was usually performed after 4 months in the mandible and 6 months in the maxilla.

The follow-up period varied between 1 and 67 months with a mean follow-up period of 30.5 months. (In the single-implant group, the mean was 35 months; in the multiple implant group, the mean was 26 months.) Implant survival was checked at the abutment connection stage and then at intervals. The intervals varied with status, traveling distance, etc; however, the patients were seen regularly. Implant survival was defined by the criteria proposed by Albrektsson et al.\textsuperscript{10}

**Results**

Seven implants were lost early in the treatment phase. In six patients, mobility of the implant was evident at the abutment connection stage. In one patient, the implant was mobile immediately after the connected crown restoration was brought into function.

The implant survival rate was 93.6%. If the material is split into two groups according to the diagnoses of the extracted teeth, five losses were found (in four patients) in the periodontitis group (success rate 92.0%) and one loss in each of two patients in the nonperiodontitis group (success rate 95.8%). In the periodontitis group, where usually several implants were placed, the definitive fixed prostheses were not delayed or modified because of the loss of implants. However, in the nonperiodontitis group, the final therapy was delayed 12 months in both patients pending bone healing and the placement of new implants. All lost implants were of the Mk II type: three were 13 mm; two were 15 mm; and two were 18 mm in length.

The clinical impression at the abutment connection stage was that total remodeling of the socket had occurred in all implant sites. Although the buccal surface of a few implants lacked 1 to 2 mm of bone covering, no remnants of the socket could be detected, and in the majority of patients the marginal bone was at the level of the cover screw. In 18 patients, the cover screw was partially covered. In five patients, the screws were totally covered by bone. Bone formation seemed greater in the nonperiodontitis group.

In addition to loss of implants, other complications occurred. In five patients, infections developed. In four of these, the extraction indication had been periodontitis. The infections developed between 3 and 5 weeks after implant placement and were controlled by the use of antibiotics. However, in four of these patients, the implants were eventually lost.

Gingival perforation caused by the cover screw occurred in 12 patients. In 10 of these, the extraction indication had been periodontitis. Four occurred earlier than 2 months after implant placement and were closed by small flaps. In three of these
patients, the implant was eventually lost. In the early stages of the study, no intervention was made in patients where the perforation developed later than 2 months after implant placement. In the latter stages of the study, the routine in these patients was changed and the overlaying gingiva was removed by a punch to allow better oral hygiene and hence minimize the risk of infection.

**Discussion**

Because the number of subjects observed in the present study is small and the length of the follow-up period is short, conclusions should be drawn with caution. However, a success rate of 93.6% as found in the present study is comparable to results reported in studies with greater numbers of subjects where the implants were placed after healing of the extraction sockets.\textsuperscript{11-14} Thus, with regard to implant survival, there seems to be no reason to refrain from immediate placement of implants into extraction sockets.

Immediate implant placement has several advantages compared to the traditional procedure that provides a healing period of 6 to 12 months between the time of extraction and subsequent implant placement. The total treatment period is reduced, which is usually appreciated by the patient. In addition, bone resorption is reduced. Resorption of the buccal wall of the extraction socket may lead to significant disadvantages, especially in the anterior part of the maxilla. A buccal concavity in the alveolar process or an implant that is placed more lingually than the adjacent teeth can result in poor esthetics. In addition, with increasing resorption, the incisive canal is positioned relatively farther buccally, which forces the surgeon to place implants replacing the central incisors too close to the laterals. Eventually, the alveolar process may become too narrow to allow implant placement. Immediate implant placement thus optimizes the prerequisites for implant treatment that is successful from both a functional and an esthetic standpoint. The bone volume is sufficient to ensure initial stability, and the implant can be placed in an identical position and with the same inclination as the natural tooth it replaces.

Certain implants are designed for immediate placement. These are usually root-shaped and made of ceramic materials. The Nobelpharma and other cylindrical implants are meant to be placed into prepared artificial sockets. However, it has been shown earlier in both dogs\textsuperscript{15} and humans\textsuperscript{6} that bone healing can occur around cylindrical implants placed into extraction sockets. Becker et al\textsuperscript{15} placed 12 implants into extraction sockets in dogs. Six of these sockets were sealed by e-PTFE barrier membranes, and six were closed without membranes. In all cases, healing with bone formation around the implants was found. Membranes increased the amount of bone formed. Gelb\textsuperscript{6} obtained formation of new bone in humans with various techniques; demineralized freeze-dried bone, membranes, and a combination of both were used in 50 patients. In the present study, no grafts were used to fill the space between the socket and the implant, and e-PTFE membranes were used in only five patients. The reason was that it was feared that the graft and/or membrane might promote an
infection induced by leakage through the relief incisions of the modified Rehrmanplasty that was frequently used. Membranes were only used when a substantial number of implant threads were exposed because of a fractured or resorbed buccal wall of the socket, and in these situations no infection occurred. In most patients, the intact periosteum of the buccal flap was judged to be superior to a membrane because the risk of infection was considered less and the cambrium layer of the periosteum was expected to induce bone formation. Because there was no need to increase the width of the alveolar process in the majority of these patients, the main advantage of a membrane compared to the periosteum, a greater stiffness, could not be exploited. It was found that bone formation in the sockets was excellent without the use of membranes. Overgrowth of new bone on top of the cover screws was found in 18 patients. This was more pronounced where single implants were placed even though the buccal bone loss was greater at the time of implant placement. This may be the result of two factors: the adjacent teeth may have acted as an external matrix for bone regeneration; or the implants may have been placed deeper in these patients.

In addition to loss of implants, other complications were also recorded. Cover screws penetrated the gingiva in 12 patients. An initial peri-implantitis around a cover screw can often spread, and osseointegration may eventually fail. The protocol in the early stages of the present study called for all cover screws that were partially exposed within 2 months after surgery to be covered. Later exposures were not treated. During the study, the protocol changed and when partial exposures developed, the cover screw was completely exposed by means of a punch to facilitate cleaning. The reason for this change in procedure was that in three of the four patients in whom flaps were raised to cover the cover screw, the implants were eventually lost. Possibly the peri-implantitis was already manifest or the exposures were noted too late and peri-implantitis had already developed. A partial exposure is probably more likely to induce peri-implantitis than total exposure on the analogy of the development of pericoronitis around an erupting third molar. That cover screws can be totally exposed without adverse effect on osseointegration has been indicated by the findings of Ericsson et al. They found normal osseointegration when abutment connection and implant placement were made simultaneously with Nobelpharma implants.

Ten of 12 cover screw exposures in the present study were recorded in patients who had periodontitis as the indication for extraction. The predominance of cover screw exposures in this group may be explained by the fact that the flaps in these patients had been sutured in a zipperlike fashion. Thus, the flaps may not have been perfectly adapted. In addition, all 31 patients with periodontitis used removable complete dentures as provisional replacements for the extracted teeth. This can give rise to bone resorption and gingival perforation. Closure of flaps in a zipperlike fashion should thus be avoided, and implants should be placed deeper when multiple extractions of teeth are performed.
When single implants were placed, space retainers of various designs were normally used during healing. In the few situations where space retainers were not used for various reasons during healing, migration of adjacent teeth was noted. In one patient, the abutment could not be connected until the space was expanded, and in others the esthetic result was jeopardized because even minor tilting of an adjacent tooth appears to have a large negative impact on the shape of the crown restoration. Thus, it is imperative that space retainers be used during healing in single-implant cases.

The esthetic problems inherent in immediate implant placement should be anticipated. The extraction socket containing the implant is usually closed by a flap. The keratinized gingiva is thereby displaced toward the alveolar crest. This results in a buccal deficit of keratinized gingiva, which may be a functional disadvantage, but most certainly is an esthetic inconvenience. In the present study, various surgical techniques were used to cover the sockets after implant placement. At the abutment connection stage, other methods had to be used to correct esthetically disturbing results of the first operation.

**Conclusion**

The immediate placement of implants into extraction sockets without grafts or membranes seems to be a safe and predictable method. The main advantage of the method is the gain of time and thus bone volume. Less bone resorption precludes the formation of the buccal concavity so often seen after extractions and offers the possibility for placing the implant in an optimal position. The main disadvantage of the method is that it requires a more complicated soft tissue handling technique to obtain an esthetically satisfactory result.


**Table 1** Types and Lengths of the Nobelpharma Implants Placed

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>10</th>
<th>13</th>
<th>15</th>
<th>18</th>
<th>20</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Self-tapping</td>
<td>2</td>
<td>5</td>
<td>20</td>
<td>3</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>Mk II</td>
<td>5</td>
<td>30</td>
<td>26</td>
<td>10</td>
<td>0</td>
<td>71</td>
</tr>
<tr>
<td>Conical</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>7</td>
<td>39</td>
<td>49</td>
<td>13</td>
<td>1</td>
<td>109</td>
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**Table 2** Indications for Extraction According to Age of Patients

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>15-20 y</td>
<td>21-35 y</td>
<td>36 y</td>
<td>15-20 y</td>
</tr>
<tr>
<td>Horizontal root fracture</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Vertical root fracture</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Root resorption, permanent tooth</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Root resorption, primary tooth (permanent tooth agenesis)</td>
<td>5</td>
<td>4</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Chronic periodontitis</td>
<td>0</td>
<td>2</td>
<td>28</td>
<td>0</td>
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