Immediate Implant Placement Following Tooth Extraction: A Clinical and Radiological Evaluation

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Abstract
A waiting period of 12 months or longer to allow total socket healing used to be accepted protocol for placing implants. This paradigm has been challenged within the last decade by reducing the time between tooth extraction and implant placement. New protocols have been developed in which implants are placed at the time of extraction of the tooth, or soon after, before significant bone resorption occurs, known as immediate implants. This study aims to determine the success rate of implants placed immediately into fresh extraction sockets, by evaluating clinically and radiographically the soft tissue and hard tissue changes that occur up to 9 months following placement of implants.

Keywords: Immediate implant placement, atraumatic extraction, fresh extraction sockets, primary stability, osseointegration, peri-implantitis.

INTRODUCTION

The goal of modern dentistry is to prevent tooth loss and to provide a healthy dentition with optimal functional efficiency, structural balance and esthetic harmony. The dental implants provide a realistic treatment alternative for rehabilitation of patients with lost teeth.1 Due to the advantages provided by the implant supported prosthesis, like improved esthetics, improved hygiene accessibility, osseous preservation and reduced future maintenance, it appears that replacement of tooth with implants may be a more viable option for today’s patient. It was shown that after extraction of natural teeth, the greatest reduction of the alveolar bone occurs in the first 6 months to 2 years.2,3 For this reason, within the last decades, the ‘gold standard’ implant treatment protocol has been challenged by experiments, which aimed at shortening the treatment period and by reducing the number of surgical procedures.4 New protocols have been developed in which implants are placed at the time of extraction of the tooth, known as immediate implants.5

Immediate implantation has provided implant dentistry the opportunity to achieve better and faster functional results and a predictable treatment strategy with a very high-rate of success. Such implants has several advantages, such as reduced number of surgical treatments, reduction of time between tooth extraction and placement of definitive prosthetic restoration, prevention of bone resorption, and preservation of alveolar ridge in terms of height and width.6 So this study aims to determine the success rate of implants placed immediately into fresh extraction sockets, by evaluating clinically and radiographically the soft tissue and hard tissue changes that occur up to 9 months following placement of implants.

MATERIALS AND METHODS

Ten participants were recruited from among the patients who visited the Department of Periodontics, The Oxford Dental College and Hospital, Bengaluru and who were found to have at least one maxillary or mandibular single rooted teeth indicated for extraction were selected for the study. Patients aged between 21 to 55 years requiring extraction of
tooth for reasons like caries without any abscess formation or draining sinus, trauma not affecting the alveolar bone, residual roots and root fracture with presence of at least 4 mm of bone beyond the root apex, absence of acute signs of infection and absence of any systemic pathologies, were included in the study. Teeth with multiple roots, sites showing bone fenestrations, bone dehiscence and bone defects exceeding 2 mm, smokers and teeth with close proximity to anatomical structures were excluded from the study.

The implant system used for the study was EZ, HI-TEC IMPLANTS™, manufactured in Israel and marketed by Life Care Devices Private Limited in India. All the patients were informed of the procedure being performed in detail and the consent obtained. A thorough initial therapy was done and adequate instructions were given on oral hygiene maintenance and its importance on the success of implant therapy. In each patient the inter-arch relationship was evaluated using diagnostic casts. Preoperative photographs were taken (Figs 1 and 2). Periapical (Fig. 13) and panoramic radiographs were obtained.

The following parameters were measured at base line, (before surgery) 6 and 9 months after implant placement. Plaque index (PI), gingival index (GI), width of keratinized gingiva was measured with a University of North Carolina Probe (UNC-15) as the distance from the gingival margin to the mucogingival junction (Fig 3). Intraoral periapical radiographs were taken at baseline, 6 and 9 months. The level of crestal bone height was measured from standardized radiographs as the distance from the cementoenamel junction of the adjacent tooth to the most apical extent of the crestal bone, using vernier calipers and presence or absence of peri-implant radiolucency. All the implants were checked for mobility with the two blunt ends of the instrument to see for any perceivable mobility.

Study models were prepared for each patient and occlusal analysis was performed. Complete hemogram was done to evaluate the fitness of the patient for implant placement. Before surgery, the patients were advised to rinse for 1 minute with 0.2% chlorhexidine mouthwash. After local anesthesia, teeth were gently extracted using Periotomes and extreme care was exercised to avoid fracture of the socket walls (Fig 4). After extraction, the site was thoroughly degranulated using curettes, the socket irrigated thoroughly with Povidine- Iodine and carefully examined to be certain that the socket walls were intact. The length and width of the extracted root was measured with UNC-15 probe to determine the length and diameter of implant placed. (Fig 12). The osteotomy sites were prepared with standard drills using the socket walls as guides, with maximum use of bone apical to the extraction sockets. After the pilot drill, parallelism was checked using paralleling pin and a radiograph (Figs 5 and 14). A sequential drilling was carried out with drill sequences of 2.2, 2.8, 3.2, 3.65, 4.3 and 5 with a speed ranging from 500 to 1200 rpm under copious irrigation (Fig 6). The drill was extended 3 to 4 mm beyond the apex of the socket to ensure primary stability after placement, taking care of the anatomical boundaries.

Once the osteotomy site was prepared, the longest and widest possible implants were placed (Figs 7 to 10). All the implants placed had shown good primary stability. Prior to suturing, the surgical area was thoroughly irrigated and debrided. The buccal and lingual soft tissue edges were sutured using 3-0 (Ethicon Limited, Edinburgh, UK) silk sutures to enable maximum approximation and to ensure soft tissue coverage to protect the implant sites (Fig. 11) followed by placement of periodontal dressing. Antibiotics and analgesics were prescribed for all patients for 5 days along with chlorhexidiene mouth wash for 15 days. Sutures were removed after 7 days.

The supra structures were seated 6 months postsurgically. All the clinical and radiological parameters were recorded at 6 months (Fig. 15). Recall appointments were made 3 months postinsertion and the necessary clinical and radiological measurements were made (Figs 16 to 19).

**STATISTICAL ANALYSIS**

Statistical software namely SPSS 15.0, Stata 8.0, MedCalc 9.0.1 and Systat 11.0 were used for the analysis of the data and microsoft word and excel have been used to generate graphs, tables, etc. Student t-test was used to find the significance of study parameters.

**Case 1: (Figs 1 to 19)**

**Fig. 1:** Baseline photograph of patient who had an extruded tooth following orthodontic treatment
Fig. 9: Implant flushed with alveolar crest

Fig. 10: Cover screw placed

Fig. 11: Interrupted sutures placed

Fig. 12: Measurement of extracted root

Fig. 13: Preoperative IOPA

Fig. 14: IOPA with paralleling pin

Fig. 15: IOPA showing implant placement
RESULTS

A total of 11 implants were placed in 10 patients, which included 7 male and 3 female patients with age range of 21 to 38 years.

Out of the 11 implants, 7 implants were successful; four implants in 3 cases had to be removed because of failure of osseointegration. In one case, it was a technical error which caused it as the implant was labially placed and hence was removed at the end of 6 months (Figs 24 to 27). Two implants were removed at 2 months after placement as the implants were mobile and there was periapical radiolucency on radiographic examination. The reason for the failure in this case was that the implants were placed in a patient with aggressive periodontitis (Figs 20 to 23) and in the remaining one case no attributable cause was found (Figs 28 to 31). The implant was removed after 6 months as it was mobile with periapical radiolucency and failure to achieve osseointegration.

Overall, the success rate of implants in this study was 70%.

The clinical and radiological parameters were recorded in all the cases at baseline, 6 and 9 months (Table 1).

DISCUSSION

Dental implant therapy is one of the pioneering treatment modality for replacement of missing teeth. It is understandable that, patients are more satisfied with implant supported prosthetic rehabilitation in terms of comfort, stability and esthetics compared to conventional prosthesis.
Case 2: Immediate Implant Placed in Aggressive Periodontitis Patient (Figs 20 to 23)

Table 1: Clinical and radiographic parameters assessed at baseline, 6 and 9 months

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Baseline</th>
<th>6 months</th>
<th>9 months</th>
<th>% change from baseline to 9 months</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI</td>
<td>0.98 ± 0.61</td>
<td>0.64 ± 0.25</td>
<td>0.47 ± 0.34</td>
<td>52</td>
<td>0.177</td>
</tr>
<tr>
<td>GI</td>
<td>0.93 ± 0.26</td>
<td>0.53 ± 0.32</td>
<td>0.41 ± 0.38</td>
<td>55.9</td>
<td>0.015*</td>
</tr>
<tr>
<td>Implant mobility</td>
<td>Absent</td>
<td>Present (30%)</td>
<td>Absent</td>
<td>_</td>
<td>_</td>
</tr>
<tr>
<td>WKG</td>
<td>3.96 ± 0.55</td>
<td>3.39 ± 1.36</td>
<td>3.64 ± 0.38</td>
<td>8.1</td>
<td>0.030*</td>
</tr>
<tr>
<td>Distance between M and D papilla</td>
<td>7.35 ± 1.08</td>
<td>7.17 ± 1.25</td>
<td>7.14 ± 1.43</td>
<td>2.9</td>
<td>0.078*</td>
</tr>
<tr>
<td>Periapical radiolucrency</td>
<td>Absent</td>
<td>Present (20%)</td>
<td>Absent</td>
<td>_</td>
<td>_</td>
</tr>
<tr>
<td>Bone loss on mesial aspect</td>
<td>_</td>
<td>0.82 ± 1.07</td>
<td>0.62 ± 0.67</td>
<td>24.4</td>
<td>0.049</td>
</tr>
<tr>
<td>Bone loss on distal aspect</td>
<td>_</td>
<td>0.66 ± 0.84</td>
<td>0.60 ± 0.66</td>
<td>9.1</td>
<td>0.042*</td>
</tr>
</tbody>
</table>

PI: Plaque index; GI: Gingival index; WKG: Width of keratinized gingiva; M: Mesial; D: Distal
*: Statistically significant

Fig. 20: Baseline photograph of an aggressive periodontitis patient

Fig. 21: At 2 months (Purulence) after implant placement

Fig. 22: IOPA at baseline

Fig. 23: IOPA showing failure of osseointegration at 2 months of implant placement
Case 3: Immediate Implant Placed Labially  
(Figs 24 to 27)

Fig. 24: Baseline photograph of implant placed labially

Fig. 25: At 6 months (Implant visible through the gingiva)

Fig. 26: IOPA of the same patient

Fig. 27: IOPA at 6 months

Case 4: (Figs 28 to 31)

Fig. 28: Baseline photograph of implant failure

Fig. 29: Photograph after 6 months

Fig. 30: IOPA of the same patient
Bone loss after tooth extraction remains an important issue in dentistry. Anatomically, bone resorption occurs both buccolingually and apicocoronally, and the first 6 months postextraction are critical carrying the highest rate of bone resorption in either direction. 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. To reduce the problems resulting from this loss of bone, dental implants have been placed into fresh extraction sockets.

In the present study out of 11 implants, 7 implants were successful showing good osseointegration with no signs of pain or discomfort and no periapical radiolucency at the end of 9 months.

The plaque control in all these patients was optimum. The gingival status was good throughout, there being no signs of gingival inflammation. This demonstrates that if proper care is taken following implant placement in an otherwise healthy patient, peri-implantitis is preventable.

In all the cases of this study, implants were placed using a flapless surgical technique. This is the popular technique in vogue in any form of implant therapy and has been applied in cases of implants placed in extraction sockets as well. High success rates and satisfactory esthetic results were achieved for anterior maxillary single tooth implants placed without incisions. However, two major disadvantages are encountered using this technique. There is no scope for visualizing any defect that might be present in the recipient site and further ridge preservation/tissue augmentation is not possible. But, if presurgical evaluation has been satisfactory, and if the concerned tooth has been extracted without traumatizing the soft or hard tissues, a flapless implant placement seems to be ideal. Primary stability in all the cases treated in this study was achieved. This was mainly due to the fact that implants were placed 3 to 4 mm apical to the base of the socket.

Frequently, when implants were placed into extraction socket, a partial incongruency between the outer surface of the implant and the bony walls of the socket is often seen. This space is known as jumping distance or critical space. Use of wide diameter implants helped in obliterating the jumping distance. Therefore, there was no need to place any bone grafts to compensate the jumping distance, also several studies have shown that bone augmentation techniques may not be required when the distance between implant and bony wall is < 2 mm.

One of the problems encountered in this study was failure to obtain primary closure of the implanted site in most of the cases (Figs 11, 12). This is believed to be an important factor as it prevents epithelial downgrowth and alveolar crestal bone loss during the healing period. Further, plaque accumulation on the exposed cover screw could result in inflammation of the surrounding soft tissues. However, despite partial exposure of the cover screw, no inflammation of the surrounding tissues was noticed in all the successful cases, mainly because of regular maintenance and reinforcement of oral hygiene. On the contrary, various
surgical techniques have been proposed to achieve primary soft tissue closure over implants placed into extraction sites. Becker and Becker\textsuperscript{14} described the use of a rotated buccal flap from an adjacent tooth to achieve primary closure over implants placed in extraction sockets in conjunction with barrier membranes.

None of the successfully treated 7 patients showed implant mobility at the end of 9 months, thereby achieving good osseointegration which was confirmed by radiographs. The width of keratinized gingiva, level of mucogingival junction and distance between mesial and distal papillae were all constant throughout the study. All the above findings are in confirmation with that of the previously reported studies.\textsuperscript{6}

Radiographic evaluation of bone forms a very important and viable means of detecting health and stability of bone around the peri-implant hard tissue. The mean bone levels were measured from the cementoenamel junction of the adjacent teeth to the alveolar crest\textsuperscript{8} at baseline, 6 months and 9 months. All the implants were flushed with the crest of the alveolar bone at baseline. The mean bone loss at 9 months was 0.62 mm on the mesial side and 0.60 mm on distal side which was statistically significant. This is in similarity to the results obtained by the studies conducted by Covani et al.\textsuperscript{5}

Four implants in 3 cases had to be removed because of failure of osseointegration. In one case, it was a technical error caused due to labial placement of implant. Two implants were removed because they were placed in a patient with aggressive periodontitis and in the remaining one, no attributable cause could be found. This provided an overall success rate of 70\% during 9 months follow-up which is slightly less compared to other studies showing success rate of 95\% with only 5\% failures in the first year of their study.\textsuperscript{15,16}

Placing implants either immediately or later in aggressive periodontitis cases has been a matter of controversy. The study conducted by Mengel and Flores-de-Jacoby,\textsuperscript{17} Malmstrom\textsuperscript{18} stated that patients with a history of aggressive periodontitis are more clearly prone to high failure rates. This is an aspect which needs to be investigated further.

Apart from conventional diagnostic methods such as thorough clinical examination and routine radiographs, this study has not used any advanced diagnostic aids such as CT scan, MRI, etc. Such techniques, besides not readily available everywhere also increase the treatment cost considerably.

Notwithstanding the very short period of follow-up, overall, it emanates from this study that immediate implant placement following extraction is a viable treatment approach.

CONCLUSION

Immediate implant placement following tooth extraction has been found to be a viable and predictable solution to tooth loss. Minimally invasive surgical technique, ease of procedure and shorter time involved together with minimum postextraction complications are the important advantages of this method. However, proper case selection and meticulous postoperative care preceded by good surgical and prosthetic protocol are the essentials for success. Patients with aggressive periodontitis need more investigation and trial before considering for immediate implant placement.

More extensive controlled and prospective clinical studies are needed to evaluate the success of immediate implant placement.

REFERENCES