Immediate implantation in an extraction socket: A review

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Abstract
Tooth removal and immediate implant placement have turned out to be a normal routine treatment modality as a result of reduced treatment time as well as the protection of anatomical structures. Nevertheless, most of the time, this procedure entails teeth with various stages of tissue damage because of underlying bacterial contamination. Hence far, the level of implant damage has not really been explained neither has scientific conduit algorithm criteria been set up for these kinds of cases. The aim of this article is to present the clinician with a clear understanding about immediate implant placement and to differentiate the dos from the donts in a systematic manner.

Keywords: Extraction, immediate, implants

Introduction
The masticatory functions of partially or completely edentulous patients have been efficiently and successfully restored by dental implants. Previously, it was believed that post extraction alveolar remodeling should be allowed for 2-3 months prior to placement of implants. An additional load free waiting period of 3-6 months was required for osseointegration of implants to occur. This conventional approach, of allowing the extraction sockets to heal completely prior to implant placement, is now being replaced by techniques for placing implants directly into extraction sockets at the time of tooth extraction. Implants placed immediately after extraction of the tooth or at the same surgical appointment are increasingly gaining popularity due to shortened treatment time.

When teeth are extracted due to pathology or trauma, hard and soft tissue changes follow. Resorption of bone and recession of soft tissue is commonly seen. In this situation either an immediate implant placement can be considered or a more traditional treatment plan has to be determined. The responsibility of the implant team is to establish a correct diagnosis by evaluating all the clinical parameters and select the optimal time for implant placement depending on the clinical situation encountered.

Immediate implant placement allow advantages over conventional approach such as reduction in the number of surgical procedures and hence the treatment time required, ideal axial orientation of the implant, preservation of the bone at the extraction site and optimal soft-tissue aesthetics, significantly reduced period of wearing of an interim prosthesis. Studies showing high success rates of immediately placed implants have made this protocol more favorable for implantologists. However, this protocol has been associated with shortcomings like ideal modality for the treatment of marginal voids. These are the gap present between the implant body and the wall of the bony socket. The procedure is also technically more demanding. Although, implant placement in fresh extraction socket has been described previously, it is only recently that such clinical approach has gained popularity. However, there is a lack of general consensus on the various aspects of immediate implant placement in an extraction socket, this article reviews the literature available on implants placed into the extraction socket and summarizes its clinical outcome.

Materials and Methods
A Medline search was conducted from 1979 to 2011 to identify the article published on immediate implantation. Search terms like “immediately placed implants” and “post extraction socket,” “immediate placement” and “immediate loading,” “immediately placed implants” and “bone augmentation procedures” were used to collect case reports, case series, randomized clinical trials’s and animal studies on immediate implantation. Literature obtained was divided under subheadings for convenience.
Effects of immediate implant placement on alveolar ridge resorption

Post extraction, the alveolar ridge undergoes dimensional changes. These changes occur in the horizontal as well as vertical direction.\(^{[6]}\) Ridge resorption affects the buccal plate more than the lingual plate. Schropp et al.\(^{[9]}\) assessed bone formation in the alveolus and the contour changes of the alveolar process following tooth extraction in 46 patients in premolar and molar areas. They demonstrated that major changes in dimensions of an extraction site occurred during the 1st year after tooth extraction. Though vertical changes were a negligible but horizontal resorption was found to be 30\% at 3 months and 50\% of the ridge at the end of 12 months. These changes were found to be greater at molar areas than premolar sites and more in the mandible than the maxilla. Due to these marked changes seen in the dimensions of alveolar ridge, immediate implant placement has been suggested as an alternative to reduce ridge resorption post extraction and it can also be used as a treatment approach in cases with presence of compromised bone. Placing immediate implants after tooth extraction helps in preserving the denser area of the socket wall. In cases of HD of <2 mm a membrane or bone grafts is considered not necessary to promote osseointegration to occur.\(^{[16-20]}\) Prognosis of implants placed with HD more than 2 mm is more critical.\(^{[21]}\) These sites require concomitant augmentation procedures with a combination of barrier membrane and bone grafts for osseointegration to occur uneventfully.\(^{[22]}\)

Wilson et al.\(^{[15]}\) established making use of histologic evaluation that osseointegration can happen in immediate extraction sites in individuals utilizing titanium dental implants having a plasma-sprayed exterior. 5 titanium plasma-sprayed dental implants had been biopsied from a human volunteer half a year following the placement. The horizontal aspect with the peri-implant deficiency was evidently one of the most crucial aspects about the final amount of bone-implant connection. Minimal level of bone-implant contact (17\%) appeared to be observed in 2 molar dental implants with huge peri-implant bone deficiencies (horizontal deficiency size of 4 mm) in spite of the positioning of buffer membranes. Canine sites representing with a horizontal deficiency measurement of 1.5 mm or less. These dental implants had been positioned with no boundary membrane layer, however in a enveloped manner. The histometric evaluation demonstrated an average bone implant contact of 50\% for these two implants. Only reported drawback of this study was the use of a small sample size.

Bone grafts along with barrier membrane are commonly used for bone regeneration in peri implant defects of large dimensions. Collagen membrane,\(^{[23-25]}\) deproteinized bovine bone mineral with e-polytetrafluoroethylene barrier membrane,\(^{[30]}\) composite graft of polymethyl methacrylate and calcium hydroxide,\(^{[31]}\) hydroxyapatite, autogenous bone\(^{[22]}\) have been used successfully to obtain clinically acceptable bone fill in the defect area. Studies showing successful use of resorbable barriers for bone augmentation purposes have also been reported.\(^{[33,34]}\) Bioresorbable membranes offered the advantage that membrane removal was not needed; however, these possessed drawbacks such as lack of stiffness (thus requiring a membrane-supporting material).\(^{[9]}\) The combination of resorbable barriers and immediately placed implants seems to be comparable to the combination of nonresorbable barriers and immediately placed implants in terms of integration of the implants.\(^{[30]}\)
Contrary to this Chen et al.,[35] in their study of 62 consecutively treated patients each receiving an immediate implant for a single tooth replacement at a maxillary anterior or premolar site. Concluded that vertical defect height and horizontal defect depth reduction at defects adjacent to immediate implants may be achieved without the use of membranes and/or bone grafts. They reported that the results were comparable when the defects were allowed to heal with the blood clot alone.

Studies reporting the use of implants with sandblasted and acid etched surfaces enhancing implant bone contact allowing spontaneous osseointegration in HD <2 mm have been reported[12,36,37] and can hence improve prognosis in large HD cases.[39]

Schropp et al.[9] conducted a study to compare bone healing and crestal bone changes following immediate (Im) versus delayed (De) placement of titanium dental implants with acid-etched surfaces (Osseotite) in extraction sockets. The results of this investigation demonstrated significant bone formation in 3-wall infrabony defects associated with immediately placed implants with a double acid-etched surface following tooth extraction. Less, but still considerable, bone generation was found in defects around the delayed implants. Without the use of any bone-reconstructive techniques such as graft materials or barrier membranes, the number of 3-wall infrabony defects in the Im group was halved after 3 months, whereas an increase was found in the De group.

Bone healing and augmentation procedures in immediately placed implants in case of dehiscence

In a post extraction socket, loss of one or more socket wall is commonly seen during extraction procedures. Chen et al.[35,36] reported that sites with dehiscence defects achieved similar bone fill in the defect area as site with presence of intact bone. Only area of concern in these sites was that they showed higher rate of horizontal resorption in spite of the bone augmentation procedures used. However, Schropp et al.[9] reported that greater bone fill was reported at sites with intact bony walls than sites with dehiscence.

Since, studies support that the sites with dehiscence can achieve bone fill with bone augmentation procedures, but facial bone resorption occurs more commonly, it is important to consider this as a factor, which can affect the esthetic outcome.

Immediate implantation in extraction socket with periapical infections

Concept of immediate implantation in infected sockets have been contraindicated by various authors such as Block and Kent[39] and Sciar.[40] They considered immediate implant placement following tooth extraction, only in extraction socket that are free from any pathologic lesions. Presence of infection can lead to post-surgical complications which can eventually lead to implant failure. Nemcovsky et al.[41] however recommended delayed/ immediate implant placement in such cases; timing of implant placement can be delayed for 4-6 weeks after tooth extraction in case of presence of periapical infection Cavicchia and Bravi[42] considered placement of immediate implants in the presence of an abscess may lead to high failure rates and also complicate surgery. However, granulation tissue associated with a chronic infection may not be dangerous and should not be considered as a contraindication for immediate implant placement.

Lindeboom et al.[43] in their RCT’s concluded that the survival rate for type I implant was lower than Type III implants in infected sites. In another study by Seigantehler, 17 tooth sites with apical pathology were compared with 17 tooth sites without apical pathology. The survival rates for both groups were found to be 100% at the end of 12 months.

Novaes and Novaes,[44] Novaes et al.[45] Rosenquist and Grenthe[46] proposed based on their clinical experience that if certain preoperative and postoperative steps are carefully followed and complete debridement of the alveolus is done during the surgical procedure, immediate implants can be successfully placed into chronically infected sites. Novaes et al.[45] did a histomorphometric study in dogs and compared effect of chronically infected sites on the immediate placement of implants to non-infected sites on immediate placement. They found all areas healed without inflammation or exudation and all implants were clinically immobile and were surrounded by normal-appearing bone radiographically. Histologically, there were no signs of infection, and the histomorphometric analyses revealed that 28.6% of implants placed in chronically infected site had osseointegrated in comparison to 38.7% implants placed in non-infected sites. Rosenquist and Grenthe[46] in their study placed a total of 109 nobelpharma implants into extraction sockets of 51 patients immediately following extraction. The follow-up period varied between 1 and 67 months. They found that 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.

Immediate loading of immediately placed implants

Loading implants after a waiting period of 3-6 months is based on the concept that the initial wound healing period is critical and loads applied prematurely to implants may jeopardize initial stabilization of the implants.[47-49] The advantages of this 1-stage procedure include immediate function and esthetics, elimination of second-stage surgery and adjacent papillae are well preserved.

Loading of the implant within 24 h without functional occlusal contacts provides a superior solution to tackle difficult aesthetic problem. The anatomy of the temporary restoration either keeps the original shape of the soft tissue or guides the soft tissue to a correct soft tissue/implant relationship.[50] Various studies have been done to assess success rate of placing implants in immediate function with unclear results. High survival rate has been reported in various case series of immediate loading of single tooth or short span implants, comparative clinical trials have reported lower survival rates for the same. Chaushu et al.[51] contrasted the surgical results of immediately loaded single-tooth dental implants put into fresh extraction sites to that of instantly loaded single-tooth implants put into the symptomless site.
19 dental implants had been put into clean extraction sockets, as well as 9 dental implants were positioned directly into recovered sites. They discovered that immediate loading associated with single-tooth dental implants used in fresh extraction sockets had a hazard of a failure estimating to 20%.

Ribeiro(52) evaluated the success rate of maxillary immediate non-functional single-tooth loaded implants immediately placed in extraction socket or healed ridge. No evident differences were seen in immediate non-functional single-tooth loaded implants in immediate placement conditions in contrast to those inserted under delayed placement condition; both protocols had high success rate in maxillary incisors, canines, and premolars areas.

Block et al.(53) identified a substantial distinction within the soft and hard tissue response evaluating immediate along with delayed implant placement following tooth extraction, with quick provisionalization, within maxillary anterior sites; as well as to figure out and also assess the crestal bone levels as being the principal endpoint variable for dental implants positioned and straight away temporized within extraction sockets, to dental implants put into extraction sites once the extraction socket happens to be grafted and healed for 4 months, most promptly restored through an anatomic provisional refurbishment. Within their research, they discovered there was clearly a substantial alteration in the positioning of the facial gingival border, having a much more apical placement of the facial gingival border within the delayed group in comparison with the immediate group. The choice to make use of either method should take into account the movements of the facial gingival margin, that, within a essential esthetic parameter. Affected individual may need soft tissue support coming from a provisional restoration or even comparable kind of anatomical healing abutment.

**Survival rate**

Schwartz-Arad et al.(6) within their research performed from 1989 to 1996, put 380 dental implants (117 immediate as well as 263 non-immediate) with 43 individuals subsequent to tooth removal of left over teeth. As many as 253 dental implants had been placed into the maxilla along with 127 within the mandible. Of the implants, 31% had been carefully placed promptly into healthy extraction sockets. Overall 5 years collective rate of survival (CSR) was 92%, mandibular 96% as well as maxillary 90%. Immediate implants stood a far better 5 years CSR (96%) versus non-immediate implants (89.4%). The maxilla primarily led to this particular distinction (95% vs. 88%). Immediate implants within the posterior maxilla stood a 100% 5 years CSR as opposed to 72% with the non-immediate implants.

**Conclusion**

1. Immediate implantation may not completely inhibit ridge resorption of alveolar ridges but due to other benefits like shorter treatment time, decrease in surgical procedure can be more beneficial to the patients.
2. Bone augmentation procedures have been used in immediate implant placement sites with successful outcome. However these procedures should be implemented in cases with HD dimension of more than 2 mm to aid in successful osseointegration.
3. Immediate implants can also be considered as a favorable treatment option in chronically infected extraction sockets. However whenever this treatment option is chosen it is mandatory for the implantologist to follow stringent protocol and complete curettage of the site prior to placement is mandatory to ensure higher survival rates.
4. Immediate loading of immediately placed implants in extraction sockets have shown favorable results in maxillary incisors, canines and premolar area. Temporization can be achieved with predictable results when kept out of contact in centric and in excursions. Improved peri implant esthetics are seen as compared to the delayed loading protocol.
5. Morphology of alveolar bone, extraction socket, peri implant tissue, type of bone augmentation procedure used are all important to achieve high success rate. Greater emphasis should be placed on case selection to achieve predictable results.

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