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RESEARCH ARTICLE

IMMEDIATE IMPLANTS IN INFECTED SITES

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ABSTRACT

Immediate implantation is a growing trend in modern implant dentistry. Immediate implant placement of dental implants into infected sockets has been shown to be a predictable and successful procedure when proper protocols are followed. Various studies have suggested that immediate placement of an implant into an infected site is contraindicated, as sites exhibiting pathology have been thought to compromise osseointegration. When placed with appropriate protocol, immediate placement appears to be a valid technique for preserving bone at the site of implantation with infection allowing to maximize the bone available for osseointegration and to develop the restoration supported by osseointegrated implants from the functional and esthetic standpoint. This review discusses the current scenario of immediate implant placement in infected sockets.

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INTRODUCTION

Dental implant placement after tooth extraction is known as immediate implant implantation. Immediate implant placement is indicated primarily to replace missing teeth with pathologies not amenable to treatment. (Jotfre *et al*., 2012) Immediate implantation is a growing trend in modern implant dentistry. The first clinical application of immediate placement of implant was introduced by Schulte *et al* in 1976. It has become a preferred procedure for both dentists and patients. Immediate placement of an implant after tooth extraction has several advantages. It maintains the horizontal and vertical dimensions of osseous tissues and keeps implant at the same angulation as the pre-existing natural teeth. It can also be performed without raising a flap, which altogether reduces the number of surgical procedures, postoperative complications and treatment time and costs. With evolution of implant protocols and implant surfaces, it has become a predictable procedure. (Viskic *et al*., 2011)

Advantages of Immediate Implants

- It saves the total treatment time on the part of the dentist and the patient. (Gupta and Gupta, 2013)
- It prevents tissue loss and preserves the buccal plate of bone giving a good gingival architecture around the implants and a good emergence profile along with good esthetics. (Waasdorp *et al*., 2010)
- Reduces resorption of alveolar process and avoids undesirable resorption after extraction. (Waasdorp *et al*., 2010)
- It saves the patient from another additional surgical procedure for second time i.e it saves the 2nd appointment for implant placement. (Bell *et al*., 2011)
- The tooth extraction, bone grafting and implant placement can be done in one single appointment. (Bell *et al*., 2011)
- Preserves bony walls
- Prevents collapse of alveolar bone after extraction. (Birang *et al*., 2012)
- Decrease the treatment time. (Birang *et al*., 2012)
- Decrease the treatment cost. (Birang *et al*., 2012)
- Increases the patient satisfaction. (Birang *et al*., 2012)
- Better axial placement. (Birang *et al*., 2012)
- Better esthetics. (Birang *et al*., 2012)
- Replacement of lost tooth an early stage leads to better esthetics. (Birang *et al*., 2012)
- Preservation of morphology of peri-implant soft tissues. (Waasdorp *et al*., 2010)
- Early restoration of the function. (Waasdorp *et al*., 2010)
- Reduce psychological stress for the patient. (Waasdorp *et al*., 2010)
- Decreases healing time. (Cavicchia and Bravi, 2008)

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- Improved maintenance of alveolar architecture. (Bell *et al*., 2011)

Disadvantages of Immediate Implants : (Jotfre *et al*., 2012)

1. Infected implant sites have been considered unsuitable for implant placement because of their lower osseointegration values.
2. Need the regenerative procedure
3. Bone graft and / or barrier membrane that can complicate the procedure.
4. Expensive if bone grafts are needed

Immediate implant placement into infected sockets

Immediate implant placement of dental implants into infected sockets was shown to be a predictable and successful procedure when proper protocols were followed. Oftentimes, the clinical situation of teeth requiring extraction and implant placement exhibit-

I. Periapical pathology
Ii. Periodontal pathology
Iii. Endodontic pathology
Iv. Perio-endodontic pathology
V. Root fractures

Classification of Periapical Lesions Periapical lesions: [8]

Type 1: Adequate bone exists apical to the periapical lesion to achieve primary implant stability at the time of insertion. Additional stability may or may not be attained from the lateral walls of the extraction socket defect, depending on the pattern of bone destruction.

Type 2: Adequate bone does not remain apical to the periapical lesion to ensure primary implant stability following insertion. Primary stability is attainable laterally as a result of the difference between the implant diameter at its apical third and the bone defect following tooth extraction and debridement.

Type 3: Inadequate bone is present following tooth extraction and defect debridement for ideal positioning of an implant of the desired dimensions as the result of an inability to achieve primary implant stability, either through extension of the osteotomy into bone apical to the defect or through expansion of the osteotomy to engage the lateral walls of the extraction socket and/or periapical lesion.

Various authors have suggested that immediate placement of an implant into an infected site is contraindicated, as sites exhibiting pathology have been thought to compromise osseointegration. (Gupta and Gupta, 2013) Alsaadi *et al*. (2007), in a large consecutive case study, noted a greater tendency toward implant failure in sites with apical lesions, especially with machined surface implants. The placement of immediate implants represents an alternative to compromised teeth involved with infectious conditions. Alveolar ridge resorption after tooth extraction may considerably reduce the residual bone volume and compromise the favorable positioning of implants required for optimal restoration. Following correct clinical indications, additional benefits, which are also valued by patients, are the avoidance of a second surgical intervention and the reduction in rehabilitation treatment time. (Viskic *et al*., 2011) Several microorganisms exist in inflammatory periapical lesions resistant to healing and form the bacterial plaque in the apical third of the root. Microbial colonization has been claimed to be the primary etiologic factor for peri-implant infections causing early or late implant failures. Therefore, all authors suggest that the affected area must be carefully debrided and completely decontaminated before implant placement. The goal of apical curettage is to eliminate periapical infected tissues, but it is difficult to determine whether all of the infected tissues and pathogenic microorganisms have been completely removed by curettage and rinsing the region or not. Some studies have reported that apical lesions have radiographic signs of complete healing but histological studies have shown that have micro-organisms remain in these lesions.

Indications: (Waasdorp *et al*., 2010)

1. Periapical granuloma: A periapical granuloma (also termed an apical granuloma or radicular granuloma) is mass of chronically inflamed granulation tissue that forms at the apex of the root of a nonvital (dead) tooth.
2. Periapical cyst-(radicular cyst & apical periodontal cyst)- The periapical cyst (also termed radicular cyst, and to a lesser extent dental cyst) is the most common odontogenic cyst. It is caused by pulpal necrosis secondary to dental caries or trauma. The cyst lining is derived from the cell rests of Malassez. Usually, the periapical cyst is asymptomatic, but a secondary infection can cause pain.
3. Periradicular lesions- An inflammatory disorder caused by a persistent microbial infection of the root canal system of the affected tooth.
4. Ligature –induced periodontitis- It is an experimentally induced periodontal disease.
5. Recurrent endodontic & periapical radiolucency-
6. Endo-perio lesions- Combined periodontic-endodontic lesions are localized, circumscribed areas of bacterial infection originating from either dental pulp, periodontal tissues surrounding the involved tooth or teeth or both.
7. Chronic periapical pathology
8. Fistula, Suppuration or Combination lesions
9. Root fractures
10. sUbacute periodonal infection
11. Root Resorption
12. Root Perforations
13. Unfavourable crown-root ratio.

Contraindications: (Waasdorp *et al*., 2010)

1. Uncontrolled infection sites.
2. Recurrent infectious lesions.
3. Areas left without adequate bone support.
4. Infected lesions with large amount of bone loss.
5. Uncontrolled diabetes

Literature review

Novaes *et al*. (1995)- proposed that, if certain preoperative and postoperative steps are carefully followed and meticulous debridement of the alveolus is done during the surgical procedure, immediate implants can be successfully placed into chronically infected sites.

Lindeboom *et al*. (2006) studied immediate implant placement in chronic periapical infected sites of 50 patients. Implant

stabilty quotient values, gingival esthetics, radiographic bone loss & microbiologic characteristic of immediate as well as delayed group was found to be similar confirming the indication of immediate implant placement in infected sockets.

Siegenthaler *et al.* (2007) aimed to test whether or not immediate implantation leads to more biological complications, when performed at extraction sockets of teeth exhibiting periapical pathology compared with teeth not exhibiting periapical pathology. It was concluded that where primary stability was achieved, implants with periapical pathology did not lead to an increased rate of complications and rendered an equally favorable type of tissue integration of the implants as in non infected sites.

Casap *et al.* (2007) studied the immediate placement of endosseous implants into debrided infected dentoalveolar sockets inluding subacute periodontal infection, perio-endo infection, chronic periodontal infection, chronic periapical lesion, and a periodontal cyst. It was concluded that successful immediate placement in debrided infected alveoli depends on the complete removal of all contaminated tissue and the controlled regeneration of the alveolar defect.

Aly *et al.* (2008) evaluated the clinical and radiographic outcomes of immediately placed implants into fresh extraction sockets of maxillary central incisor teeth with periapical lesions, badly decayed teeth that cannot be restored, teeth with failed endodontic treatment, fractured teeth after endodontic treatment and teeth with fractured roots after facial trauma, without raising a flap and loaded immediately with the final abutments. Favourable clinical and radiographic outcomes after 6 and 9 months favoured placement of immediate implants in infected sockets.

Massimo *et al.* (2009) evaluated the clinical outcome of implants immediately placed into fresh extraction sockets of teeth affected by chronic periapical pathology, using plasma rich in growth factors (PRGFs) as an adjunct during the surgical procedure. It was concluded that, the use of PRGFs combined with an immediate implant placement procedure can be considered a safe, effective, and predictable treatment option for the rehabilitation of fresh post-extraction infected sockets.

Crespi *et al.* (2009) compared the outcome of the immediate placement of implants with and without chronic periapical lesions. It was concluded that, at the 24-month follow-up, endosseous implants placed immediately in extraction sites affected by periapical infection rendered an equally favorable soft and hard tissue integration of the implants, revealing a predictable outcome.

Crespi *et al.* (2010) compared the outcomes of immediate loading of implants in replacing teeth with and without chronic periodontal lesions at 4 years of follow-up. It was concluded that, immediate placement of implants in chronically infected sockets may not be necessarily contraindicated if appropriate clinical procedures like antibiotic administration, meticulous cleaning, and alveolar debridement are performed before the implant surgical procedure.

Truninger (2010) compared the clinical and radiological outcome of immediately placed implants in sockets with or without periapical pathology 3 years after implant placement. It was concluded that, after careful debridement of the extraction socket, immediate placement of implants into sites with periapical pathologies can be a successful treatment modality for at least 3 years with no disadvantages in clinical and radiological parameters to immediately placed implants into healthy sockets.

Bell *et al.* (2011) evaluated the success of dental implants placed immediately into extraction sites in the presence of chronic periapical pathology. Success of the implants was defined as successful osseointegration, successful restoration, and absence of evidence of bone loss or peri-implantitis. Other variables such as age, gender, smoking, diabetes, bisphosphonate use, lucencies of adjacent teeth, and implant stability at the time of placement were also evaluated. The success rate of implants placed in the study group was 97.5%, whereas the success rate of the control group was 98.7%. The placement of implants in sockets affected by chronic periapical pathology can be considered a safe and viable treatment option.

Fugazzotto (2011) conducted a retrospective analysis of implants placed immediately in sites with and without periapical pathology. It was concluded that, implants placed immediately in sites demonstrating periapical pathology yielded results comparable to those immediately placed in pristine sites.

Fugazzotto (2012) studied patients with periapical pathology were treated with tooth extraction, defect debridement, and immediate implant placement and concluded that, the implant placement at the time of extraction of teeth demonstrating periapical pathology will result in implant survival rates comparable to those of implants placed immediately into sites without periapical pathology.

Jung *et al.* (2012) evaluated the clinical radiological and aesthetic outcome after 5 years of immediately placed implants in sockets exhibiting periapical pathology. It was concluded that, the replacement of teeth exhibiting periapical pathologies by implants placed immediately after tooth extraction can be a successful treatment modality with no disadvantages in clinical, aesthetical and radiological parameters.

Risk Factors

1. Infections- The presence of infection may have plays a role in implant failure. Typically implant failure have been observed when pathology is or within close proximity to the implant site, adjacent to an undiagnosed endodontically involved tooth, adjacent to an existing lesions like a cyst, or when periodontitis is present. (Gehrke, 2005)
2. Smoking- Smoking is a prevalent behavior in the population. The exact mechanism by which smoking compromises wound healing is unknown but various mechanisms hypothesized include cytotoxicity of nicotine, carbon monoxide, and hydrogen cyanide to the cells involved in wound healing, vasoconstriction and decreased tissue perfusion due to catecholamine release, increased platelet adhesiveness and blood viscosity leading to the augmented risk of microvascular occlusion, increased levels of fibrinogen, carboxyhaemoglobin, and compromised polymorphonuclear leukocyte function. (Baig and Rajan, 2007)
3. Absence of mobility (Buser *et al*., 1997)
4. Absence of persistent subjective complaints (pain, foreign-body sensation and/or dysesthesia) (Mombelli and Lang, 2000)
5. Absence of recurrent peri-implant infection with suppuration (Mombelli and Lang, 2000)
6. Absence of a continuous radiolucency around the implant. (Mombelli and Lang, 2000)

7. No pocket probing depth (PPD)- No PPD ≥ 5 mm (Albrektsson *et al*., 1987)
8. No bleeding on probing (Albrektsson *et al*., 1987)
9. Annual vertical bone loss after the first year of service not exceeding 0.2 mm (mesially or distally)- (Mombelli and Lang, 2000; Gomez-Roman *et al*., 1997)
10. Inflammation and purulence- if any purulent exudates is present during the course of surgery, the implant placement and/or grafting procedures are not carried out. A delayed procedure is utilized instead. The presence of an asymptomatic apical granuloma or cyst is not necessarily a contra indication to an immediate insertion of an impant, but if there are any signs of active inflammation or infection, this must be treated prior to implant surgery. Antibiotic thearpy is initiated whenever there is evidence of acute infection. (Schwartz-Arad and Chaushu, 1997)
11. Temporary restoration post implant placement- the literature advocates the wearing of a prosthesis is not earlier than 2 weeks post-implant placement to prevent early trauma to the gingival site above the implant. The area should be left without pressure during the entire healing period by an appropriate temporary restoration. (Spörlein and Stein, 1992)
12. Implants and occlusion- It is essential that the occlusion is adjusted in such a way that the implant is just out of contact with the opposing tooth at a position of lightest occlusal contact of the opposing arches. Occlusal adjustment should also ensure that the implant-supported crown does not bear excessive loads in lateral or protrusive excursions of the mandible. A single implant supported canine guidance should be avoided. Peri-implant bone loss is more pronounced in implants which are subject to excentric loads due to lateral protrusive movements. (Schulte and Heimke, 1922)
13. Primary closure - Schulte *et al*. (1992) stated that a periosteal detachment of the mucosa may lead to a reduction in the underlying alveolar bone, and recommends, therefore, a transmucosal application of a root-analog implant system (anatomic crestal diameter) without incisions. In cases when an implant design is employed which does not mimic the anatomic root form, primary closure of the soft tissues is recommended. (Jotfre *et al*., 2012)

Management:

The diagnosis of infection is often clinically based clearly on periapical lesions which present with a similar radiographic appearance can differ histologically. Different periapical pathologies with radiolucency are important to know before starting the immediate implant placement procedure in infected sites.

Waasdorp (2010) reviewed the steps in the treatment of immediate placement of implants in infected sites. This included all the conducted study data from animal research, human case reports and case series, and prospective studies which has showed similar success rates for implants placed into infected sites compared to implants placed in non-infected or pristine sites. Evidence suggested that implants can be placed into sites with periapical and periodontal infections. The sites must be thoroughly debrided prior to placement. Guided bone regeneration is usually performed to fill the bone–implant gap and/or socket deficiencies. Although controversial, systemic antibiotics should be used until further controlled trials prove otherwise.

Steps : (Waasdorp *et al*., 2010)

- Antibiotics, 1hr prior to surgery
- Tooth extraction
- Thorough debridement of socket
- Repeated sterile solution irrigation
- Peripheral intrasocket ostectomy
- Removal of granulation tissue.
- Implant loading
- Guided Bone Regeneration(GBR)/Plasma Rich Growth Factor (PRGF) placement around implant
- Antibiotic course for 5-7 days

Additional Factors of Importance for Immediate Implant Placement in Infected Sites: (Gupta and Gupta, 2013)

The patient should be a non smoker (without any ill habits). The patient should be able to maintain good oral hygiene. Longer implants must be used in case of poor bone quality. Acid etched or grit blasted implants should be used for increased stability in infected Sites All provisional prosthesis should be screw retained to avoid any residual cement interfering with tissue healing. Interim surgical endodontics can be performed before extraction to minimize infection at future implant placement site

According to **Jotfre *et al.* (2012)** gave the protocol for immediate implant replacement of infected sites, extraction and immediate implant placement in infected site has become routine procedure due to reduced treatment time and the preservation of anatomical structures. It was aimed to report the clinical results of a protocol used for immediate implant placement and provisionlization in infected extraction sockets. It is also possible to maintain the benefits of immediate implant placement and provisionlization in infected sites by applying a clinical protocol that considers antibiotics therapy, a thorough curettage of infected tissues, antisepsis, and sufficient primary implant stability.

Minimal Requirement for Immediate Implant Placement & Provisionlization in an Infected Socket: (Jotfre *et al*., 2012)

1. Pre & post surgical antibiotic therapy
2. Thorough debridement of the socket
3. Profuse irrigation of the compromised area with chlorhexidine 0.12%
4. Avoid a flap or design a flap as small as possible
5. Choose implant geometry that better fits with marginal crest level of the socket Conical, Surface- treated, self tapping implant for better anchorage
6. Surgical technique with a drill sequence that allows maximal implant coverage
7. Keep an adequate implant position considering prosthetic outcome, maximal socket closure at the coronal level (use of surgical guide or clinical experience)
8. Gap more than 2mm between implant & socket, use graft
9. Maintenance of periodontal health & periodical controls

Also he has given the classification of the implant surface compromise (in contact with previously infected tissues) which

also described to facilitate the comparative analysis. Classification of CRAI- Compromised Rate Associated to Implant: (Jotfre *et al*., 2012)

Classification of crai in contact with previously infected tissue	
CRAI	% Surface Compromise of implant
CRAI- 0	0%
CRAI-I	1 face < 50%
CRAI-II	1 face ≥ 50%
CRAI-III	2 + faces < 50%
CRAI-IV	2 + faces ≥ 50%

CRAI-0 – there is no compromise of the implant surface
CRAI-I - apico-coronal exposure of the implant that affects 1 wall in a Percentage of < 50%
CRAI-II - apico-coronal exposure of the implant that affects 1 walls in a percentage of ≥ 50%
CRAI-III - apico-coronal exposure of the implant that affects 2 or more walls in a percentage of < 50%
CRAI-IV - apico-coronal exposure of the implant that affects 2 or more walls in a percentage of ≥ 50%

Outcome

To date, only few studies have reported on the clinical outcomes of immediate implants inserted in post extraction socket. The technique of immediate implant placement was first described by Lazzara in 1989, is one-step surgical procedure that reduces treatment time, improves aesthetic outcomes, increases comfort during healing, and has proven to be a predictable strategy with a high success rat, in absence of periapical lesions). In contrast with the traditional protocol, the immediate placement of an implant after tooth extraction also maintains the horizontal and vertical dimensions of the osseous tissues, and keeps the implants at the same angulation as the pre-existing natural teeth. (Lazzara, 1989) Furthermore, using implants to replace endodontically compromised teeth has been proposed when periapical surgery is inadvisable. Even though some local and systemic factors could contraindicate dental implant placement, recent investigations verify that the presence of a periradicular infection may not be an inconvenience for immediate implants, if the surgical sites are appropriately leaned and decontaminated. (Siegenthaler *et al*., 2007) In these cases, guided bone regeneration (GBR) is usually performed to fill the bone implant gap and/or other bone deficiencies. Although controversial, systemic antibiotics have also been recommended until further controlled trials prove otherwise. (Waasdorp *et al*., 2010) Immediate placement appears to be a valid technique for preserving bone at the site of implantation with infection. It allows us to maximize the bone available for osseointegration and to develop the restoration supported by osseointegrated implants from the functional and esthetic standpoint. Patients who, therefore, might have had insufficient bone to implants, can now be treated with implants. In these patients, immediate implantation also avoids the possibility of an esthetic and/or functional compromise in the implant-supported prosthesis. (Lazzara, 1989)

The immediate placement of dental implants into infected sites is a predictable treatment and it depends mainly on-

- Good patient and case selection.
- Presence of sufficient healthy bone beyond the peri-apica lesion.
- Surgical technique used; Atraumatic extraction, good curettage of the extraction socket, and drilling at least 3-4 mm beyond the root apex to gain maximum degree of primary stability.
- Implant selection; The implant has to be in length and diameter greater than that of the extraction socket, implants with a flared neck are better to be placed into fresh extraction sockets to increase bone- implant contact at the coronal part of the implant and implants with rough surface are recommended to be used for immediate loading.
- Patient's motivation, patient's co-operation to follow instructions and the follow-up program. (Aly, 2008)

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