Protocol for Immediate Implant Replacement of Infected Teeth

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Dental implant placement after tooth extraction is known as immediate implantation.[1–9] Immediate implant placement is indicated primarily to replace missing teeth with pathologies not amenable to treatment and teeth with root rhizolysis or teeth with chronic apical lesions that do not regress after endodontic treatment or periapical surgery and that do not present processes of exacerbation.[10–14] Furthermore, it is indicated in teeth with dentoalveolar trauma[15] and vertical root fractures,[11,12] as well as in retained teeth.[16]

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The main advantages of immediate implants are decreased resorption of the alveolar process after extraction, shortened treatment time, and reduced psychological stress for the patient by avoiding the need for a second surgical stage.[13,17–19] Immediate implants also allow for the preservation of the morphology of periimplant soft tissues.[17,20–22] On the other hand, some disadvantages may arise, including the need to perform regenerative techniques. Bone grafts and/or barrier membranes on the defect created by the alveolar-implant discrepancy are complicated and expensive treatments.[17,23]

Abstract: *Extraction and immediate implant placement has become routine procedure due to reduced treatment time and the preservation of anatomical structures. However, in many cases, this technique involves teeth with different degrees of tissue compromise due to underlying infections. Until now, the degree of implant compromise has not been described, nor has a clinical management protocol been established for these cases. The aim of this article is to report the clinical results of a protocol used for immediate implant placement and provisionalization in infected extraction sockets. A classification of the implant surface compromise (in contact with previously infected tissue) is also described to facilitate the comparative analysis. It is possible to maintain the benefits of immediate implant placement and provisionalization in infected sites by applying a clinical protocol that considers antibiotic therapy, a thorough curettage of the infected tissue, antisepsis, and sufficient primary implant stability. (Implant Dent 2012;0:1–8)*

Key Words: dental implants, immediate implant placement, infected sites, extraction socket

Some authors consider implant placement in chronic apical lesions to be a contraindication.[24–26] In fact, it has been postulated that periapical and periodontal lesions have a negative effect on osseointegration, resulting in implant failure.[19,27]

On the other hand, studies of both animals[28–32] and humans[21,33–36] have shown that immediate implants placed into infected postextraction sockets are a predictable procedure with success rates close to 92%.[37] Even in cases that require preservation and bone tissue enhancement, immediate implant placement has been described as a successful technique.[38] However, at present, a standardized protocol describing a detailed sequence of the steps to follow is lacking. Moreover, most published cases of immediate implant in infected sockets use a 2-stage surgical protocol.[13,33,37,39] Considering the esthetic demands of patients requiring dental extraction for an immediate solution,[40,41] it is essential to evaluate procedures that preserve the anatomical structures with predictable results.

The purpose of this article is to report the clinical outcomes of immediate implant placement and provisionalization in infected sites using a standardized protocol. A classification of implant surface compromise in contact with previously infected tissue is presented.

MATERIALS AND METHODS

This study reports a series of 31 cases treated according to the protocol of antisepsis after extraction of infected

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teeth, and immediate implant placement and provisionalization.

All patients were recruited consecutively from January 2008 to July 2010 at the Center for Advanced Prosthodontics and Implant Dentistry at the University of Concepcion, Chile. The minimum follow-up time was 6 months.

The inclusion criteria included partially edentulous patients older than 18 years with 1 or more teeth in need of extraction, root rhizolysis, chronic apical lesions that did not regress after endodontic treatment and periapical surgery, teeth with dentoalveolar trauma,[15] vertical root fractures (determined by clinical and radiographic evaluation), and no general medical contraindications for oral surgical procedures. Patients with uncontrolled systemic disease (eg, hypertension, diabetes), severe osteoporosis (bone mineral density >2.5 standard deviations below the mean young adult reference, plus 1 or more fragility fractures), and/or taking bisphosphonates were excluded, as were patients with mental disorders or people on radiotherapy at least 18 months before the surgery.

Infected teeth were defined by the presence of acute or chronic endodontic or periodontal disease, as assessed by clinical and radiographic examination. Each patient was informed about the benefits and possible risks of the procedure before signing the written informed consent. The protocol for immediate implant placement and provisionalization in infected sockets (see F1 Fig. 1) was used to all patients.

The primary outcome was the incidence of postsurgical complications defined as infection around the implant, as determined by the presence of signs and symptoms (eg, pain, suppuration, mucositis, periimplantitis, implant mobility), and evident radiographic bone resorption.[13] Variables such as sex, age, dentoalveolar pathology, implant surface compromise, insertion torque, follow-up time, need of graft, and need of flap were recorded.

The data were analyzed using SPSS version 15 (SPSS, Inc, Chicago, IL). Continuous variables were summarized by mean descriptive statistics using measures of central tendency and dispersion, with mean and standard deviations, medians, and extreme values. Categorical variables were summarized by frequency and percentage.

RESULTS

The case series consisted of 31 patients with a median age of 48 years (range, 19–84 years). Twenty-four (77.4%) of the patients were female. The median patient follow-up was 15 months (range, 6–297 months). No patient had postsurgical complications during the follow-up period. Table 1 T1 shows the sample distribution according to compromise rate associated to

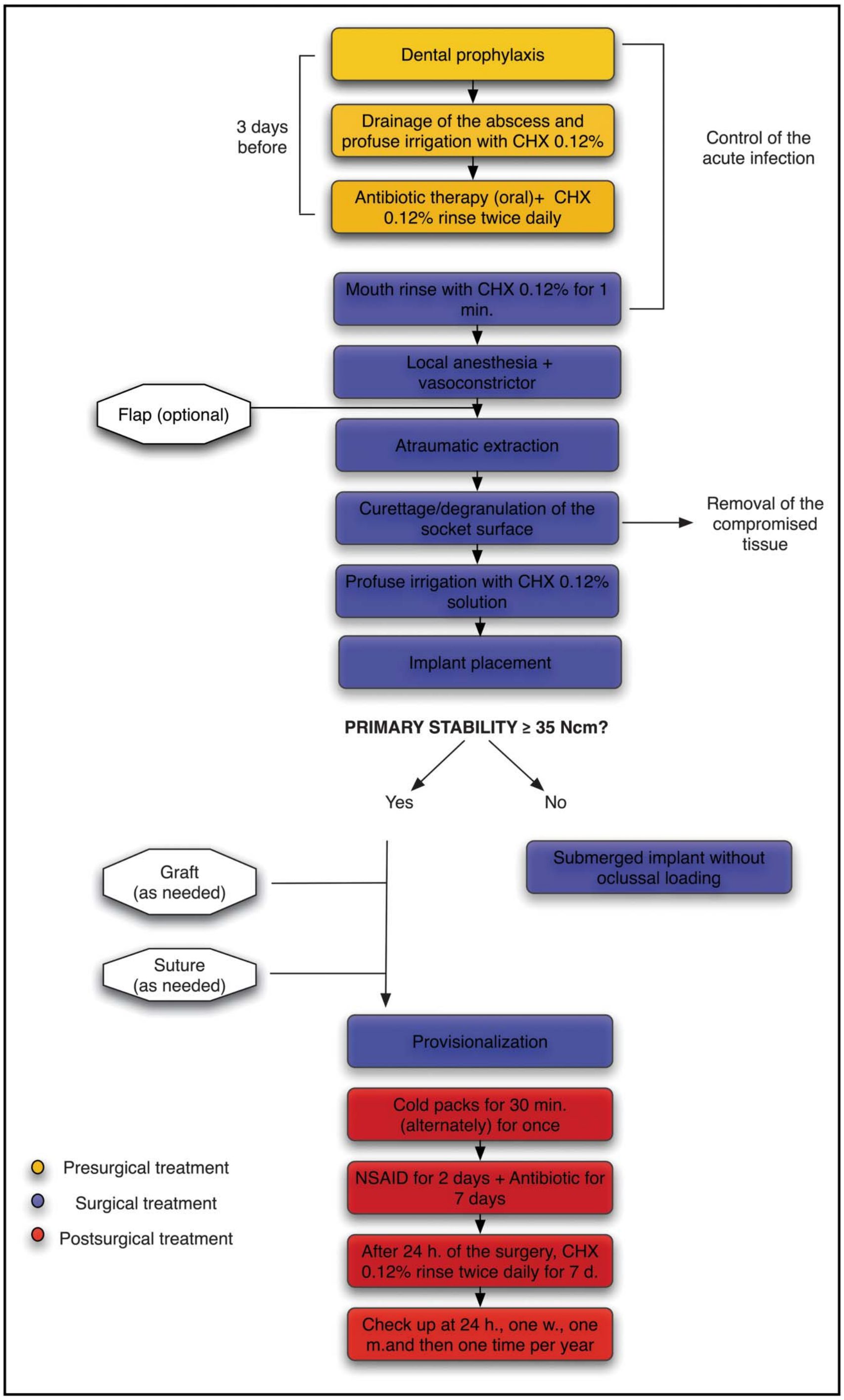

Fig. 1. Protocol for immediate implant placement and provisionalization in an infected socket.

Table 1. Distribution of CRAI in Contact With Previously Infected Tissue in a Case Series of 31 Patients

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CRAI	Frequency	Percentage
0	4	12.9
I	5	16.1
II	3	9.7
III	13	41.9
IV	6	19.4

implant (CRAI). The most frequent dentoalveolar pathologies were granuloma + root fracture (22.6%) and dentoalveolar cyst + root fracture (16.1%) T2 (see Table 2). The median torque for implant placement was 50 N.cm (range, 40–50 N.cm). Of the sample, 45.2% required flap and 38.7% were grafted. F2 – F4 Figures 2 to 4 show 2 cases treated with the proposed protocol.

Discussion

This report proposes a protocol for 1-stage immediate implant placement and provisionalization in infected

Table 2. Pathology Distribution in a Case Series of 31 Patients

Dentoalveolar Pathology	n	%
Cyst + root fracture	2	6.5
Dentoalveolar cyst + root fracture	5	16.1
Granuloma +root fracture	7	22.6
Granuloma	2	6.5
Root fracture	1	3.2
Dentoalveolar abscess	1	3.2
Periodontic-endodontic lesion + root fracture	2	6.5
Cyst + periodontic-endodontic lesion	1	3.2
Aggressive generalized periodontitis+granuloma	1	3.2
Periodontic-endodontic lesion+ dentoalveolar abscess	1	3.2
Chronic generalized periodontitis	1	3.2
Furcation lesion +granuloma	1	3.2
Palatine cyst+ dentoalveolar abscess	2	6.5
Root dwarfism	1	3.2
Cyst + chronic generalized periodontitis	2	6.5
Root fracture+ cyst+ dentoalveolar abscess	1	3.2

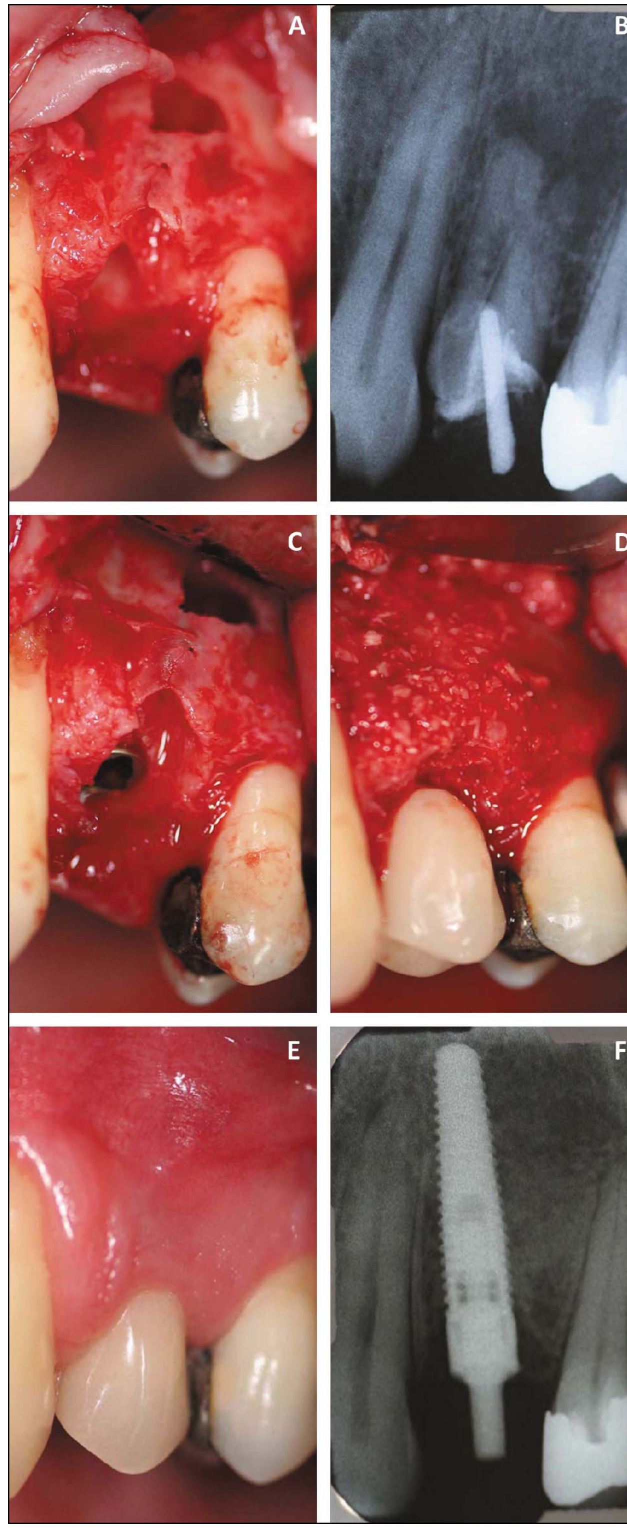
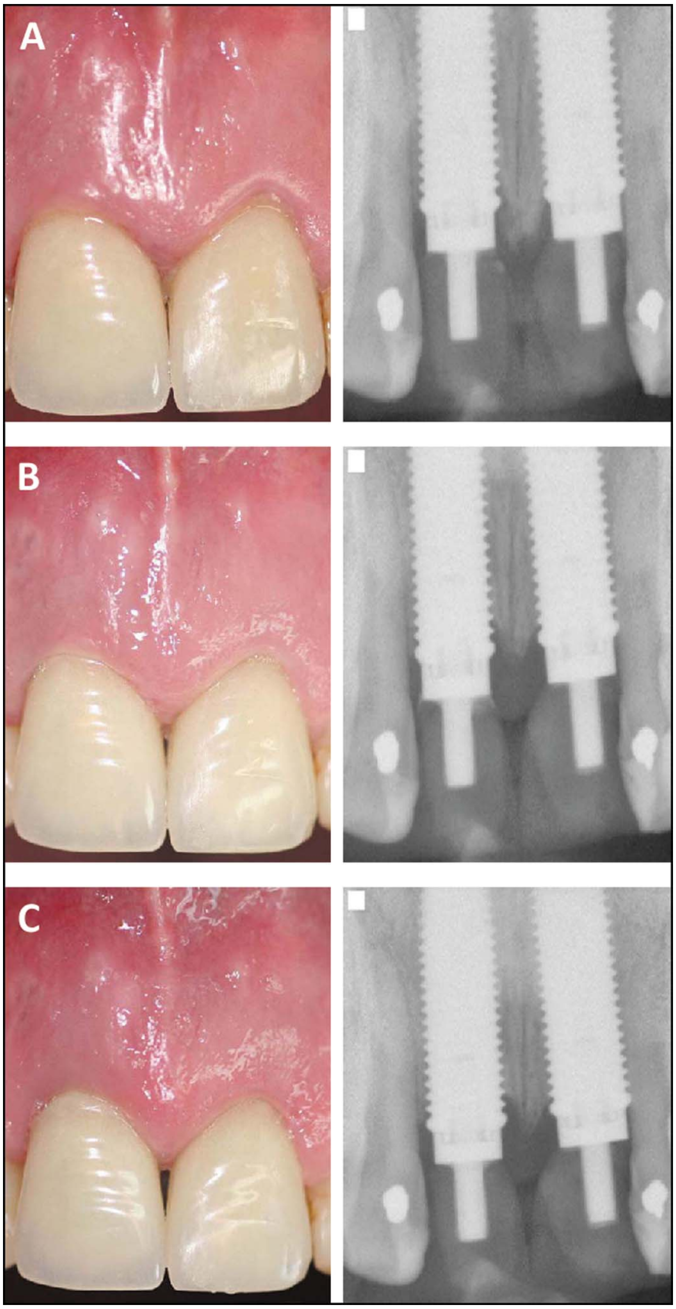


Fig. 2. Case 1: A 34-year-old man with a dentoalveolar abscess in tooth 2.4 (CRAI III). **A**, Bone destruction caused by infection. **B**, Periapical radiography showing a periradicular lesion. **C**, Insertion of the implant into the socket with palatal tilt after the removal of contaminated tissue and profuse irrigation with chlorhexidine gluconate 0.12%. **D**, Provisionalization on immediate temporary abutment and bone graft. **E**, Six months after the surgery, periimplant tissues are in healthy condition and showed satisfactory esthetics. **F**, X-ray 6 months after the surgery showing healthy condition around the implant.



AU7 **Fig. 3.** Case 2: Postsurgical follow-up. **A**, After 72 hours of surgery. **B**, A month after the surgery. **C**, Postoperative aspect at 6 months.

sockets. This procedure could be con-
AU3 troversial because the absence of infection has been considered an essential condition for immediate implant placement.[24–26] However, the literature suggests that immediate implant could be performed in cases of controlled chronic infection.[13,21,28,36,37]

This contradiction could be explained by the lack of standardized criteria for classifying compromise rate associated with implants in contact with infected tissue. Thus, it is difficult to compare published results.

Small infected areas are completely removed during preparation for the surgical procedure, leaving the implant inserted into healthy tissue. On the other hand, infected lesions that are associated with large areas of bone loss usually leave part of the implant surface in contact with a previously infected zone.

Areas of the implant left without a bone support could be used to determine the degree of implant compromise. Based on this criterion, a classification of CRAI in contact with previously infected tissue is presented (Table 3). T3

Baelum and Ellegaard[42] reported that in periodontally compromised patients, the implant survival rate at 10 years was 78% when using the 1-stage technique (implants are immediately connected through the oral mucosa[43,44]) and 97% for the 2-stage procedure (implant is submerged under the mucosa to heal load free).[43,44] Lindeboom et al[37] observed that in patients with chronic periapical infected sites, the implant survival rate at 6 months was 92% for the 1-stage versus 100% for the 2-stage protocol. These results seem to indicate that a 2-stage procedure would be more appropriate for immediate implant placement into an infected site. However, a closer analysis of these studies shows that some other factors could have a more significant effect on the outcome than the surgical stages of implant placement. In the study by Baelum and Ellegaard,[42] they presumed that these results could be related to the fact that the 1-stage implants were hollow screw implants, which are virtually impossible to treat once periimplantitis has developed. In the study by Lindeboom et al,[37] 1-stage implants were placed with a torque of 25 N.cm, and all sockets required bone grafts to cover the buccal fenestrations. After 2 weeks, they were loaded by a removable provisional partial denture. Currently, the minimal insertion torque suggested for loading during the bone healing process should be a minimum of 35 N.cm.[45–48]

In the present report, the use of bone graft was considered only if the gap was 2 mm or more, as indicated by Cordaro et al.[49] Because many authors have reported a potential risk of membrane exposure[4] leading to further contamination,[50,51] the periosteum was used as a natural barrier.[52,53] Some studies have reported the immediate implant placement in infected dentoalveolar

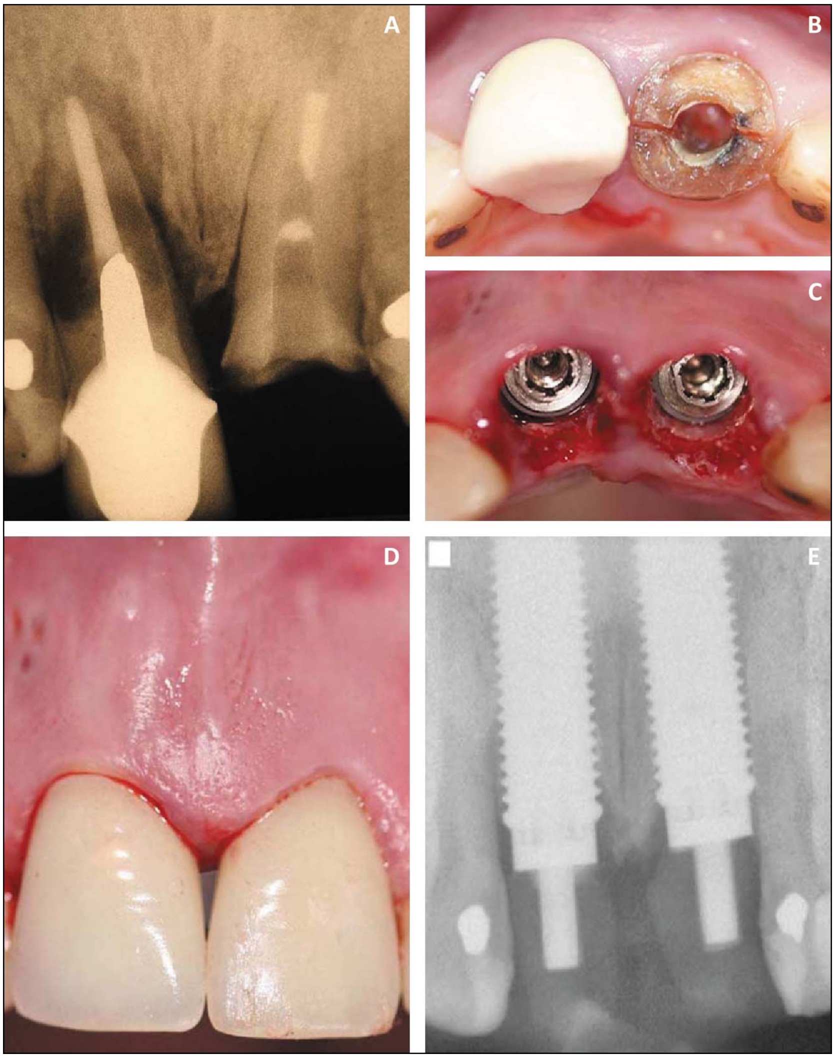


Fig. 4. Case 2: A 43-year-old man had a metal ceramic crown with a root fracture plus resorption associated to dentoalveolar abscess in tooth 1.1 (CRAI III) and a vertical root fracture in tooth 2.1 (CRAI 0). **A**, Periapical x-ray taken at baseline. **B**, Occlusal view of metal ceramic crown on tooth 2.1 and fracture of tooth 2.2. **C**, Insertion of implants into the alveolar sockets after removal of contaminated tissue and profuse irrigation with chlorhexidine gluconate 0.12%. Immediate provisionalization (**D**) and standardized x-ray (**E**) after the surgery.

Table 3. Classification of CRAI in Contact With Previously Infected Tissue

CRAI	Percentage of Surface Compromise of the 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 indicates there is no compromise of the implant surface; CRAI I, apicoronal exposure of implant that affects one wall in a percentage <50%; CRAI II, apicoronal exposure of implant that affects one wall in a percentage ≥50%; CRAI III, apicoronal exposure that affects 2 or more walls in a percentage <50%; CRAI IV, apicoronal exposure that affects 2 or more walls in a percentage ≥50%.

sockets, but without provisionalization, proposing the closure of the wound with soft tissue to obtain good results.[33,36,54]

Primary closure is difficult to achieve in 2-stage procedures after extraction; a vestibular flap should be mobilized to completely cover the place of extraction.[20,55] This technique results in an adequately sealed wound but has the disadvantage of reducing the width of the attached gingiva around the implant, which could lead to both functional as well as esthetic complications in periimplant tissues.[20]

Provisional restoration in partially edentulous patients can be completed the same day of implant placement,[56] taking special care to avoid any occlusal contact.[57] Immediate provisionalization contributes to the final esthetic results and the patient's satisfaction.[58–60]

In the protocol described herein, infection control and primary stability were the key factors for successful treatment, as they established a favorable basis for hard and soft tissue healing.[57]

Infection Control

The infection was controlled by administering antibiotic therapy combined with rigorous debridement and chemical control of the contaminated areas.[21,33] The literature suggests that sites with acutely infected lesions may require systemic antibiotics after debridement to assure an effective infection control.[21,33,61] The aim of debridement is the complete removal of the underlying infected tissue.

The routine use of antibiotic therapy as premedication before dental surgery is not recommended.[62] However, due to the inherent risk of an infected area in these cases, this treatment protocol includes the use of an antibiotic as premedication to avoid the acute inflammation process becoming chronic and to cover the surgical and postsurgical period during the healing process.

In the proposed protocol, the socket was irrigated with chlorhexidine gluconate 0.12% solution to prevent and treat infection. The presence of infection is known to cause failure or delay in the healing process and even the deterioration of injured tissues.[63] Therefore, the prevention of bacterial contamination and a tight control of bacterial plaque are essential to achieve successful results.[52] In addition, the postoperative protocol for the maintenance of healthy periimplant tissue is based on the use of chlorhexidine mouth rinse during the wound healing process[21,34,36,37,64] and rigorous patient hygiene.[65] Chlorhexidine is considered to be a gold standard in terms of antiseptic agents due to its antimicrobial activity spectrum and its ability to reduce plaque formation at different concentrations.[66] High dosages used in some *in vitro* studies have shown to

Table 4. Minimal Requirements for Immediate Implant Placement and Provisionalization in an Infected Socket

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

be cytotoxic to epithelial cells of the oral cavity in humans, which could lead to a delay in the healing process.[67–70] However, studies in animals and humans have shown that applications of chlorhexidine solutions of 0.1% to 0.2% do not alter this process.[71–74] Therefore, the use of chlorhexidine in the concentration and dosage proposed herein would promote healing through the chemical control of bacteria at the surgical site. Furthermore, chlorhexidine favors oral health during the postoperative phase, preventing microbial growth and, consequently, decreasing the risk of postsurgical complications.

Primary Stability

Primary stability is a consequence of the surgical procedure, bone quality, and implant design. Some studies[11,21,34] have shown acceptable results after applying immediate function protocols in patients with compromised periodontal tissues.

A key requirement for immediate implant placement and provisionalization is to obtain primary stability exceeding 35 N.cm.[45–48] Therefore, it is of vital relevance to select a geometric implant design that allows optimal anchorage. The conical implant design with a treated surface enhances primary stability[75,76] because it reduces the distance between the socket wall and the implant, favoring bone contact. Moreover, the use of a surgical protocol in which the drilling sequence is modified avoiding the use of the wider drills, leading to insertion of the self-tapping implant. This latter ensures a high level of implant-bone interfacial stiffness with maximal apical anchorage.

The clinical results presented in this article show that immediate provisionalization is a feasible technique for compromised sites with acute and widespread destruction of bone tissue (presence of abscess, fistula, and suppuration). Nevertheless, it is necessary to follow a rigorous protocol to control and chronification the underlying infection and to obtain a high degree of primary stability (Table 4).

There is no evidence that limits the use of immediate implant placement and provisionalization in an infected socket when following an appropriate clinical protocol. This report shows the results of a case series in which a protocol of antibiotic therapy, local antisepsis, and prosthetic surgical procedures was applied into infected socket, allowing benefiting from immediate implant placement and provisionalization during the initial healing phase, to favor esthetics and patient satisfaction without complications.

CONCLUSION

Immediate implant placement and provisionalization could be indicated in infected lesions when following a protocol that includes antibiotic therapy, debridement, antisepsis of the compromised tissue, and high primary implant stability.

DISCLOSURE

The authors claim to have no financial interest, either directly or indirectly, in the products or information mentioned in this article.

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