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Climacteric Review of Immediate Implant Placement and Complications

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Abstract: ***Implant dentistry has become successful with the discovery of the biological properties of titanium. In the original protocol, studies have advocated a 2-stage surgical protocol for load-free and submerged healing to ensure predictable osseointegration. However, the discomfort, inconvenience, and anxiety associated with waiting period remains a challenge to both patients and clinicians. Hence, loading implant right after placement was attempted and has gained popularity among clinicians. Issues/ questions related to this approach remain unanswered. Therefore, it is the purpose of this review article to (1) review and analyze critically the current available literature in the field of immediate implant loading (2) discuss, based on scientific evidence, factors that may influence this treatment modality and (3)provide the useful information related to the complications of placement of dental implant immediately after tooth extraction into fresh socket.***

Keywords: Immediate implant placement, implant failure, Membrane exposure, jumping Gap

1. Introduction

Many clinicians feel that a two-stage approach involving extraction, ridge augmentation and a healing period of 4-12 months will enhance the implant success rate. However, this approach not only prolongs the time for eventual tooth replacement and return to function and esthetics, but also increases the cost to the patient. Placement of implants into infected extraction sites is even more controversial and avoided by most clinicians. Implant replacement of maxillary and mandibular molars using an Immediate Implant Protocol (IIP) is also often avoided by most clinicians. In all of these cases, with proper surgical management the success rates are also similar to implant placement into edentulous or previously augmented sites[1,2]. Placement of implants at the time of extraction of the natural tooth offers many advantages over delayed placement. These include improved healing without flap advancement, decreased treatment time, fewer surgical procedures, decreased cost, and decreased discomfort. These advantages have been discussed in numerous studies all reporting high implant survival rates for IIP[3-6]. Frequently, compromised teeth that are indicated for extraction are enveloped in infection, which conventionally contraindicate their immediate replacement with endosseous dental implants because of the risk of microbial interference with the healing process. Some studies on immediate implants suggest that this procedure should be avoided in the presence of periapical or periodontal pathosis, and clinical reports have suggested that history of periodontal or endodon-tic infections is a predictive marker for implant infection and failure. Clinical experience has led most clinicians to avoid the immediate placement of endosseous dental implants at infected sites and to consider infection a contrain- dication for immediate implantation. A published systematic review emphasized the paucity of available literature discussing this subject. It also stressed the need for studies incorporating designs that eliminate confounding variables, including implant placement immediately compared with placement in intact ridges, implant placement in sites with periapical pathology and in sites without periapical pathology, implant placement in sites with periapical pathology and sites without periapical pathology in similar areas of the mouth, and when comparing these two treatment modalities in the same patient. Complications with the IIP protocol can occur, as they do with all implant placement protocols. Therefore, it is the purpose of this review article to (1) review and analyze critically the current available literature in the field of immediate implant loading (2) discuss, based on scientific evidence, factors that may influence this treatment modality. and (3)provide the useful information related to the complications of placement of dental implant immediately after tooth extraction into fresh socket.

2. Material and Methods

Search strategy

This systematic review was designed as an update to a previously prepared publication with the same objectives. For that purpose, a Medline (PubMed) search was performed for clinical studies. The search was limited to the English language. In addition, fulltext articles of reviews published were obtained. An additional hand search was performed identifying relevant studies by screening these reviews and the reference list of all included publications (reference list "list of reviews")

Search terms

The following search terms (all MeSH terms) were selected: "immediate dental implants" AND ("crowns" OR "survival" OR "complications"). The search was limited to "humans" (MeSH term), "Dental Journals", and "Medline".

Inclusion criteria

Clinical publications were considered if all the following criteria were suitable: (i) human trials with a minimum amount of 10 patients with SCs; (ii) mean follow-up of at least 5 years in function; (iii) randomized controlled trials (RCT), controlled clinical trials (CCT), prospective case series, cohort studies, and retrospective studies; (iv) patients needed to be examined clinically; and (v) reported details of suprastructures.

Exclusion criteria

Studies not meeting all inclusion criteria were excluded from the review. Publications dealing with the following topics were also excluded: studies not reporting in detail the prosthodontic component, reports based on questionnaires, interviews, and charts.

3. Literature Review

Results

High success rates from immediately loaded implants in humans were first documented in the middle 1980s, when the 1-stage implant protocol gained popularity. Subsequently, many authors have shown the possibility of loading implants immediately (Buser et al. 1988; Piattelli et al. 1993; Henry & Rosenberg 1994; Salama et al. 1995; Bijlani & Lozada 1996; Chiapasco et al. 1997; Piattelli et al. 1997a, 1997b, 1998; Tarnow et al. 1997; Randow et al. 1999; Scortecci 1999; Ericsson et al. 2000b; Gatti et al. 2000; Horiuchi et al. 2000; Jaffin et al. 2000; Malo et al. 2000; Colomina 2001; Ganeles et al. 2001)[7-25] with predictable success rates and subsequent complications. Henry & Rosenberg (1994)[9] reported 2-year clinical results using a single-stage surgical protocol in conjunction with controlled immediate loading. They suggested that clinical performance and prognosis of the procedure were comparable to the traditional 2-stage method (e.g., allowing time for implant healing without any interference from occlusal contact). Schnitman et al. (1997)[26] observed 61 implants placed in 10 patients. Out of these 61 implants, 28 were placed and immediately loaded to support an interim fixed bridge. A success rate of 85% was reported in immediately loaded implants compared to 100% for submerged unloaded implants. Tarnow et al. (1997)[16] placed a minimum of 10 implants with half of them being submerged to load free healing. Subsequently, more implants were loaded immediately in the last four patients. Totally, 69 implants were immediately loaded and 38 were submerged without loading. Almost 97% (104/107) were successfully integrated. One submerged implant failed due to infection that spread from the adjacent extraction socket. Two immediately loaded implants were lost when the cemented provisional restoration was tapped off to verify healing. Interestingly, no difference was found between maxillary and mandibular implants.

Bijlani & Lozada (1996)[11], in a retrospective study, evaluated the success rate of immediately loaded implants placed in four patients after 3–6 years of clinical function. All implants placed and loaded immediately were successfully osseo integrated, according to the criteria described by Albrektsson (1986)[27]. It is important to note that patients in this study received complete removable prostheses in the maxilla and soft-tissue-supported over dentures in the mandible (Bijlani & Lozada 1996)[11]. This suggests that the occlusal scheme may be another key factor for a successful outcome with immediately loaded implants. This was later confirmed by Balshi & Wolfinger (1997)[28], who found that 75% of failures in immediately loaded implants occurred in patients with bruxism. In this study, 130 implants were placed in 10 patients, 40 being immediately loaded and 90 left submerged, according to the second-stage protocol. Results after 12–18 months showed a survival rate of 80% for immediately loaded implants, while unloaded implants had an average of 96% success rate. A multicenter retrospective study was conducted by Chiapasco et al. (1997)[12] on 226 patients with a mean follow-up period of 6.4 years (ranging from 2 to 13 years). Totally, 904 immediately loaded implants had been placed between the interforaminal area of the mandibular symphysis (4 implants per patient). Thirty-two patients did not complete the study for unknown reasons. The overall failure rate of immediately loading implants was very small (3.1%). Randow et al. (1999)[17] further compared the oral rehabilitation of edentulous mandibles with fixed implant prostheses using either a 1-stage immediate loading or a 2-stage unloaded protocol. For the unloaded cases, dentures were not used for the first 10 days and a relining of the original denture was placed in function after this period. Results showed no difference between the 2 groups examined after 18 months. The survival rate for both groups was 100%. Scortecci et al. (1999)[18] placed 783 titanium implants (627 laterally inserted disk implants, with orwithout 156 axially inserted structure implants). Implants were evaluated using Periotests and torque testing at 20 N cm. They found that 98% of immediately loaded implants were considered osseointegrated after 6–48 months. The authors attributed their high long-term success to the unique implant design, which allows better stress distribution to ensure long-term success. Gatti et al. (2000)[20] evaluated long-term results of immediately loaded implant retained overdentures supported by 4 TPS screw implants. Overdentures were supported by 4 implants and bar clips were immediately placed. A cumulative survival rate of 96% was reported in 19 patients who were followed for 25 months. Chiapasco et al. (2001)[29] compared the success rate of immediately loaded vs. delayed loaded implants in 20 patients with implant- retained mandibular over dentures and demonstrated a similar success rate, 97.5% for both groups. Another study utilizing Bra°nemark fixtures has also obtained a high success rate (98.3%) in edentulous mandibles (Chow et al. 2001)[30]. A similar success rate was also achieved in a new protocol for immediately loaded implant treatment (Bra°nemark et al. 1999)[31]. In this study, 150 implants were placed in 50 patients. The proposed guidelines involve prefabricated components and surgical guides, elimination of the prosthetic impression procedure, and placement of a permanent bridge on the day of implant placement.

Results from these studies clearly suggest that implant immediate loading could achieve equal success rates as those found in delayed or unloaded implants with related complications. Few studies have focused on immediate loading of implants for single-tooth replacement (Gomes et al. 1998; Ericsson et al. 2000a; Malo et al. 2000; Chaushu et al. 2001; Cooper et al. 2001)[32,33,23,34,35]. Gomes et al. (1998)[32] placed HA-coated implant and loaded immediately with a provisional crown. Clinically, the implants showed no mobility and remained in function for the duration of the study. However, it should be noted that the restoration was removed from any centric and lateral occlusal contacts. Ericsson et al. (2000 a)[33] reported the failure of 2 out of 14 (14%) immediately loaded single implants vs. no failure in single implants placed in the 2-stage protocol (8 out of 8). Implants were loaded via temporary crowns within 24 h. More recently, Chaushu et al. (2001)[34] compared

immediately loaded implants placed in fresh extraction sites to that of healed sites in 26 patients. The survival rates were 82% and 100% respectively. This implies that immediate loading of single-tooth implants placed in fresh extraction sites may carry a risk of failure in 1/5 of fixtures. It is understandable that the occlusal scheme favors the placement of single immediate loading implants for tooth replacement compared to fully edentulous situations, since adjacent natural teeth may protect implant prostheses from occlusal trauma during early phases of healing. However, the hypothesis remains to be proven.

4. Discussion

This review was designed to provide a broad perspective on the most important aspects of immediate implant placement. Due to data heterogeneity, it was impossible to perform a meta-analysis nor provide recommendations based on conclusive scientific evidence, given the lack of long-term randomized studies and relatively small sample sizes. A preferable technique could not be suggested. Over time, clinical experience has provided the criteria for immediate implant treatment success: atraumatic tooth extraction, sterilization and minimal invasive surgical approach, as well as implant primary stability (36,37-39). Most papers contained only data on implant loss, but did not provide useful information on implant failure or hard and soft tissue changes. Their data match the results of the present review, in which most of the articles reported data on implant survival rates but not on implant success rates, according to the criteria described by Albrektsson et al. (40).

In The Fourth ITI Consensus Conference (November 2009), the advantages and drawbacks of the various points in time for implant placement after tooth extraction were reported. They concluded that immediate implant placement is a more difficult technique than delayed implant placement to allow initial stability and a good prosthetic position. There is also an in-creased risk of mucosal recession. Nonetheless, based on the aesthetic index, 80% of immediate implant sites show satisfactory outcomes. The survival rates of post-extraction implants are high and comparable to those of implants placed in healing sites, like many authors in the present review (41). Despite many articles previously described limited marginal bone level or gain in immediate implant therapy, caution is needed because few of these studies report radiographic outcomes (42). Few studies comparing implant stability between delayed and immediately placed implants seem to be available in the literature. From the reviewed studies, it seems that ISQ values are somewhat lower in immediately placed implants compared to implants placed in pristine bone (43). However, these differences tend to disappear overtime (44,43). ISQ values seem to increase progres-sively during healing over the first few months in immediate implants (45,44,43). Further controlled clinical studies should be performed in order to verify these findings.

However, the most common complications that occur with IIP after extraction of the natural tooth include:

- Poor Implant Positioning
- Membrane Exposure During Healing
- Inadequate Bands of Keratinized Tissue After Healing
- Gingival Recession
- Implant Failure
- Unacceptable Esthetic Outcomes.

Poor implant positioning

Poor implant positioning could occur owing to the failure of the clinician to initiate the osteotomy in the correct position. The ideal position is along the lingual incline in a maxillary anterior tooth, at the apex of the socket for a premolar, and in the area of the interdental septum for a molar. The standard round entry bur often cannot guide the 2 mm drill into the ideal position after the natural tooth is extracted. Use of a pointed and very sharp entry bur will make the initial entry and position more reliable. It is critical to know in advance what type of final restoration is planned for the sites and the location of the central fossa or cingulum. For a screw-retained restoration the implant should exit in the central fossa of the posterior teeth and in the cingulum area of the anterior teeth. For a cemented restoration the implant should exit in the central fossa of the posterior teeth and in the incisal area of anterior teeth. For removable dentures the implant should exit just palatal to the teeth in the anterior and posterior and may be better positioned between two teeth. This will decrease the chances of the denture teeth being dislodged.

Membrane exposure during healing

Membrane exposure during healing is a common occurrence. Depending on the type of membrane used this may or may not be significant. With most membrane systems it is important to have primary flap closure. Proper advancement of the flap without tension and use of a suture material which will help to retain the flaps in place during the initial stages of healing are recommended. Membrane exposure with absorbable membranes such as Polyglactin 910 (PG910) (Vicryl, Ethicon; Johnson and Johnson, Somerville, NJ, USA) or collagen membranes usually does not significantly affect the results. The PG910 membrane breaks down in acid form and bacterial growth over it is minimal. These membranes do not require advancement of the flaps for membrane coverage, as it is not critical to success. After the membrane dissolves there is usually an adequate volume of keratinized tissue between the original flap margins when the flaps are not advanced. In certain circumstances, such as in smokers, it is recommended to advance the flap even with this membrane as the tissues tend to shrink more in smokers and plaque accumulation is usually increased.

Inadequate bands of keratinized tissue after healing

The gingival marginal levels around implant restorations tend to be maintained over time more coronally when there are adequate bands of keratinized tissue. Advancement of flaps during healing leaves minimal keratinized tissue labial to the implant restoration. This usually requires reposition of the flaps that have previously been advanced or placement of a tissue graft to increase the dimension of tissue labially.

Gingival recession

Implant placement too far to the labial surface or the use of very wide implants which approach the labial bone leaving little "gap" space tend to increase the potential for gingival recession around implants placed with an IIP protocol. Adequate space labial to the implant is essential for long-

term maintenance of the implant. Another problem concerns the unpredictable postsurgical gingival recession that may occur after extraction and IIP. This has been documented in several studies [46-50].

Implant failure

Implant failure can occur with the IIP protocol in native bone or previously regenerated ridges. Studies have demonstrated that the implant survival rate is similar with either an IIP or a delayed placement protocol[51]. If an implant fails it can be replaced, either immediately by placing a wider implant or in a staged protocol after removal and ridge augmentation. Implant replacement, however, has recently been reported to have a lower implant survival rate.

Unacceptable esthetic outcomes

Even when the clinician follows the correct IIP protocol, the resulting restoration may still present with an unacceptable esthetic outcome[52,53]. It is essential, therefore, before placement, to determine the patient's expectations. Those with high esthetic expectations should be considered for a staged approach for restoration of the ridge before implant placement. The limiting factor with regard to the potential for interdental papillae between a single implant and a natural tooth is the bone level on the adjacent teeth.

Immediate tooth replacement (non-occlusally loaded) at the time of extraction of the natural tooth

Implants placed at the time of extraction of the natural tooth which are in the esthetic zone are often a challenge to the clinician. As mentioned previously, it is essential that the implant be placed in the proper position related to the final restoration. Patients are usually not comfortable with removable provisionals such as partial dentures or Essixappliances. Acid etch retainers are difficult to manage because of the coordination necessary for removal and replacement. Fabrication of a provisional restoration allows the clinician to create an emergence profile and tissue support of the gingiva and papillae, which also help to maintain the contour of the natural tissue forms. There are essential criteria for IIP and immediate provisionalization which include:-

- Removal of all infectious material from the socket
- Adequate available tissue dimension
- Initial stability of the implant
- Patient cooperation with postsurgical maintenance.

It is essential that the clinician is able to avoid loading the immediate placed implants. The provisional restorations are usually single-tooth replacements in the anterior or maxillary bicuspids (a cuspid form is used to avoid an occlusal table) and are susceptible to macromotion from mastication. Food must be cut into small pieces and placed on the posterior dentition for mastication. Although casual contact is expected to occur, overloading could lead to the failure of the implant. All of this must be explained to the patient and the patient must agree to comply with the postsurgical regimen. If the patient is not cooperative the IIP protocol and immediate provisionalization should not be the treatment option. For success of this protocol, the provisional restoration must be out of occlusion during maximum intercuspation as well as working movements.

How to avoid the consequences for IIP

Achieving successful results with the IIP protocol requires strict adherence to proper procedures. The following criteria are essential for the success of IIP:-

- All residual infection has to be removed. The socket must be examined after a thorough debridement which removes all residual fibers from the apical and lateral wall areas
- Apical or lateral stabilization. The implant must be placed into enough native bone to attain primary stability. Dehiscence with thread exposure at the time of implant placement does not contraindicate this technique if initial stability can be obtained.
- The surgical and restorative clinicians must determine patient expectations, work with an ideal wax up, and consider postsurgical bone resorption to determine whether the results will satisfy the patient's demands.
- The implant must be placed in an ideal position with precise surgical technique and consideration of the anatomy of the recipient site.

Management of complications

Specifically, to treat implant malposition, it is important to try to recognize this problem at the time of implant placement using a surgical guide based on an ideal wax up and computed tomographic (CT) scans.

If proper positioning is not attained at initial placement, removal of the implant and redirection, where possible, is indicated.

If there is not enough bone to position the implant correctly, the implant should be removed and the bone augmented with a GBR procedure, and after adequate healing a delayed placement protocol used (3-6 months).

If an implant integrates in a poor position either a prosthetic solution or implant removal is indicated. Treatment for membrane exposure includes membrane removal (with non-absorbable membranes) or keeping the area clean until the membrane absorbs and the area heals.

Postsurgical gingival recession can be avoided in many cases by proper implant positioning and patient selection (gingival recession is less likely in patients with a thick biotype). Following implant integration and restoration, connective tissue grafts can be used to treat gingival recession.

Adequate bands of keratinized tissue can be created by flap positioning or connective tissue grafting at the time of or after implant placement.

Poor esthetic outcomes are at times subjective and subject to patient expectations. A number of procedures can be performed to enhance esthetic outcomes after final restoration. However, these procedures are costly, include more surgery and time, often require multiple surgeries, and are not always predictable.

5. Conclusion

There is not enough reliable evidence proving higher success of immediate implant placement over delayed placement.

Post-extraction implants have survival rates similar to implants placed on healed sites. Nevertheless, some guidelines could be extracted from this review's data:

- Interproximal bone level and soft tissue recession.

Crestal bone as well as soft tissue preservation could be achieved with either by immediate implant placement following tooth extraction or by a delayed protocol.

- Treatment of the gap between implant and bone wall

There is no consensus whether bone augmentation with GBR at immediate implants placed into fresh extraction sites are necessary, and which is the most predictable procedure. However Bio-Oss and membranes therapy seem to show a higher position of the gingival margin.

- Presence of periapical infection
- Chronic periapical infection is a risk factor but not an absolute contraindication for immediate implant placement.

However, debridement of the alveolus should be made. The presence of a periapical infection should be carefully weighed.

- Primary implant stability

Primary implant stability is an important factor in achieving osseointegration. Several methods have been used to quantify this parameter, such as insertion torque values and resonance frequency analysis (RFA). However, few scientific studies reveal comparative data between immediate and delayed implant placement. It seems that there are no significant differences between primary stability of immediate and delayed implants, but in both cases implant stability increases during the healing process.

Based on this review of the literature tackled, immediate implant placement following tooth extraction might be a viable alternative to delayed placement. However, it requires a careful case selection and a specific treatment protocol because it is a very sensitive technique and more difficult to execute than a conventional protocol.

Important aspect which clinician must take into consideration in relation to placement of immediate implant include primary stability when there is sufficient apical bone, jumping distance i.e gap between the buccal plate and implant , presence of the buccal and lingual cortical plates, condition of the gingival biotype and implant design (Self Tapered). The Immediate Implant Placement protocol is technique sensitive and should be avoided in the esthetic zone by clinicians with limited experience with this procedure. Moreover, appropriate surgical treatment planning, proper restorative measures are essential factors for implantation of the IIP.

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