

Immediate X Delayed loading dental implants: an overview

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Abstract

The aim of this investigation was to accomplish an overview about the principles of the indication and of the success parameters involving immediate and delayed loading dental implants procedures. Studies about the philosophies (immediate and delayed loading dental implants) and their clinical indications will be discussed in order to overview the rules for the clinical success in both techniques. In addition, studies regarding the criteria for immediate loading implants as primary stabilization, surface treatments and bone density and amount will be also analyzed. More important than the philosophy selection, is how and when to use it according to biomechanical rules and principles. Among the vast limitations pointed by the literature regarding procedures of immediate and delayed loading are evidenced the parafunctional habits, primary stabilization, bone quality, surface treatments and the number of dental implants. The anterior region of the jaw seems to be associated with a major percentage of satisfactory results, regardless of rehabilitation procedures. Although several studies have demonstrated high success rates for the immediate loading dental implants, several aspects remain without an explicit definition and further studies are needed to elucidate some reservations.

Key Words:

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Introduction

The obtaining of a satisfactory osseointegration is an expected principle after the surgical placement of the dental implants. A great number of traditional articles describe surgical protocols for the placement of dental implants in two-steps¹⁻⁵. According to the original protocol, Branemark implants require a two-step surgical procedure in order to become osseointegrated. In addition, other parameters as insertion of the implants below the bone crest, maintenance of the implants under soft tissues by periods that may vary between 3 and 6 months and absence of loads during osseointegration should also be observed^{3,5-7}. These parameters have been followed by many researchers and clinicians in order to avoid fibrointegration areas and the post-surgical risk of bacterial infection, to maintain an atmosphere with absence of forces or micromovements on the bone/implant interface and to favor the bone remodeling and apposition on the dental implants surfaces^{5-6,8-14}.

On the other hand, the placement of the dental implants following a one-step surgical procedure has been used thoroughly during the last ten years^{2,5-6}. Therefore, the second surgical procedure is eliminated, in other words, the step of implant exposition for the fabrication of the crowns, fixed partial denture or overdenture are eliminated. According to Attard and Zarb¹⁵, the maintenance of exposed implants soon after the surgical procedures, does not detrimentally affected the osseointegration. The immediate loading procedures reduce the number of clinical steps and appear to propitiate a more comfortable and acceptable condition for the patients¹⁶. The great advantage, besides avoiding a second surgical procedure, is the possibility to carry, or better, to provisionalization the dental implants immediately after the surgery or some brief period after it⁵⁻⁶. Several clinical studies have observed similar success among immediate loading implants and delayed loading implants^{2-3,12,14,17-21}.

The aim of this investigation was to accomplish an overview about the principles of the indication and of the success parameters involving treatments with the use of immediate and/or delayed loading dental implants.

Literature review and Discussion

In agreement with Babbush et al.²², clinical studies of immediate loading dental implants have been demonstrating encouraging results. Although the most positive results have been obtained when the primary osseointegration is reached²³, researchers discern it in a very different way. Thus, the comparison among the results of the different literature studies becomes hard²². Tarnow et al.²⁴, after a 5 year-study of immediate loading dental implants in edentulous patients, verified that of 69 implants placed in upper or lower jaws, 96% presented high osseointegration success rates. Other studies have been demonstrating satisfactory osseointegration

results for the immediate loading implants^{2,12,14,19,25-26}. Ericsson et al.² accomplished a study to evaluate if surgical procedures into two steps are a compulsory procedure to reach an appropriate bone anchorage when Branemark implants are used. Eleven edentulous patients were evaluated. The patients' mouths were divided into quadrants. On the right quadrant, the traditional procedure of two steps was used for the placement of the implants. On the left quadrant, a one-step surgical procedure was used. Clinical exams (probing depth, probe bleeding index and test of stability) were made 12 and 18 months after the prostheses installation. X-rays were taken immediately after the insertion of the prostheses and after 12 and 18 months. The probing depth, bleeding and stability of the implants and the radiographs results were similar between the 2 experimental groups. Hence, the authors concluded that dental implants can be properly osseointegrated in mandibular bone and successfully used for bridge retention also when a one-step surgical procedure is used. Jo et al.²⁷ accomplished a study to evaluate the effectiveness of expandable implants for immediate or delayed loading implants. Forty months after the placement of 286 implants in the jaw or maxilla, these authors observed a tax of 96% of success for jawbone and 94.8% for the maxilla bone, when the immediate loading implants procedures were used. In addition, the authors verified that when the implants were inserted in fresh extraction socks, a rate of success of 98.9% was obtained. On the other hand, the indication of dental implants in fresh extraction socks should be limited to clinical conditions where there is absence of periodontal diseases¹⁵. Additional researches are necessary to provide evidence for these statements. Although several studies have demonstrated high osseointegration success rates for immediate loading implants^{2-4,6,12,14,17-21}, little is known about the loss of the periimplantar bone crest tissues^{4,6}. Therefore, further studies should be accomplished with the purpose of evaluating other relevant parameters and not only the success rates of clinical osseointegration.

Among the reasons for the immediate loading dental implants is the surgical trauma which is minimized in a one-step surgical procedure⁵. Roberts et al.²⁸ observed as a result of surgical trauma, a 1.0mm or more bone area without vitality around the recently inserted implants. Therefore, special attention should be drawn in order to avoid osteonecrosis areas and thus a development of a fibrous tissue around the implants^{5-6,15}. In agreement with some authors, the heating of the periimplantar bone area to above 40°C may propitiate cellular death that could be associated to a compromised osseointegration process, mainly in the area of periimplantar bone crest²⁸. According to Misch et al.⁵, the reduction of the surgical trauma in immediate loading procedures can be obtained by reducing the generation of heat during the surgical steps and reducing the stress on the bone/implant

interface. Physical and biomechanical procedures as implants ferulization and appropriate occlusal adjustment seem to be always followed, thus decrease the overload risks and the stress on the bone/implant interface^{17,26,29}.

As described in the previous paragraph, the immediate loading may propitiate, by generating an excessive stress on the bone/implant interface, overload and failure of the dental implants⁶. According to Misch et al.⁵⁻⁶, the smaller the applied stress to the bone is the smaller will be its micro-deformation and an increased surface area on the bone/implant interface will be expected. On the other hand, short and long-term histological studies have demonstrated that immediate loading implants do not necessarily result in excessive stress on the bone/implant interface³⁰. A suitable juxtaposition between implants and bone may contribute for the apposition and bone remodeling¹¹. Many *in vitro* and *in vivo* studies have observed little or no difference in the osseointegration of dental implants with delayed or immediate loading^{2-6,12,17-21,29,31}. Becker et al.¹⁷ described a high success rate for one-step surgical procedures. Through the evaluation of changes in the periimplantar bone crest, these authors concluded that one-step surgical procedures may produce satisfactory results in patients with good bone quality (density) and amount. On the other hand, Schnitman et al.³² observed a larger failure rate for immediate loading implants. Sixty three implants (3.75mm; Nobel Biocare) of varied sizes were installed in jaws arches of 10 patients that were followed up for 10 years. Twenty-eight implants were immediately loaded after the surgical procedures and 35 were maintained under the soft tissues during the osseointegration period (3 months). Initially, all the immediate prostheses presented success. After 3 months, four immediate loading implants had failure. No failure was observed for the delayed loading implants. The success rates among the implants with immediate and delayed loading were 84.7% and 100%, respectively. The authors concluded that, although the procedures of immediate loading presented satisfactory results, long-term evaluations should be appraised carefully for implants inserted in the posterior regions of the jaw, where the failure rate was shown to be larger. Similarly, Lorenzoni et al.²³ observed, in a clinical study of immediate/delayed loading, that the cervical bone level and the primary stability of the implants with immediate loading were significantly lower than the delayed loading implants.

In a general way, the protocols of immediate loading require a primary stabilization of the implants during the surgery between 35 and 60 N/cm^{6,33}. Uribe et al.³³ affirm that when a primary stability and a torque equal or superior to 35 N/cm is reached, a predictable osseointegration could be expected. Primary stabilization is influenced by the surgical procedures, implants design and bone density and amount. After the primary stabilization, the bone responds to the local stimulus, thus propitiating its repair through properties of bone

plasticity, reabsorption and apposition. Lamellar and immature bones are primarily found around the dental implants¹¹. The lamellar bone (highly organized) is the one with higher resistance and modulus of elasticity, being the ideal bone for the load support. On the other hand, the immature bone is disorganized, fragile and flexible not being ideal for the load support. Most of the immature bone tissues are substituted by lamellar bone 3 to 6 months after the surgical placement of the implants in the delayed loading procedures¹¹. Therefore, one of the reasons for the indication of the immediate loading implants would be not only to reduce the risk of development of fibrous tissues, but also to minimize the development of immature bone and to promote a faster maturation of the immature bone to lamellar bone^{11,34}. Immediately after the placement of the implants, a bone remodeling begins on the bone/implant interface, accelerated by the loads which induce the bone cells stimulation³⁵. In addition, the patient's diet has a major importance during the bone apposition and remodeling after the immediate loading procedures. Consequently, small portions of soft diet should be indicated during the initial period (3 to 4 months) of the healing process and bone deposition⁵⁻⁶. According to the information described previously, other parameters should be observed for the decrease of the potential risks proportioned by the immediate loading procedures. The number, size, design, surface treatment and region of insertion of the dental implants should be taken into consideration. Following these parameters, an increased contact surface area between implant and bone may be obtained⁵⁻⁶. It seems to be quite evident the use of a larger number of implants and their ferulization (if possible) when one-step surgical procedures are indicated¹⁵. For the immediate loading procedures in edentulous patients, a larger number of implants are indicated, thus leading to an increased treatment cost. Therefore, the acceptance of the patients may be reduced or limited¹⁵⁻¹⁶. Moreover, different bone density may be observed for the maxilla (less dense bone) and jaw. Consequently, researchers have been unanimous for the indication of a larger number of implants in the maxilla, when extensive rehabilitations, overdentures or Bränemark protocols are indicated. The design of the implants is more associated to the area of functional surface than to its size. Cylindrical implants without threads and with larger diameter possess smaller surface area in comparison to a screw implant of smaller diameter⁶. Consequently, implants with threads should be the most appropriate for the immediate loading procedures. According to Uribe et al.³³, the implants for immediate loading procedures should be threaded, with surface treatment (rough surface) and with minimum length of 10 mm. Moreover, these and others authors¹⁵ related that larger success rates are obtained in the anterior mandibular region (90 to 100%). According to Attard and Zarb¹⁵, the posterior region of the

arches should be carefully evaluated for the indication of immediate loading implants. In addition, the cantilever elimination (in Branemark protocols) and the accomplishment of bilateral ferulization (in extensive rehabilitations) seem to be advantageous in order to reduce the implants stress concentrations. Therefore, as previously discussed, the concept of splinted arch seems to be very pertinent when immediate loading procedures are indicated for patients with extensive implant-supported prostheses and for edentulous patients.

On the other hand, few studies were accomplished in order to compare different types of screw implants and their design for the immediate loading procedures. The implant surface conditions may significantly influence the surface area on the bone/implant interface and also the growth of lamellar bone^{4,8,11}. Hence, clinicians should prefer larger contact surface implants in order to propitiate a more satisfactory lamellar bone apposition and remodeling. Different types of implant surface treatments have been proposed in the dental literature³⁶. Implants treated with hydroxyapatite have demonstrated a smaller potential to allow the bone remodeling when occlusal loads are present³⁷. According to Piatelli et al.³⁸, immediate loading procedures using implants with titanium plasma spray surface treatment may contribute to excellent osseointegration results. Satisfactory results have also been verified for implants that received acid surface treatment³⁹. In a general way, the different types of surface treatment seem not to possess more or less satisfactory effects in the success rate of immediate loading implants⁶. Satisfactory osseointegration results may also be obtained with the use of non-surface treatment implants in immediate loading techniques³⁶.

Another relevant aspect that must be taken into account is the presence of parafunctional habits. Parafunctional habits may generate occlusal overload and may contribute with up to 75% of the immediate loading implants failure. Moreover, parafunctional loads may increase the looseness or fracture risk of the abutments and of the temporary restorations⁶. Hence, in agreement with some authors, it would be an exclusion criteria for this type of treatment^{5,19}. Finally, the decreasing of the functional surface of the crowns, the loads being directed to the long axis of the implants, the absence of cantilevers during the provisionalization and an adequate occlusal adjustment seem to favor the immediate loading implants results^{32,39}.

According to the information described in the literature, *in vitro* and *in vivo* studies should still be accomplished so that a precise and safe indication of immediate loading procedures can be indicated, thus reducing its potential of failure face to the different variables previously discussed.

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