Immediate Loading of Dental Implants- Review Article

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Abstract

Dental implants have proven to be a successful and predictable treatment option which provide adequate function and esthetics even in patients with compromised alveolar ridge. Immediate loading of dental implant gained popularity now a days as it reduces the treatment time, possible trauma, patient's discomfort, anxiety and increases the patient's acceptance of treatment. A search of electronic databases including Medline, PubMed and the Cochrane Database of Systematic Reviews was undertaken using the terms "immediate loading", "dental implants", "immediate function", "immediate restoration" and "systematic review"

Within the limitation of this review, there is evidence to suggest that immediate implant loading protocol have high success rates and may be cautiously recommended for certain clinical situations. However, more high level evidence studies over a long time frame are required to show a clear benefit over conventional loading protocols.

Key words: Immediate loading, Immediate restorations, Osseointegration.

INTRODUCTION

Implant dentistry has become a predictable and widely accepted option for patients with total or partial edentulism. This treatment is based on the osseointegration concept, which consists of the direct and close union between dental implant and bone surface without the interposition of any tissue. The density of available bone is a determining factor when planning the surgical approach, healing time and time loading.[1]

Since Branemark introduced the osseointegration system in 1977, new protocols have been proposed regarding the prosthetic-load timing, up to the immediate implant loading. Classic protocols propose that implants should receive no loading during the osseointegration period, usually 3 to 4 months in the mandible and 6 to 8 months in the maxilla.[2]

Up to date, different loading protocols have been established and investigated because several authors have affirmed that when the implant is loaded and enters into function the risk of failure increases.[3] Literature reports a higher failure rate in poor bone quality and density especially in bone types III and IV and when an implant is prematurely loaded into immature bone. For these cases, the progressive loading (PL) protocol is recommended .This concept supports the empirical idea that gradual loading causes bone maturation, improves density and bone quality, decreases crestal bone loss and early implant failure .

Several studies have reported success rates of more than 90% for immediate and conventional loading protocols, but there are gaps in the literature if the progressive loading protocol produces changes in bone quality and density. Updated protocols have shortened the healing period, so that implants could be loaded early and even immediately, before osseointegration is completely obtained.[4]

A healing period of 3-6 months before loading was originally considered as a standard procedure using dental implants for treatment of patients. Later on, the conventional treatment protocol was questioned, and immediate loading was introduced to eliminate waiting time for healing. Many clinical-based studies show positive outcomes with reduced cost and time and high success rates.[5]

A recently published systematic review found evidence for similar implant survival rates for immediate loading - compared to early and conventional loading in partially edentulous patients with extended edentulous sites in the posterior zone - provided that strict inclusion/exclusion criteria are followed.[5]

Unfortunately, the literature isn't always consistent regarding loading protocol definitions. As per a Schrott et al. review, the definition of terms is as follows: immediate loading within one week, early loading between 1 week and 2 months, and conventional loading after 2months.[6]

Misch et al in 2004 offered several classifications for dental implant loading

- Immediate occlusal loading refers to fully functional occlusal loading of an implant within 2 weeks of placement.
- Early occlusal loading refers to functional loading between 2 weeks and 3 months of implant placement.
- Nonfunctional immediate restoration refers to implant prostheses placed within 2 weeks of implant placement with no direct functional occlusal loading.
- Nonfunctional early restoration refers to implant prostheses delivered between 2 weeks and 3 months from implant placement.
- Delayed occlusal loading refers to the restoration of an implant more than 3 months after placement.

These categories helps to describe the different time for the restorative phase of the implant[7].

IMMEDIATE LOADING OF DENTAL IMPLANT

Immediate loading can be defined as an implant that carries a prosthetic superstructure that makes occlusal contact within the

first 1 or 2 days after placement. It should be distinguished from early loading, which means the occlusion is re-established within 2 weeks.[8]

When loading is only allowed after several weeks, it should be called 'delayed' loading independent of the fact whether it is a one- or two-stage procedure.[9] Later on, many clinical & experimental studies by Chiapasco et al.[9]; Schnitman et al.[10]; Tarnow et al.[11] on early and immediate loading protocols are reported in order to offer the patients the prospect of expected dental rehabilitation. This research led to the introduction of the concept of immediate loading.

Main objective of immediately loaded implant prosthesis is to reduce the risk of occlusal overload and thereby, resulting in increase in the remodeling rate of bone. Woven and lamellar are the two types of bone forming at the interface. Woven bone is produced in response to extraordinary loading condition, forming at a rate of more than 60 microns each day and is found to be less mineralized[12] whereas lamellar bone forms at a rate of 1-5 microns each day. Thereby, a higher turnover rates lead to higher risks for the bone-implant interface. The ultimate goal of an immediate loading protocol is to predictably decrease the surgical intervention and to reduce the time gap between surgery and prosthesis completion.[13]

INDICATION AND CONTRAINDICATIONS

Not every tooth or every patient is indicated for the immediate loading approach. Patients must understand the limitations of such treatment and be willing to accept the scientifically based precautionary measures.[12] Chief among them is the fact that, in order to limit the functional forces during osseointegration, patients need to abstain from chewing anything but soft food or otherwise applying force to the restoration for approximately 3 months.[14]

INDICATIONS:[12,15]

- Completely edentulous jaw.
- Partially edentulous jaw.
- Patients with missing dentition requiring long span fixed partial dentures.
- Patients who are not willing to use removable type prosthesis.
- Immediate loading protocol should be limited to the patients who have the most to gain and least to lose. Eg: patient who cannot tolerate a removable prosthesis due to social or psychological reasons.
- Patients who cannot wait for 3 months for the prosthesis.

OTHER INDICATIONS DESCRIBED ARE AS FOLLOWS[15]

1. Poor oral muscular coordination.
2. Unrealistic patient expectations for complete denture.
3. Patient psychologically against removable partial denture.
4. Single tooth loss: avoid preparation of sound teeth.

CONTRAINDICATIONS:

The suggested contraindications, in general, for consideration of an immediate loading protocol include the following[12,16].

- Chronic smoker.
- If bone volume is not adequate.
- If density of bone is not good (D4).
- Para functional chewing habits (bruxing, clenching, tongue thrust).

PRINCIPLE FOR IMMEDIATE LOADING

Whenever a controlled load is applied to the bone, bone responds by remodeling its architecture according to the direction and magnitude of load applied. The process of adaptation of the bone to the load applied has been described by Frost Mechanostat theory.

According to this theory there exists four biological process of bone adaptation: Trivial, Physiological, Overload and Pathological. Remodelling is described as the process of resorption and formation of bone which replaces the existing bone, tends to conserve or remove bone and is activated by reducing the mechanical usage in trivial zone or micro damage in pathological loading zone. Main objective of immediately loaded implant prosthesis is to reduce the risk of occlusal overload and hence resulting in the rate of bone remodeling.[12]

GUIDELINES FOR IMMEDIATE LOADING IMPLANTS BY TARNOW etal[11]

1. Immediate loading should be attempted in dentulous arches only, to create cross-arch stability
2. The implants should be at least 10mm long.
3. A diagnostic wax-up should be used for the template and the provisional restoration fabrication.
4. A rigid metal casting should be used on the lingual aspect of the provisional restoration.
5. A screw retained provisional restoration should be used where possible.
6. If cemented, the provisional restoration should not be removed during the 4-6 month healing period.
7. All implants should be evaluated with Periotest at StageI, and the implants that show the least mobility should be selected for the immediate loading.
8. The widest possible anterior-posterior distribution of the implants should be used.

CLINICAL CONSIDERATION

1) PRIMARY STABILITY

Cameron et al in 1974 first proposed that the goal of primary stability is limitation of excessive micro movement, which was later confirmed by the study conducted by Szmuklker- Moncler[18].

Micromovement can be influenced by the prosthetic design and the implant- bone relationship. This is most crucial in maxilla, where the quality of bone is typically less favourable.

Instead of osseointegration, fibrous healing results when there occurs excess of micromovements. A minimum torque of 32 N-cm should be used at the time of implant placement. Periotest and other frequency signal values have been used to evaluate implant at the time of insertion as an indication of whether fixation was adequate for immediate load.

Surgical micromotor can be used to evaluate the Insertion Torque Values (ITV) at the time of implant placement. The implant placement starts with initial IT value of 25N/cm and 5N/cm is increased until the micromotor stops and the ultimate ITV is obtained.[19] An alternative approach is to use a reverse torque of 20 Ncm to evaluate the bone quality and interface initial fixation.[20]

2) QUALITY AND QUANTITY OF TRABECULAR AND CORTICAL BONE

Density of the host bone plays a major role in predicting the success of immediate implant loading. Implant placed in compact bone has better initial stability and hence, better able to sustain the immediate loading forces. Successful ossseointegration of immediately loaded maxillary implants can be determined by bone preservation by atraumatic extraction.[21]

3) IMPLANT FACTOR

Dimension of Implant

There will 20 -30% increase in surface area for every 3mm increase in length of dental implants. Majority of studies have suggested that the implant should be more than 10mm long to ensure high success rates.[22]

Surface Texture

Roughness of implant surface increases the bone-implant contact (BIC). Studies have

shown that there is an increase in the success rate of immediately loaded implant coated with hydroxyapatite (HA).[20]

Implant Design

The screw implant design have a higher rate of mechanical retention as well as greater ability to transfer the compressive forces. Along with the improvement in initial stability, the screw implant design also minimizes the micromotion of the dental implant, the principle requirement for immediate loading success.[23]

4) SURGICAL TECHNIQUE

Thermal injury and excessive surgical trauma can lead to osteonecrosis and fibrous encapsulation of the implant. Inadequate cooling and excessive load on drill during osteotomies are associated with bone damage. Studies have shown that temperature over 470 C for 1minute can cause heat necrosis in the bone.[24]

5) PROSTHETIC DESIGN

Cross arch splinting of implant is recommended for immediate implant loading. The temporary prosthesis, once inserted, should not be removed during the healing period to avoid any unnecessary movement. A screw retained temporary restoration should be used whenever possible. Cantilevers should be avoided in provisional restoration.[25]

OCCLUSAL OVERLOAD IN IMMEDIATE LOADING [17]

Occlusal overload is considered as one of the main cause for the peri-implant bone loss and implant/ implant prosthesis failure. Different studies have been conducted to compare the relation between occlusal overload and implant success rate.

In majority of the studies conducted it was found that the occlusal overload may contribute to the implant bone loss and / loss of osseointegration of successfully integrated implants. (Adell et al. 1981; Rosenberg et al. 1991; Quirynen et al. 1992; Rangert et al. 1995; Isidor 1996, 1997; Miyata et al. 2000)

Literature has reported that the clinical success and longevity of dental implants can be achieved by biomechanically controlled occlusion (Rangert et al. 1989, 1997; Adell et al. 1990; Misch1993). Three occlusal concepts have been successfully accepted nowadays (group function, balanced and mutually protected) with certain modifications for the implant supported prosthesis. All the concepts may have habitual maximum intercupation during centric or habitual occlusion.

POSSIBLE OVERLOADING FACTORS

Overextended cantilever

- Greater than 15mm in mandible (Shackleton et al. 1994)
- Greater than 10-12mm in maxilla (Rangert et al. 1989; Taylor 1991)

Parafunctional habits or heavy bite force

Excessive premature contacts

- Greater than 180 mm in monkey studies (Miyata et al. 2000)
- Greater than 100mm in human studies (Falk et al. 1990)

Poor bone density / quality

Steep cuspal inclination

Large occlusal table

Inadequate number of implants

POTENTIAL COMPLICATION AND SOLUTIONS

Clinical complications that can be seen associated with implant overload are screw loosening, screw fractures, fractures of the veneer materials, prosthesis fracture, continuing marginal bone loss below the first thread along the implants, implant fractures, and implant loss (Zarb & Schmitt 1990; Jemt & Lekholm 1993; Wennerberg & Jemt 1999;Schwarz 2000).

All of the above mentioned complications can be well prevented by application of sound biomechanical principles such as passive fit of the prosthesis, reducing cantilever length, narrowing the bucco-lingual / mesio-distal dimensions of the prosthesis, reducing the cuspal inclination, eliminating excursive contacts and centering occlusal contacts (Zarb & Schmitt 1990; Jemt & Lekholm 1993; Rangert et al. 1997; Wennerberg & Jemt 1999; Schwarz 2000).

Immediate loading of dental implant is an innovative treatment method available in implant dentistry today. A good knowledge of bone biology and the remodelling process that occur during the healing phase is a must for the success of the dental implants. When initial stability is achieved and a proper prosthetic treatment plan is formulated, the immediate functional implant loading is a feasible concept.

This treatment method have proven to reduce the treatment time and thus increase the patient acceptance. Future studies should be conducted to evaluate the long term success rate of the immediate restoration on the implants and possible applications of this techniques in situations like multiple implants and poor bone qualities.

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