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**Review Article**

# Immediate Loading in Implants

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***ABSTRACT* :**

**Purpose**- Dental implants have proven to be a predictable and successful treatment modality which provide optimum esthetics and function even in patients with compromised alveolar ridges which were previously difficult to rehabilitate. Immediate loading of the implant is the outcome of the patients desire to lessen the treatment time. The purpose of this article is to present the outcomes of clinical studies on immediate and early loading protocols and identify their requirements. **Methods**- English language clinical studies, limited to peer-reviewed journals between 1990 and 2000, were reviewed to identify treatment outcomes with immediate loading protocol using immediate occlusal loading and early loading. **Conclusion**- Immediate loading protocol has demonstrated high success rates for dental implants. The anterior region of the jaw seems to be associated with a major percentage of satisfactory results, regardless of rehabilitation procedures.

Key words: immediate occlusal loading, early loading, implant prosthesis.

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## INTRODUCTION

Dental Implants today offer the best treatment option to replace missing teeth with optimum esthetics and function. There is a great demand for implant based prosthesis from the patients reporting for dental care.

The original protocol established by Branemark consisted of waiting for approximately three to six months after the extraction socket to heal. [1,2,3] The implants were placed in the healed alveolar ridge and left submerged for another six months in the case of maxilla and four months in the case of mandible for osseointegration and then loaded. Patient's desire to decrease the period of edentulousness has led to a change in this original treatment protocol in the last few decades by shortening the time between extraction and implant placement and loading.

**Immediate Occlusal Loading (IOL)** is a concept in which an implant is placed with adequate primary stability; its corresponding restoration has full centric occlusion in maximum intercuspation and is loaded within 48 hours postsurgery.[4]

■ **Immediate Non-occlusal Loading**—An implant with adequate primary stability is loaded immediately but is not in functional occlusion. These implant restorations are essentially used for aesthetic purposes, frequently in single-tooth or short-span applications, particularly when a provisional removable prosthesis is undesirable during the healing period.

■ **Early Loading**—An implant with adequate primary stability is placed under full occlusal load and prosthetic function within two months of implant placement Early loading, in contrast to immediate occlusal loading, is based on the interaction of the implant surface with the host bone for achieving biologic implant stability.[5]

## HISTORICAL BACKGROUND

Immediate loading for completely edentulous mandibles was reported by Schnitman et al. in 1990 using 28 screw-shaped implants to support a fixed prosthesis in 10 patients.[6] Later, Henry and Rosenberg evaluated immediate loading for mandibular completely edentulous patients with a prospective clinical trial in 1994 [7] In 1995, Salama et al. described two cases, and in 1996, Biglani and Lozada did a retrospective report of four completely edentulous patients after 3 to 6 years of function. [8,9] In 1997, Tarnow et al. presented 10

edentulous patients in both the maxilla and mandible over a 1- to 5-year period with a 97% survival of implants, which were immediately loaded and splinted together to support a full arch prosthesis. [10] Misch in 1998 reported 10 consecutive cases for both single teeth and multiple adjacent missing teeth. [11,12] In the same year, Wohrle evaluated 14 consecutive single tooth replacements in the esthetic zone[13,14,15].

## HISTOLOGIC EVALUATION

Immediate loading of an implant does not necessarily result in excessive stresses. Brunski found that the direct bone-implant interface may develop as long as the implant moved less than 100 micrometers. Szmukler-Moncler et al. indicated that micromotion beyond 150 microns resulted in fibrous tissue encapsulation instead of a direct bone interface. Romanos et al. evaluated a square thread implant design in monkeys and found no statistical difference between immediate- and delayed-loaded implants. Testori et al. reported on the histologic interface of two titanium threaded implants in humans, in which one implant was immediately loaded and the other did not receive any load for 4 months. The bone implant contact (BIC) was 39% for the submerged, nonloaded implants and 64% for the immediately loaded. [16] A biologic explanation of the positive effect of loading improving the initial phase of bone healing has been shown in both in vitro and in vivo studies. Qi et al evaluated the response of mesenchymal stem cells to mechanical strain and their consequent gene expression patterns. Their results suggested that mechanical strain might act as a stimulator to induce differentiation of stem cells into osteoblasts.

## ADVANTAGES OF IMMEDIATE LOADING

Immediate loading of implants has got several advantages over delayed loading like reduction in overall treatment time and alveolar ridge resorption. It offers an acceptable restoration esthetically, increases patient acceptance as there is quicker return of function, need of removable prosthesis is avoided that may interfere with healing or simultaneous bone grafting and/ or may require additional maintenance during the healing period. There is potentially superior soft tissue profile when accompanying immediate dental implant placement. Surgical trauma is also reduced with ease of surgery. Immediate restoration of implants placed in fresh extraction sites displayed an excellent implant prognosis and aesthetic outcome.

## DISADVANTAGES

Immediate loading requires more chair time at the time of implant placement for both the patient and the clinician. It also requires effective communication and coordination among the surgical and restorative teams. Careful patient screening and adequate primary stability as well as good bone quality are required for the success of immediate loading.

## CLINICAL CONSIDERATIONS

### 1. PRIMARY STABILITY

Cameron *et al*. first proposed in 1974 that the goal of primary stability is limitation of excessive micromovement, which was later confirmed by Szmukler‑Moncler [17] The implant‑bone relationship and prosthodontic design can influence micromovement. This is crucial in the maxilla, where the quality of bone is typically less favorable. Fibrous healing instead of osseointegration results due to excess of micromovement. A minimum of 32 N‑cm of torque should be used at the time of implant placement.

**Periostest** and various frequency signal values have been used to evaluate implants at the time of insertion as an indication of whether fixation was adequate for immediate load.

The Insertion torque values (ITV) can be evaluated by a surgical micromotor at the time of implant placement. The implant placement begins with initial IT of 25 N/cm, and 5 N/cm is increased until the surgical micromotor stops, thus obtaining the ultimate ITV. A Smartpeg can also be screwed onto these implants, and resonance frequency analysis (RFA) can be performed using Ostell Mentor device. (Ostell/Integration Diagnostics, Goteborg, Sweden) The values are called ISQ values and are recorded in two different orientations: buccal and lingual. The Ostell Mentor is brought into very close contact with the Smartpeg until an audible signal confirms that the measurement has been taken.

An alternative approach is to use a reverse torque test of 20 Ncm to evaluate the quality of the bone and interface initial fixation.[18]

### 2. QUALITY AND QUANTITY OF CORTICAL AND TRABECULAR BONE

Host bone density plays an important role in determining the predictability of the success of immediate implant loading. An implant placed in compact dense bone is more likely to ensure initial stability and, hence, better able to sustain immediate forces. Maxillary immediate implant loading can be quite challenging because of factors like lesser bone density, a thin cortical plate and proximity to the maxillary sinus. Successful osseointegration of immediately loaded maxillary implants can be determined by bone preservation by atraumatic extraction. Micromovement levels that are between 50 and 150 µm are known to cause no detriment to osseointergration.[19]

### 3. IMPLANT FACTORS

1.) **Implant design**

The screw implant design develops higher mechanical retention as well as greater ability to transfer compressive forces. The screw design not only minimizes micromotion of the implant but also improves the initial stability, the principal requirement for immediate loading success.

Use of threaded implant result in higher percentage of implant being in contact with bone cortex. Threaded implants show a greater functional area effecting a better stress distribution at the implant bone interface. [20]

**2.) Surface textures**

Rough implant surfaces render a significant increase of BIC. Improved implant success rates have also been noted in immediate loading environments with hydroxyapatite (HA) coatings. [21]

**3.) Dimensions of the implant**

For every 3mm increase in length, the surface area of a cylinder-shaped implant increases by an average of 20–30%. The majority of studies have suggested that implants should be more than or equal to10mm long to ensure high success rates.

## 4. SURGICAL TECHNIQUE

Excessive surgical trauma and thermal injury may lead to osteonecrosis and result in fibrous encapsulation of the implant. Heat generated during drilling without adequate cooling and excessive load on the drill during the preparation of osteotomies is associated with bone damage. It has been shown that a temperature over $47^0$C for 1min causes 'heat necrosis' in the bone

## 5. PROSTHETIC DESIGN

Cross-arch implant splinting is recommended in immediate implant loading. The temporary prosthesis, once inserted, should not be removed during the healing period to avoid any unnecessary movement.

A screw retained provisional restoration should be used where possible. If cemented, the provisional restoration should not be removed during the 4 to 6 month healing period. Cantilevers should be avoided in the provisional restorations.[16]

## IMMEDIATE LOADING PROCEDURE

### 1. For Completely Edentulous Arch Replaced With Fixed Prosthesis

Two different options are available for immediate occlusal loading for the completely edentulous patient desiring a fixed prosthesis. The first option loads the implants the same day as the surgery.

The second option is to place the implant and make an impression at surgery. Then at the suture removal appointment 7 to 12 days later, the dentist delivers the transitional fixed prosthesis

OPTION 1: Before the surgical appointment, a surgical template is fabricated for implant insertion. For delivery of the restoration on the day of surgery, the clinician may make a new denture or modify the patient's existing denture. In either case, in the region of the future implants, he makes space for implant abutments. The implants are surgically placed into the pre established positions. Implants in good quality bone, with no crestal bone grafts at insertion, are included in the transitional restoration. The more additional implants are inserted, the less the risk failure due to overload, early crestal bone loss, unretained restoration or restoration fracture.

Once the implants are inserted, the final abutments are positioned and tightened to a torque of 30 N-cm. The final abutments are prepared intraorally for parallelism and proper height requirements. ,the prosthetic field may be isolated from the surgical field with a rubber dam. The transitional prosthesis is relined with a light cure composite to eliminate toxic monomer contact with the bone. The clinician adjusts the temporary prosthesis to fit the abutments before approximation of the tissues. Sutures are placed more than 5mm away from the incision line margin to facilitate their removal at a later date without removing the transitional prosthesis. Then evaluation of the transitional restoration for harmonious occlusal contacts in centric occlusion is done. The clinician cements the immediate load relined transitional prosthesis with definitive cement such as zinc phosphate or glass ionomer.

OPTION 2: The second option for immediate occlusal load is to split the surgical appointment from the prosthesis delivery appointment. The preoperative appointments and implant surgery are the same as option 1. However, in option 2, an impression of the implant body position is made with additional silicone. In addition, the clinician records the vertical occlusal dimension and centric relation. The bite registration may be made with the shell of the transitional restoration on the abutment or with a base plate and wax rim. After the impression the dentist removes the abutments from the implants and replaces them with permucosal extensions. Suturing is carried out in a conventional manner.

The laboratory technician connects the implant body analogs to the abutments inserted into the impression, pours the impression with die stone, and mounts the cast to the opposing arch. The temporary abutments replace the permanent abutments in the cast which are then prepared for the restoration and a transitional prosthesis is fabricated. Occlusal plane height must be correct. A lingualized (lingual contact) scheme of occlusion is recommended. The upper anterior teeth are best arranged without any vertical overlap. The amount of horizontal overlap is determined by the jaw relationship. A vertical overlap for appearance can be used, provided that an adequate horizontal overlap is included to guard against interference within the functional range.

The patient returns to the office 7 to 14 days after surgery. After removing the sutures, the dentist replaces the permucosal extensions with prepared temporary abutments and then cements the transitional prosthesis with a definitive cement.[22] All restorative procedures should be completed within two days of implant placement according to the specific needs of the patient and after which time bone healing and implant stability may be disrupted by such

intervention . The provisional prosthesis should not be disturbed (if possible) during the healing process that occurs approximately two months after placement.
Although initially mini dental implants (MDIs) and narrow-diameter implants were used for temporary prosthetic stabilization during the healing phase of standard implants, but due to low success rate these implants are not in much use these days.

## 2. FOR PARTIALLY EDENTULOUS REPLACED WITH FIXED PROSTHESIS

There are multiple options for immediate loading of single implants. An implant analog is placed into the diagnostic cast at the proposed surgical site. The abutment is attached to the analog and is then prepared; the laboratory then fabricates the provisional restoration. Following intraoral implant placement, the abutment is attached and provisional can be adjusted and cemented chairside.
Another option is to prepare the abutment and provisional chairside on the same day as implant placement. After the implant is seated, the abutment is placed with minimal adjustments by the surgeon or restorative dentist. A hollow shell can be used for fabrication of the provisional restoration. This reduces preoperative preparation and laboratory costs, but increases time at chairside.
A third option involves implant and final abutment placement by the surgeon. The laboratory or restorative dentist then fabricates the provisional .After the implant is seated, the final abutment is placed and secured with the hand tightened screw. A snap-on transfer coping is placed over the abutment, and a closed tray impression is taken using less viscous impression material around the transfer coping, and more viscous impression material in the tray. The impression then has the transfer coping imbedded in the implant location. An abutment analog is then placed into the transfer coping, and sent to the laboratory. In the mouth, a cap is placed over the abutment to prevent trauma to the tongue.[23]

## POST OPERATIVE INSTRUCTIONS

a) Eating solid foods was prohibited for 6 weeks after Surgery.
b) The prosthesis was not removed during the healing period (approximately 2 months following the manufacturer's guidelines for the Straumann implant) until impressions were taken for the final restoration.
c) Mobility of the prosthesis, loosening of screws, and cracks/breakage of the provisional restoration were checked..) are given to the patient.

## POSSIBLE COMPLICATIONS WITH PROVISIONAL PROSTHESES

Patients may complaint of discomfort, including headaches and feelings of pressure within several days of the provisional restoration. These symptoms are relieved immediately after cutting the acrylic resin of the provisional prosthesis. Then, the prostheses are repaired with acrylic resin.
Complications occur that may have been caused by stress from the polymerized acrylic resin, which was used to synthesize the provisional prosthesis.
Provisional restorations are made with thick acrylic resin to avoid fracture and micromovement of the prosthesis, which seems to cause disintegration of the implant. It is believed that the shrinkage of the acrylic resin due to polymerization cause the breakage of the provisional restoration and the discomfort. It is important to consider shrinkage when planning a provisional restoration. When patients report discomfort, the choice of treatment is to cut the resin immediately.

## DEFINITIVE PROSTHESIS

For the definitive prosthesis, impressions and bite for the final restoration are taken more than 2 months after surgery based on the manufacturer's protocol.
b) A distal cantilever is avoided in all maxillary cases.
c) A 1-tooth distal cantilever is made when implants are inserted between the mental foramina in the mandible.
d) The occlusal pattern is chosen depending on the opposing dentition. Canine guided posterior disclusion or group-function is selected.

Classification of various Mechanical environments relevant to *in vivo* studies

| Mechanical environment description | Diet | Definition |
|---|---|---|
| Submerged mode | Soft or hard | Submerged covered by the gingival, flush with bone level |
| Nonsubmerged mode | Soft or hard | Nonsubmerged flush or within 2-3mm of gingival level |
| Protruding loading mode | Soft | Post protruding more than 3mm above the gingival level, stress exerted by lips, tongue and cheeks |
| Partial loading mode | Hard | Post protruding more than 3mm above the gingival level, stress exerted on implant post through hard diet food |
| Functional loading mode | Hard | Crown reconstruction on implant, not in occlusion, stress exerted through hard diet food on occlusal faces, implants freestanding or splinted into bridge |
| Occlusal loading mode | Hard | Crown reconstruction on implant, in occlusion, in contact with opposite teeth, stress exerted through occlusal contact and hard diet food, implants freestanding or splinted into bridge [17] |

## CONCLUSION

Immediate-loading of oral implants is an innovative and attractive treatment method available in implant dentistry today. This approach requires good knowledge of bone biology and the remodeling processes that occur during healing. When primary stability is achieved and a proper prosthetic treatment plan is followed, immediate functional implant loading is a feasible concept. Primary implant stability is a key factor to consider before attempting immediate implant loading. It is not possible to recommend a specific treatment protocol related to the number, diameter of the implants, and attachment system used. Long-term, well-designed studies comparing different immediate loading modalities could help to establish a protocol that delivers the most clinically predictable, efficient, and cost-effective outcome for patients in need of implant restorations.

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