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Review Article

PROSTHETIC CONSIDERATIONS IN IMMEDIATE IMPLANT LOADING –A LITERATURE REVIEW

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ABSTRACT

Immediate loading in implant dentistry has provided several advantages for both patients and clinicians. Recent advances in computer-aided design/computer-aided manufacturing (CAD/ CAM) technology, medical imaging and rapid prototyping have added to the armamentarium of implant dentistry in terms of efficiency, accuracy and predictability. Immediate loading seems to be a relatively safe procedure. From the prosthetic point of view, the following points should be considered : screw retained prostheses be preferred over cement retained, implants should be splinted with a metallic bar and acrylic interim prostheses until full osseointegration occurs , if financial constraints are not there then CAD/CAM can be employed to improve the placement of implants with minimum risk , occlusion and the number of implants also should be considered.

Keywords: Immediate loading, Occlusion, Micromotion, Provisional, Interim prostheses.

INTRODUCTION

The immediate loading concept, which was first successfully applied to overdentures¹⁻⁴ but now is also being used has also for fixed full-arch provisional prostheses if few prosthodontic needs are fulfilled. Previously, studies advocated a two-stage surgical protocol to ensure predictable osseointegration. This was an inconvenience for the patients and remained a challenge to both patients and clinicians. Hence, the concept of loading implants immediately after placement was introduced and soon gained popularity among clinicians^{5,6}. Implants were defined as “immediately loaded” if they were restored by a functional, fixed interim prosthesis at the time of the surgeon within 48 hours after surgery.

The advantages of immediate loading are:

1. No second stage surgery
2. Countersinking the implant below crestal level decreases crestal bone resorption.
3. The soft tissue emergence can be developed with the immediate provisional prostheses.
4. Implants are splinted during healing for biomechanical advantage.

To place implants and load them immediately, strict protocols must be followed. The immediate load concept is based on three important clinical findings:

1. Micromotion of 50 to 150 μm can be accepted at the interface between bone and implant surface.¹⁰ Micromotion of approximately 100 μm may constitute a threshold value for implants to osseointegrate properly².
2. The assumption that joining several implants together via a rigid construction will reduce micromotion, thus facilitating the healing process and the immediate loading^{3,4}.
3. It is important to eliminate micromovement between implants and osteotomies. It is therefore recommended to have insertional torque values of at least 30 Ncm. when placing immediate implants⁸ It is also suggested that implant diameter is inversely related to the micromotion movement.

This article presents the various factors that might affect the success of immediate loading,. These include: Screwed or cemented prostheses, whether to provide interim or definitive restoration, occlusal loading- immediate functional or immediate non-functional and number and distribution of implants for overdentures and fixed interim prostheses.

Screw or cement-retained prostheses:

The interim prostheses can be either screw- or cement-retained. The interim prosthesis should be retrieved every 2 weeks for clinical procedures like suture removal, implant stability assessment, soft tissue healing evaluation, and modification of embrasure. These steps are critical for molding, contouring, and healing of soft tissues to have ideal esthetic outcome¹⁰.

If a cemented restoration has been planned, then this evaluation cannot be carried out as cement retained interim prostheses should not be removed during the 3 to 4 month healing period and other limiting factor is that the abutments should provide enough height for the retention of the interim prosthesis.

When a screwed restoration is planned, the treatment is easier to follow up, as it is easier to remove and place the interim prostheses.⁸ It is easier to remove screw-retained prosthesis for suture removal 10 days after surgery that would not jeopardize implant stability during bone remodelling, as micromovements remain in the accepted range¹¹.

Few points that dictate preferring screw-retained interim prostheses over a cement-retained prostheses are as follows:

- a. Avoidance of any residual cement interfering with tissue healing, which may cause inflammation and compromise bone and soft tissue healing¹².
- b. Easy removal during the healing period, which causes lower macro movements.
- c. In case of divergent implants, it is easier to restore with a screw-retained prosthesis.

Immediate functional or Non – functional occlusion:

There are basically two types of occlusion in immediate implants:

- 1. Immediate functional loading is when the interim prostheses are in full occlusion; it is applied in partially and fully edentulous patients.
- 2. Immediate non-functional loading combines the advantages of a single-stage procedure with those of immediate loading. In this case, the temporary restorations are not in occlusion. They are primarily for esthetics and to guide the soft tissues during the healing period.

The non functional occlusal model (INFL) has the advantage of reducing the risk of biomechanical overloading when parafunctional habits are present and is applied in the partially edentulous patients. There are different schools of thought for whether to have provisional prostheses in occlusal contact or to maintain a minimum gap with opposing tooth in centric occlusion. Some authors prefer to have an occlusion 1 to 2 mm short of occlusal contact¹³ or 1.5 mm short of occlusal contact and 1mm short of incisal contact¹⁴. One author recommends the prosthesis to be out of occlusion by 40 μ m¹⁵.

Irrespective of the type of occlusal concept chosen, there are basic rules to follow in immediate loading:

- a. Interim prostheses on posterior teeth should have a narrow occlusal platform compared to natural dentition.¹⁶
- b. It is better to place the occlusal contacts inside the implant diameter.¹⁶
- c. Interim prostheses should have flat cusps to minimize lateral forces and distribute them over a large area¹⁷.

- d. Good symmetrical distribution of the masticatory forces, especially in the initial stages of healing, is important.⁵
- e. The exposure to parafunctional forces can interrupt the course of osseointegration¹⁸.
- f. No cantilever extensions should be present to prevent the presence of non-axial forces.¹⁹ Patients should modify their diets by avoiding hard foods during the initial healing period (about 4 weeks).
- g. Controlling functional forces is one of the important factors to obtain success in immediate implant loading.
- h. It is therefore advised to start by adjusting the occlusion following the INFL model, especially in the initial stages of healing. This is very important for avoiding complications such as fracture of the bridge and peri-implant bone loss. Switching to an occlusion in IFL later on is recommended, as the distribution of occlusal support by the remaining teeth is known to reduce the risk of overloading.

Implants number: Overdentures vs fixed interim prostheses

The factor that how many implants are to be placed, depends upon whether fixed prostheses or provisional prostheses have been planned. In general, it is advised to have a fixed prosthesis on implants rather than an implant-supported overdenture. Forces acting on implant-supported overdentures increase the magnitude of the bending moment when compared to those acting on an implant-supported fixed prosthesis. This might be due to a lesser control of these forces. The minimal number of implants needed to support a fixed prosthesis should therefore be greater than the number of implants needed for an overdenture¹⁹.

In the mandible, the number of implants needed for an implant-supported overdenture ranges from two to four implants. Immediately loaded mandibular overdentures are a successful treatment option with long-term success for edentulous patients, especially when they are supported by four implants placed in a tripod configuration connected by a U-shaped bar²⁰. The rationale behind this type of treatment is usually cost effectiveness. It can be used in elderly populations with low income to improve their quality of life.

A greater number of implants are necessary in the maxillary arch due to the quality of maxillary bone. The palatal resorptive pattern of the maxilla makes a good axial alignment, but the parallel placement of right and left implants is difficult. The position of the implants in the widest anterior-posterior distribution is able to resist the micromovement at the bone/implant interface.³ A study was carried out in which 12 patients (mean age: 56.6 years) received their immediate overdentures with four implants and a bar with a minimum insertion torque of 45 Ncm. Two implants failed in two patients, but were successfully replaced the same day (they were removed with no major complication). No prosthesis failed; however, one patient was unsatisfied with his denture and requested a fixed alternative²¹.

In general, the number of implants needed when restoring cases with fixed prostheses in the maxilla is greater than the number of implants needed to restore a fixed prosthesis in the mandible. In general, at least four implants are needed in the anterior mandible to support a fixed prosthesis, and a greater

number of implants is necessary in a maxilla with good bone quality and high primary stability

Interim prostheses vs final prostheses placement for immediate load:

Interim prostheses are temporary crowns made from acrylic resin or a rigid framework. The advantages include:

- a. Acrylic resin can be fabricated and modified easily and is therefore more economical.
- b. Interim prostheses prevent the transmission of some of the load directly to the implant and provide resistance to forces in all directions^{22,23}.
- c. Temporary abutments may function as a shock absorber and limit the functional forces directed toward bone. This effect appears to be a major advantage in preventing the destabilization of implants²⁴.
- d. The acrylic interim prostheses can also be used to check the precision of the final impression by inserting the acrylic interim prosthesis on the final cast and checking its fit, thus confirming the correct positioning of the implant replicas.

There can be many disadvantages:

- a. Shrinkage of the acrylic resin may compromise the accuracy of the procedure, and heat transfer to implants during polymerization
- b. The toxicity of the monomer at the surgical field may affect the final outcome.

To reduce these disadvantages, the fabrication of interim prostheses is made using the indirect technique, and the use of a rubber dam during their placement is required. Along with acrylic resin, the use of a rigid U-shaped metallic framework connection minimizes the rotational movements, transfers the load to the implants mostly in a vertical direction, avoids deflection or fracture that could lead to macromovements, provides stability, allows osseointegration to occur safely, and improves patient comfort⁵.

In the majority of cases, the usual recommendation is the fabrication of an interim prosthesis until its replacement by the definitive restoration once the osseointegration process is complete. There are two primary systems for providing a definitive restoration at the immediate placement stage. The Branemark Novum (Nobel Biocare, Zurich, Switzerland) introduced in 1999 provided an edentulous patient with a full fixed implant-supported mandibular prosthesis on the same day. The system consisted of immediately loading three implants in the interforamina region and providing a pre-manufactured Ti bar screwed on the implant fixtures during the surgery.²⁵ This system had limitation that its usage was limited to specific patients because of the anatomic variations found in their mouth and the possible prosthetic recording difficulties. The Speed Master technique, introduced in 2006, had a similar protocol.

It can be concluded that the disadvantages of restoring immediately placed implants with definitive prostheses is greater because:

- a. Use of the pre-manufactured Ti bar may be difficult due to the anatomic variations in the patient's mouth.
- b. The poor control of soft tissue healing might compromise the definitive outcome of the soft tissue architecture.

- c. If an implant fails later during the osseointegration period, the definitive prosthesis delivered at the time of the surgery will need to be replaced by a new prosthesis, thus increasing the cost.

It is therefore better to insert an interim prosthesis during the healing period before the definitive prosthesis is fabricated as the immediate prosthesis need to be adjusted several times during the healing phase to accommodate for tissue healing and ensure patient comfort.

CONCLUSION

Among the benefits of immediate loading of dental implants are patient satisfaction and shorter treatment time. In addition, patients do not have to wear removable prostheses. Serial extractions, multiple surgical visits, and conversion from denture or tooth-supported provisional prostheses to implant supported provisional prostheses are no longer necessary. It has also been demonstrated that mechanical stimulation to the bone around healing implants can lead to increased bone-to-implant contact at earlier intervals ie, that immediate loading can stimulate faster healing. Extensive presurgical planning and precision in implant placement and provisional restoration fabrication are necessary to achieve success in immediately loading the implants.

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