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## Determining the loading protocol in implant dentistry: A review

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### Abstract

Dental implant therapy has provided us with one of the most promising tooth replacement procedures. The prognosis of dental implants as a restorative technique depends largely on the predictability of osseointegration. In the last few decades dental implants as a fixed treatment modality have emerged in various aspects. This article discusses the loading protocols for the better understanding of implant success rate. Different protocols have been discussed briefly for the selection of loading technique in implant dentistry.

**Keywords:** Implantology, immediate loading, early loading, delayed loading, partially dentate

### Introduction

Prosthetic rehabilitation of missing structures in the oral and maxillofacial region in accordance with DeVan's principle of preservation has been the ultimate challenge to the prosthodontist. Over the years, traditional methods of tooth replacement are slowly and steadily being replaced by newer modalities like implants. In the last few decades, implant dentistry has emerged as a fully accepted discipline in dentistry. The replacement of missing teeth with implant supported restorations has become a treatment modality accepted by the scientific community for fully and partially edentulous patients. Multiple factors have been found to influence and alter the quality and predictability of various loading protocols for completely and partially edentulous arches.

Branemark and his group defined a strict treatment protocol to maintain acceptable outcomes when managing patients requiring dental implants. In addition, they suggested a healing period of 3 to 6 months before loading. Premature loading was considered to result in fibrous tissue encapsulation of the implant with consequent failure, in contrast to the preferred direct bone apposition (osseointegration) to the implant surface. As one of the important requisites for successful osseointegration was extended submerged healing phase. The healing phases are divided into three-

1. Osteophytic phase – When an implant with a rough surface is inserted in the mandibular or maxillary spongy bone or marrow. Only a small quantity of the bone proceeding from trabecular bone of the interior of the marrow is in the contact with the implant surface. There is production of osteoid tissue on implant surface and this phase lasts for 1 month
2. Osteoconductive phase – It is prolonged for 3 months. The bone will continue being placed on the surface of the metal
3. Osteo-adaptive phase – There is no increase or loss of the bone on the metal <sup>[1]</sup>.

Now these treatment protocols were lengthy and often difficult and complicated for both patients and clinicians. Clinicians and researchers began to question these well accepted protocols, both for implant placement and loading. With the goal of reducing treatment duration and improving efficiency and treatment outcomes, subsequent authors began to evaluate and study on implant insertion and loading timing

Different implant loading options were defined in the last three ITI Consensus Conferences in 2003, 2008, and 2013, have also been clinically applied. The definition of loading protocols has been slightly modified over the years and is currently accepted as follows <sup>[2]</sup>:

Immediate loading of dental implants is defined as being earlier than 1 week after implant placement

Early loading of dental implants between 1 week and 2 months after implant placement, and

Conventional loading of dental implants >2 months after implant placement (Gallucci *et al.*, 2014; Weber *et al.*, 2009)<sup>[5]</sup>.

## Discussion

### Evolution of the concept of implant loading

Branemark *et al.* (1977) published the first long-term follow-up on oral implant, providing the scientific foundation of modern dental implantology. According to Branemark, one of the most important requirements was a stress-free healing period of 3-6 months, making implant treatment more time taking. During the course of their clinical study (Branemark *et al.* 1977), various delayed loading periods were studied. Consequent to their 10-year clinical experience, they concluded that osseointegration required a long healing period of at least 3 months in the mandible and at least 5-6 months in the maxilla.

The reason for such a long-delayed healing period was mentioned as:

1. Premature loading may lead to fibrous tissue encapsulation instead of direct bone apposition.
2. The necrotic bone at the implant bed border is not capable of load-bearing and must be first replaced by new bone.
3. Rapid remodeling of the dead bone layer compromises the strength of the osseous tissue supporting the bone-implant interface.

Integrity of the periosteal margin may be threatened by undermining remodeling of adjacent bone during the late healing period.

Within the initial first year after the direct bone – to- implant interface, the implant is most at risk of failure or crestal bone loss. Failure results primarily from excessive stress or poor bone strength at the interface during early implant loading.

### Protocols of implant loading

1. **Branemark's loading protocol:** Flush with bone level, covered with gingiva. Final prosthesis after 3 to 6 months of initial healing.
2. **Progressive loading:** Flush with bone level, covered with gingiva. Provisional prosthesis brought progressively into occlusion, depending upon bone density.
3. **Non submerged single stage protocol:** non-submerged implants, flush within 1-2 mm of gingival level. Soft diet should be followed.
4. **Immediate functional loading:** Temporary restoration fitted on the same day as surgery, in occlusion. Soft diet should be followed.
5. **Immediate non-functional loading:** Temporary restoration fitted on the same day as surgery, not in occlusion. Soft diet should be followed.
6. **Early loading:** Final crowns within 3 weeks from surgery, in occlusion. Soft/ hard diet.
7. **Delayed loading:** Implant subjected to loading after more than 6 weeks post-surgery.
8. **Anticipated loading:** Provisional prosthesis is fitted after about 2 months after surgery.

### Implant Loading Protocols in Edentulous Patients

While healing periods of 3 to 6 months have traditionally been considered critical for a predictable osseointegration of dental implants, modified surgical and loading protocols have also shown predictable outcomes. Protocols for the treatment of edentulous maxilla and mandible with removable or fixed prostheses present a variety of options regarding the numbers of implants, their strategic distribution, the transitional prosthesis, and the definitive prosthetic design.

Multiple parameters have been identified as influential in achieving successful osseointegration with modified loading protocols in the completely edentulous arch. These factors include: patient health, oral conditions, occlusion and function/parafunction, characteristics of the proposed implant sites, implant size and shape, implant material and surface properties, implant distribution in the arch, as well as timing and methodology of implant placement including primary implant stability, loading procedures, and long-term maintenance<sup>[3]</sup>.

### Implant Loading Protocols In Partially Dentate Patients:

Traditionally, implants have only been loaded if the tissues were considered healthy and if adequate stability could be confirmed. But now Implants can be capable of supporting load immediately upon placement if they are stable and if the prevailing conditions are otherwise favorable.

Schrott *et al.* reviewed systematically the clinical outcomes for implants restored according to immediate, early or conventional loading protocols in extended partially edentulous situations. Their meta-analysis comparing immediate with early loading found survival rates of 97.9% and 97.8%, respectively<sup>[4]</sup>

### Important Determinants of Implant Loading

- **Time:** The two surgical appointments used for initial implant placement and the two surgeries are separated by 3 to 8 months depending on the bone density at the initial surgery. In a study by Carr, the increase in bone implant contact occurred in the maxilla and mandible and ranged from a 7% to 9% increase over a 3-months period. Bone density plays a important role in most of the major prosthodontic appointments.
- **The macroscopic coarse trabecular bone** heals about 50% faster than dense cortical bone. Although it heals more slowly, D1 bone has the bone has the greatest strength and greater lamellar bone contact. The healing time between the initial and second-stage surgeries is kept similar for D1 and D2 bone and is 3 to 4 months. A longer time is suggested for the initial healing phase of d3 and D4 bone (5 and 6 months, respectively) because of the lesser bone contact and decreased amount of cortical bone to allow for the maturation of the interface and the development of some lamellar bone
- **Diet:** It is must for the dentist to instruct the patient to avoid chewing in that area. The patient is limited to soft diet, from the initial transitional prosthesis delivery until the initial delivery of the final prosthesis. This diet not only minimizes the masticatory force on the implants but also decreases the risk of temporary restoration fracture.
- **Occlusion:** The dentist gradually intensifies the occlusal contacts during prosthesis fabrication. No occlusal contacts are permitted during initial healing. If the patient is having the signs of clenching or bruxism, then it is

better to avoid the immediate loading in such patients because patients with bruxism place several times more load on teeth or implants than normal patients <sup>[5]</sup>

### Conclusion

This review summarizes various loading protocols for all the situations where implant dentistry is required. Implant loading protocols must be followed thoroughly for a successful implant placement, retention, esthetics and function. Following the conventional healing period of 3-6 months are sometime not acceptable to the patient. The immediate and early loading protocol has served as a boon in the field of implant dentistry as well as time efficiency to the patient.

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