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IMMEDIATE LOADING IN IMPLANT DENTISTRY: A REVIEW

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Abstract:

Immediate loading in implant dentistry is increasing in popularity as a clinical procedure. A scientific rationale of immediate occlusal loading of the implant support system should emphasize methods to decrease surgical trauma during implant placement and also to decrease bone loading trauma during the early loading period. This articles discusses the various rationale for immediate loading of implants.

Introduction

Dental implants have become a valid treatment modality for the completely or partially edentulous patient. Immediate loading refers to loading the implant with an interim restoration within 2 weeks of implant placement.[1] Immediate loading of dental implants is a technique that has been described in the literature to eliminate the 3- to 6-months of healing period that has been recommended before implants can be loaded. The concept of immediate loading has become popular in implant prosthodontics because of reduced treatment time and patient acceptance. The advantages include elimination of second-stage surgery, maturation of peri implant soft tissues before fabrication of the definitive prosthesis, shortened treatment time, enhanced function, and greater patient satisfaction.

Advantages of immediate loading:

When compared with conventional loading protocols, immediate loading presents following advantages:

Reduction in overall treatment time.[2,3]

Reduction in alveolar ridge resorption.[2]

Aesthetically acceptable and/or pleasing restorative solution.[2-4]

Psychological benefit resulting in increased patient acceptance.[2-4]

Quicker return of function.[3,4]

Avoidance of a removable prosthesis that may interfere with healing or simultaneous bone grafting and/or may require additional maintenance during the healing period.[2]

Potentially superior soft tissue profile when accompanying immediate dental implant placement.[3]

Reduced surgical trauma and ease of surgery.[3]

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Primary implant stability and the concept of micromotion

The primary goal of primary stability is limitation of excessive micromovement. Micromovement can be influenced by the implant-to-bone relationship and by the prosthodontic design. In the maxilla, where bone quality is typically less favourable, this factor is of paramount importance. First proposed in 1974 by Cameron et al[5] and later confirmed by Szmukler-Moncler et al,[6] micromovement must be limited if destruction of blood vessels that will later form the bone-to-implant interface is to be avoided and osseointegration have to be maintained. Excessive micromovement can result in fibrous healing rather than osseointegration.[7] Insertion torque has been cited as an indicator of primary stability and as a nonlinear, indirect indicator of micromovement of an implant in bone.[8] Although early reports indicated that osseointegration could succeed with micro movements upto 500μm,[9] currently accepted levels of micromovement ranging between 50 and 150 μm are known to produce no detriment to osseointegration.[7]

Sennerby and Roos[10] confirmed that primary implant stability is determined by bone quality, bone quantity, implant design, and surgical technique. To evaluate implant stability, non-destructive intraoral testing methods such as resonance frequency analysis (RFA), the Periotest technique, and insertion torque measurements have been introduced.[11,12] While RFA and Periotest are advocated to evaluate implant stiffness, the insertion torque method assesses circumstances at the time of implant placement. Factors such as bone density, maxillary versus mandibular bone, abutment length, and supracrestal implant length affect the RFA and Periotest measurements. High RFA and low Periotest values point toward successfully integrated implants. Low or decreasing RFA and high or increasing Periotest values may be signs of loss of osseointegration and/or marginal bone loss.[11]

Rationale for Implant Immediate Loading

A. Implant related factors:

Increased surface area:

Main goal for an immediate-loaded implant/prosthesis system is to decrease the risk of occlusal overload and its resultant increase in the remodeling rate of bone. One method to decrease microstrain and the associated remodeling rate in bone is to provide conditions that increase functional surface area to the implant bone interface.[13] The surface area of load may be increased in a number of ways, i.e., implant number, size, design, and body surface conditions .

a) Implant Number

Two different approaches have emerged for immediate occlusal loading with completely edentulous patients for full arch fixed restorations. In 1990, Schnitman et al[14] published a protocol involving placing several more implants than the usual treatment plan for a conventional healing period. Selected implants around the arch (three or more) are then immediately restored with a transitional fixed prosthesis. Enough implants are left submerged for a healing period to allow delivery of a fixed prosthesis, even if all immediately loaded implants fail. If any of the implants survive, they are also used in the final restoration.

The other protocol for fixed prostheses in immediate occlusal restoration of dental implants for completely edentulous patients was published in 1999 by Scortecci[15] and initially loaded all the implants. All the implants were splinted together for an increased area of load transfer, which could decrease the stresses along the developing multiple interfaces and increases the stability, retention, and strength of the transitional prosthesis during the initial healing phase.

b) Implant Size

In the partially edentulous patient, the number of implants is more difficult to dramatically increase, compared with the completely edentulous situation. The functional surface area of each implant support system is primarily related to the width and the shape of the implant. Wider root form implants for the same length provide a greater area of bone contact than narrower implants (of similar design) The additional implant length permits the implant to engage the opposing cortical plate, which also may increase initial implant stability. Each 3-mm increase in length can increase surface area by more than 20% for a cylinder implant design.[16]

c) Implant Body Design

The implant body design should be more specific for immediate loading, because the implant requires maximum stability at the time of the placement and the bone has not had time to grow into recesses or undercuts in the implant body or attach to a surface condition before the application of occlusal load. Macrospheres on an implant surface do not have bone present within or around the porous surfaces of the implant at the time of implant insertion.[16] In general, pressfit implants may not provide optimum conditions for immediate load applications. A threaded implant body and insertion process provides a greater likelihood for initial stabilization. A threaded implant design may have some bone present in the depth of the threads from the day of insertion. Therefore, the functional surface area is greater during the immediate load format.[16]

d) Implant Surface Conditions

Implant surface conditions may affect the rate of bone contact, lamellar bone formation, and the percentage of bone contact.[17] The coating or surface condition of the implant has been shown to be most beneficial during the initial healing and early loading conditions Improved implant success rates have also been noted in immediate loading environments with hydroxylapatite (HA) coatings.[18]

Decreased force conditions

Stress to the implant interface directly influences the amount of strain to the bone. These stresses can be reduced by increasing the area that supports the occlusal load or by decreasing the force that is applied to the prosthesis. Hence, conditions that magnify the adverse effects of these considerations should be reduced in an immediate load protocol by evaluating the magnitude, duration, type and direction of force applied.

a) Occlusal Load Direction

The occlusal load direction along an implant interface may affect the RR. A crown height can be a vertical cantilever when angled forces or cantilever (mesiodistal or buccolingual) are placed on a prosthesis.[16] Therefore, not only should posterior cantilevers be eliminated in the immediate load transitional restoration, the angle of load to the implant body should be along the long axis, especially when the crown height is greater than normal. Flat occlusal planes in the posterior regions also decrease the risk of angled loads to the implant body.[16]

b) Implant Position

Implant position is one of the most important factors in immediate loading for completely edentulous patients. In the completely edentulous patient, a cross arch splint forming an arch is a very effective design to reduce stress within the entire implant support system, especially when there is an anterior–posterior (A-P) distance between the splinted implants.[16] When compared with bone from the mandible, maxillary bone can be particularly challenging for immediate implant placement because it has lesser bone density, a thin cortical plate, and proximity to

the maxillary sinus. Understanding the quality and type of bone and preserving that bone via atraumatic extractions are necessary for promoting successful osseointegration when immediately loading implants.

c) Cantilever Forces

A cantilever on a prosthesis increases the moment loads to the implant bone interface.[17] Cantilevers have been reported to increase crestal bone loss, increase abutment screw loosening, increase implant body fracture, and increase the risk of implant failure.[16,19] It should be noted that partially uncemented restorations may result in a cantilever along the remaining implants. Definitive cement should be considered for the transitional restoration to decrease the risk of partially retained conditions.

d) Occlusal Contacts

The amount of force to the prosthesis may be dramatically decreased in partially edentulous patients by eliminating any occlusal contact on the restoration. Most often, the aesthetic aspects of the restoration may be obtained without occlusal loading.

The Non-Functional Immediate teeth (N-Fit) concept described by both Misch and Worhle in 1998 has many biomechanical advantages and decreased risk in the partially edentulous patient.[20-22] Because the bridgework associated with the implants result in no occlusal contact, the risk of parafunctional forces from bruxism or clenching are eliminated. The risk of prosthesis fracture, abutment screw loosening, and partially retained restorations are also reduced with this method

B) Patient Factors

a) Habits

Bruxism and clenching are parafunctional forces that represent significant forces, because the magnitudes of the forces are high, the duration of the forces are extensive, and the direction of the forces are more horizontal than axial to the implants.[16,23] Parafunction may pose a considerable risk for immediate load, because the poorest implant survival data has been found for this patient condition. Parafunctional loads also increase the risk of abutment screw loosening, unretained prosthesis, or fracture of the transitional restoration used for immediate loading. If any of these complications occur, the remaining implants that are loaded could have a magnification of load, because a lever may be formed. This increases the moment forces along the implants, which thereby increases the risk of occlusal overload. 16

b) Diet and oral hygiene

Diet has been known to break or loosen a transitional prosthesis in traditional prosthetics. If the immediate loaded prosthesis becomes partially uncemented or fractures, the remaining implants holding the restoration are at increased risk of overload failure. Therefore, the diet of the patient should be limited to only soft foods during the immediate load process.

Summary:

A benefit/risk ratio must be assessed for each patient condition to ascertain whether immediate occlusal loading is a worthwhile alternative. The greater the benefit and/or the lower the risk, the more likely immediate loading is to be considered.

A biomechanical rationale for immediate loading may decrease the risk of occlusal overload during initial healing. The stresses applied to the implant support system result in strain to the bone interface. Greater the stress, higher is the strain. Stress may be reduced by increasing implant area and/or reducing the forces applied to the prosthesis. The implant size, design, and surface condition all impact the area over which the occlusal forces are dissipated. The forces may be reduced by patient

factors, implant position, reducing force magnifiers as crown height or cantilever length, reducing the occlusal contacts, decreasing angled forces to the prostheses and altering the diet. Regular maintenance is necessary to ensure the long-term success of immediately loaded implants.

This treatment approach has been studied and has shown promising and predictable results. However, it is important to note that a meticulous case selection is needed to integrate this treatment into daily practice.

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