

WORKSHOP GUIDELINES ON IMMEDIATE LOADING IN IMPLANT DENTISTRY

Carl E. Misch, DDS, MDS,
Chairman
Jack Hahn, DDS
Kenneth W. Judy, DDS
Jack E. Lemons, PhD
Leonard I. Linkow, DDS, MDS
Jamie L. Lozada, DDS
Edward Mills, DDS
Craig M. Misch, DDS, MDS
Henry Salama, DDS, MDS
Mohamed Sharawy, PhD
Tiziano Testori, MD, DDS
Hom-Lay Wang, DDS, MDS

INTRODUCTION

Predictable formation of a direct bone-to-implant interface is a treatment goal in implant dentistry. The 2-stage surgical protocol established by Brånemark et al¹ to accomplish osseointegration consisted of several prerequisites, including (1) countersinking the implant below the crestal bone, (2) obtaining and maintaining a soft-tissue covering over the implant for 3 to 6 months, and (3) maintaining a minimally loaded implant environment for 3 to 6 months. The primary reasons cited for the submerged, countersunk, surgical approach to implant placement were (1) to reduce and minimize the risk of bacterial infection, (2) to prevent apical migration of the oral epithelium along the body of the implant, and (3) to minimize the risk of early implant loading during bone remodeling.¹ After this procedure, a second-stage surgery was necessary to uncover these implants and place a prosthetic abutment. Predictable, long-term, clinical rigid fixation has been reported after this protocol in patients who were either completely or partially edentulous.^{2,3} During the past 15 years, several authors have reported that root-form implants may osseointegrate, even though the

implants extend above the bone and through the soft tissues during early bone remodeling.⁴⁻⁶ This surgical approach has been called a 1-stage or nonsubmerged implant procedure because it eliminates the second-stage implant uncover surgery. As a result, the discomfort, inconvenience, and appointments of the surgery and suture removal are eliminated. In addition, the soft tissue is more mature before fabricating a final prosthesis.

IMMEDIATE LOADING

Literature review

Immediate loading of a dental implant not only includes a non-submerged 1-stage surgery, but it also actually loads the implant with a provisional restoration at the same appointment or shortly thereafter. Immediate loading was the initial protocol suggested with dental implants. These implants yielded a wide range of clinical survival.⁷⁻¹¹ A direct bone interface, on occasion, could be developed and maintained for more than 20 years.¹²

Initial studies of immediate loading, with a primary goal of a direct bone-implant contact, have been proposed for overdentures in patients who are completely edentulous. These studies have shown encouraging results. In 1986, Babbush et al¹³ reported on patients who were completely

The Immediate Function Consensus Conference was conducted on November 7, 2003, at the Westin Diplomat Resort and Spa in Hollywood, Fla, as part of the 52nd annual meeting of the AAID.

Address correspondence to the committee Chairman, Carl E. Misch, DDS, MDS, at info@misch.com.

edentulous with overdentures. Four threaded implants were inserted in the anterior mandible and splinted together with a bar-and-clip system 2 months after implant insertion. The authors reported an 88% implant survival over an 8-year period with 1739 implants. In 1997, Chiapasco et al¹⁴ reported on 226 consecutive patients with mandibular overdentures with 904 implants inserted between the mental foraminae and an average of 6.4 years of function with 96.9% implant survival.¹⁵ More recent reports by Gatti et al¹⁶ and Chiapasco et al¹⁷ about the use of overdentures have continued to demonstrate implant survival rates above 96%.

Immediate loading for completely edentulous mandibles for fixed prostheses was reported by Schnitman et al¹⁸ in 1990, who used 28 screw-shaped implants in 10 patients. Later, in 1994, Henry and Rosenberg¹⁹ performed a prospective clinical trial to evaluate immediate loading for patients who had completely edentulous mandibles. In 1996, Biglani and Lozada²⁰ did a retrospective report of 4 patients who were completely edentulous after 3 to 6 years of function. This article found a 100% implant survival. In 1997, Tarnow et al²¹ presented 10 patients who were edentulous in both the maxilla and the mandible over a 1- to 5-year period with a 97% survival rate for implants, which were immediately loaded and splinted together to also support a full-arch prosthesis.

The initial reports for immediate loading in partially edentulous and single-tooth implants are more recent. In 1998, Misch^{22,23} reported on 10 consecutive cases for both single and multiple adjacent missing teeth. In the same year, Worhle²⁴ evaluated 14 consecutive single-tooth

replacements in the esthetic zone. Both authors suggested that the temporary restoration remain out of direct occlusal contact while the bone interface matured. All implants in those initial reports survived during the evaluation period.

Terminology

Immediate restoration of dental implants not only includes a non-submerged 1-stage surgery, but it also implies that the occlusal surfaces and implants are loaded with a provisional or definitive restoration. Discussions have evolved whether a restoration must be delivered at the time of surgery for this description. Because the restoration is not truly loaded immediately after implant insertion, regardless of the technique, an agreement should be established as to what guidelines and language may be acceptable to a majority of the profession. In this report, the *immediate occlusal loading* protocol is an implant-supported temporary or definitive restoration in occlusal contact within 2 weeks of the implant insertion. *Early occlusal loading* refers to an implant-supported restoration in occlusion between 2 weeks and 3 months after implant placement and may use the time period in parentheses (ie, early [5-week] occlusal loading). *Delayed or staged occlusal loading* refers to an implant prosthesis with occlusal load after more than 3 months postimplant insertion. The delayed occlusal loading approach may use either a 2-stage surgical procedure that covers the implants with soft tissue or a 1-stage approach that exposes a portion of the implant at the initial surgery. *Nonfunctional immediate restoration* is an implant prosthesis

with no direct occlusal load with in 2 weeks of implant insertion and is primarily considered in patients who are partially edentulous. *Nonfunctional early restoration* describes a restoration in a patient who is partially edentulous delivered between 2 weeks and 3 months after the implant insertion (Table 1).

INDICATIONS FOR IMMEDIATE RESTORATIONS

As a general rule, the delayed-healing approach is the most predictable for osseointegration in implant dentistry. It depends less on patient cooperation relative to diet, maintenance, and parafunctional habits. Therefore, if the patient is able to wear a removable restoration and does not have a concern relative to the delayed-treatment approach, it is prudent to use the long-established protocols of delayed loading. However, these 2 options delay the fabrication of the final restoration by 3 to 6 months.

Some patients cannot tolerate a removable prosthesis. Many others are able to wear the device but are not comfortable or dislike the movement during function or speech. Others do not wish to wait for 3 or more months before receiving teeth to replace their missing dentition. Given the option, these people desire a fixed transitional or final prosthesis as soon as reasonable after the implant insertion.

The suggested contraindications, in general, for consideration of an immediate loading protocol include the following:

1. Severe metabolic disease
2. Inadequate bone volume for correct implant placement
3. Very poor bone density (D4)
4. Severe parafunction (eg, bruxing, clenching, tongue thrust)

5. Noncompliant patient types (eg, diet limitations, gum chewing)

SUGGESTED GUIDELINES

There are 4 different patient groups for the immediate occlusal loading protocol:

1. Patients who are completely edentulous desiring a fixed restoration
2. Patients who are completely edentulous with an implant overdenture
3. Patients who are partially edentulous replacing several teeth with a fixed prosthesis
4. Patients who are replacing a single tooth

Each of these patients may present a different benefit, risk factor, and clinical approach.

Ideally, the immediate loading protocol should be limited to patients who have the most to gain and the least to lose. The patient who is completely edentulous and unable to tolerate a removable restoration is an example. To the other extreme, the single tooth missing in the mandibular second molar region has little benefit for immediate loading and therefore has a lower benefit-risk ratio.

Overdentures

In general, patients with completely edentulous mandibles restored with an overdenture are at the least risk of occlusal overload for immediate loading protocols. This approach has been presented 15 years ago and, along with more recent reports, suggests 4 or more implants splinted together to support the restoration. To this date, maxillary overdentures have not been adequately

TABLE 1 Immediate loading terminology	
1. Immediate occlusal loading	• Occlusal load to an implant prosthesis within 2 weeks of implant insertion.
2. Early occlusal loading	• Occlusal load to an implant prosthesis between 2 weeks and 3 months after implant placement. The actual time may use the number of weeks in parentheses (ie, early [5 weeks] occlusal loading).
3. Nonfunctional immediate restoration	• An implant prosthesis in a patient who is partially edentulous delivered within 2 weeks of implant insertion with no direct occlusal load.
4. Nonfunctional early restoration	• An implant restoration delivered to a patient who is partially edentulous between 2 weeks and 3 months after implant insertion.
5. Delayed or staged occlusal loading	• Occlusal loading to an implant restoration more than 3 months after implant insertion.
6. Two-stage delayed occlusal loading	• The soft tissue covers the implant after initial placement. A second-stage surgery after 3 months exposes the implant to the oral environment.
7. One-stage delayed occlusal loading	• The implant is positioned slightly above the soft tissue during the initial implant placement. The implant is restored into occlusal load after more than 3 months.

addressed in the literature. The suggested guidelines for a mandibular implant overdenture are presented in Table 2.

Fixed restoration—completely edentulous

The benefit-risk relationship for a patient with completely edentulous mandibles who desires a fixed prosthesis is high. The patient who is completely edentulous for a fixed restoration that has adequate bone in the mandible for at least 1 implant in the bilateral posterior regions and another in the anterior region has been evaluated for more than 13 years. A biomechanical approach to reduce implant-bone interface overload is to load 5 or more implants to support the immediate restoration. Regardless of whether the protocol loads all the implants inserted or loads specific implants by location, size, and bone quality, at least 5 threaded implants >10 mm are suggested for the final restoration (Table 3).

The fixed prosthesis in the maxillary arch for the patient who is completely edentulous has been evaluated in the literature for only the past 6 years. As such, a more cautious approach is warranted. The panel agreed this procedure was in the low

TABLE 2 Immediate loading suggested guidelines for overdentures	
1. Completely edentulous mandible.	
2. Abundant to moderate bone height and width.	
3. Prosthetic space ≥ 12 mm.	
4. Opposing a maxillary denture.	
5. At least 4 implants inserted between the mental foraminae.	
6. Screw-type implants ≥ 10 mm long and ≥ 4 mm wide at the crest module.	
7. When possible, the implants should engage the opposing cortical plate.	
8. Splint implants together with a bar or a fixed bridge.	
9. Minimum cantilever on bar ($\leq 1 \times A-P^*$ distance).	
10. Sleep without the prosthesis.	
11. Severe bruxism contraindicated.	

*A-P indicates anterior-posterior.

TABLE 3
Suggested guidelines for immediate loading complete edentulous fixed prostheses*

Surface-area factors	
1. Implant number	<ul style="list-style-type: none"> • Eight or more splinted implants for the completely edentulous maxillary arch and 5 or more splinted implants for the mandible. More implants if the bone is poorer in quality (D3) or force factors are greater (eg, crown height, mild to moderate parafunction).
2. Implant size	<ul style="list-style-type: none"> • At least 10 mm long and 4 mm wide. • Larger-diameter implants in the posterior molar regions of the mouth. If larger diameter is not possible, greater implant number is suggested (eg, 2 implants for each molar).
3. Implant design	<ul style="list-style-type: none"> • Threaded implants.
4. Implant surface condition	<ul style="list-style-type: none"> • Rough surface area implants.
Force factors	
1. Patient conditions	<ul style="list-style-type: none"> • Mild to moderate parafunction, and muscular dynamics require more implants.
2. Implant position	<ul style="list-style-type: none"> • In the completely edentulous maxilla, anterior implants should be at least in the bilateral canine position and posterior implants in the first to second molar position for the largest anterior-posterior dimension. In the mandible, at least 1 implant in the anterior section and 1 in each posterior region is necessary. The largest anterior-posterior dimension possible should be used.
3. Occlusal contacts	<ul style="list-style-type: none"> • Only anterior occlusal contacts in the transitional restoration (first bicuspid to first bicuspid).
4. Cantilevers	<ul style="list-style-type: none"> • No posterior cantilevers should exist on transitional restorations in either arch.
5. Occlusal load direction	<ul style="list-style-type: none"> • Narrow occlusal tables and no posterior offset loads on the transitional prosthesis. • Long axis loads to the implant bodies whenever possible.
6. Diet	<ul style="list-style-type: none"> • Soft

*The cemented transitional restoration should be screw retained or use a definitive cement (eg, polycarboxylate or glass ionomer cement) rather than a more temporary, weaker cement.

benefit-risk category. Patients can tolerate a maxillary denture, and the bone volume and density is usually poorer than the edentulous mandible. Additional implants are suggested to improve the biomechanical load conditions. Most reports indicate at least 8 screw-type implants 10 mm or longer should be used. Two of these implants should be in the bilateral molar position and

2 in the canine bilateral position (Table 3).

Partially edentulous—multiple adjacent teeth

The patient who is partially edentulous, missing 2 or more adjacent teeth, and requesting immediate restoration is a moderate benefit-risk ratio. A partial denture may not solve the esthetic concerns of

the patient because of psychologic or abutment-support reasons. In these patients, the benefit-risk ratio is increased. This procedure has only been evaluated only since 1998 and has the fewest clinical studies. The patient who is partially edentulous and missing several adjacent teeth should limit the use of immediate restoration to the esthetic zones, where 1 implant may be inserted for each tooth. The transitional restoration should avoid occlusal contact to decrease the risk of parafunctional overload. The suggested guidelines are listed in Table 4.

Single tooth

The immediately restored single-tooth implant has an increased risk of failure of about 5% in the first year and has also been evaluated for the least amount of time in the literature. The final restoration should not be compromised in appearance or health because a resin retained fixed temporary is usually possible, and therefore less benefit may be appreciated for the fixed transitional restoration. Both soft and hard tissue should be ideal, and the implant size should obliterate the socket yet not be positioned too close to the adjacent teeth or too facial in position. Hence, the use of this procedure is more guarded than the other patient categories, when ideal conditions do not exist (Table 5).

SUMMARY

The delivery of care for patients missing 1 or all of their teeth very often requires implants to restore function, esthetics, bone and soft-tissue contours, speech, and intraoral health. The delayed occlusal loading protocol, either the 1- or 2-stage approach, has been evaluated for more than 30 years

by a number of clinical settings and situations. However, in some patient conditions, the delayed-healing process can cause psychologic, social, speech, or function problems. A full range of treatment options relative to the initial hard- and soft-tissue healing is available. Immediate restoration of a patient after implant surgery is one of these alternatives.

A benefit-risk ratio may be assessed for each patient condition to ascertain whether immediate occlusal loading is a worthwhile alternative. The greater the benefit or the lower the risk, the more likely immediate loading is considered. A complete edentulous mandible restored with an overdenture supported by 4 or more implants is a very low-risk condition. If the patient cannot tolerate a mandibular denture and does not wear the device, an immediate loading protocol would be highly beneficial.

The highest risk for immediate loading would be a posterior single-tooth implant. Implant number cannot be increased, and implant length cannot engage cortical bone. When the single-tooth replacement is out of the esthetic zone, very low benefit is obtained with the immediate restoration approach.

In patients who are partially edentulous, immediate restoration does not necessarily mean immediate occlusal loading. A nonfunctional transitional device is less likely to cause occlusal overload during the initial bone-healing response. Whether or not the restoration is in function is not the most critical factor. Minimal micromotion at the implant-to-bone interfacial zone during bone healing, however accomplished, appears to be a key factor.

TABLE 4

Immediate loading suggested guidelines for patients who are partially edentulous (missing 2 or more adjacent teeth)

Patient conditions
1. Esthetics zones
Implant number
1. One implant or tooth when possible
Implant size
1. At least 10 mm long and 4 mm wide (when possible)
2. Larger diameters for molars
Implant design
1. Screw-type implant
Implant surface condition
1. Rough
Occlusal contacts
1. No occlusal load for at least 2 to 3 months
Cantilever
1. No cantilever load
Diet
1. Soft
Parafunction
1. No gum or pencil chewing
2. No tongue thrust

The traditional 2-stage approach to implant restorations have been evaluated for almost 3 decades. The immediate occlusal load approach, in comparison, is relatively new and has far less research and documented studies. Therefore, the staged approach to implant restoration should always be the first approach. This is especially noteworthy for the less-experienced practitioner.

Immediate restoration does not necessarily mean immediate loading at the higher magnitude forces and cycles. Conservative approaches to reduce stress to the prostheses should lead to enhanced outcomes.

Additional clinical studies to evaluate the associated risks, especially in the maxillary arch, are expected over the next several years. Until the profession has longer-term evidence and more

TABLE 5

Immediate loading guidelines for single-tooth replacement

1. In the esthetic zone
2. Ideal soft-tissue conditions
3. Ideal bone condition
4. Ideal implant position
5. No occlusion on transitional restoration
6. D1, D2, and D3 bone type in region
7. Screw, shape implant body
8. ≥ 12 mm long (engage cortical bone at apex where possible)
9. Soft diet
10. Cement the transitional prosthesis with definitive cement or screw retain
Contraindication
1. Parafunction habits that load the transitional restoration (eg, gum chewing)
2. Hard foods

multicenter studies, immediate occlusal loading will be a secondary treatment option, restricted on a case-by-case basis.

REFERENCES

1. Branemark PL, Hansson BO, Adell R, et al. Osseointegrated implants in the treatment of edentulous jaw. Experience from a 10 year period. *Scand J Plast Reconstr Surg Hand Surg.* 1977;2 (suppl 10):1-132.
2. Adell R, Lekholm U, Rockler B, Branemark P-I. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. *Int J Oral Surg.* 1981;10:387-416.
3. Van Steenberghe D, Lekholm N, Bolender C, et al. The applicability of osseointegrated oral implants in the rehabilitation of partial edentulism; a prospective multicenter study of 558 fixtures. *Int J Oral Maxillofac Implants.* 1990;5:272-281.
4. Gottfredsen K, Hjorting-Hansen E. Histologic and histomorphometric evaluation of submerged and nonsubmerged titanium implants. In: Laney WR, Tolman DE, eds. *Tissues Integration in Oral, Orthopedic and Maxillofacial Reconstruction.* Chicago, Ill: Quintessence; 1990: 31-40.
5. Schroeder A, Mawglen B, Sutter F. Hohlzylinderimplantat: typ-F zur prothesen-retention bei zahnlosen Kafer.

Schweiz Monatsschr Zahnherkunde. 1983; 93:720-733.

6. Buser D, Weber HP, Bragge U, et al. Tissue integration of one stage ITI implants. 3 year results of a longitudinal study with hollow cylinder and hollow screw implants. *Int J Oral Maxillofac Implants.* 1991;6:405-412.

7. Strock AE, Strock M. Experimental work on a method for the replacement of missing teeth by direct implantation of a metal support into the alveolus. *Am J Orthod Oral Surg.* 1939;25:467-472.

8. Linkow LI. The blade-vent—a new dimension in endosseous implants. *Dent Concepts.* 1968;11:13-18.

9. Cranin AN, Rabkin MF, Garfinkel L. A statistical evaluation of 952 endosteal implants in humans. *J Am Dent Assoc.* 1977;94:315-320.

10. Smithloff M, Fritz ME. The use of blade implants in a selected population of partially edentulous adults: a five-year report. *J Periodontol.* 1976;47:19-24.

11. Kapur KK. Veterans Administration co-operative dental implant study comparison between fixed partial dentures supported by Blade-Vent implants and partial dentures. *J Prosthet Dent.* 1987;59:499-512.

12. Linkow LI, Donath K, Lemons JE. Retrieval analysis of a blade implant after

231 months of clinical function. *Implant Dent.* 1992;1:37-43.

13. Babbush CA, Kent JN, Misiek DJ. Titanium plasma spray (TPS) screw implants for the reconstruction of the edentulous mandible. *J Oral Maxillofac Surg.* 1986;44:274-282.

14. Chiapasco M, Gatti C, Rossi E, Haefliger W, Markwalder JH. Implant-retained mandibular overdentures with immediate loading. A retrospective multicenter study on 226 consecutive cases. *Clin Oral Implants Res.* 1997;8:48-57.

15. Schnitman DA, Wohrle PS, Rubenstein JE, DaSilva JD, Wang NH. Branemark implants immediately loaded with fixed prostheses at implant placement. Ten year results. *Int J Oral Maxillofac Implants.* 1997;12:495-503.

16. Gatti C, Haefliger W, Chiapasco M. Implant-retained mandibular overdentures with immediate loading: a prospective study of the ITI implants. *Int J Oral Maxillofac Implants.* 2000;15:383-388.

17. Chiapasco M, Abati S, Romeo E, Vogel G. Implant-retained mandibular overdentures with Branemark System MK II implants. A prospective comparative study between delayed and immediate loading. *Int J Oral Maxillofac Implants.* 2001;16:537-546.

18. Schnitman DA, Wohrle PS, Rubenstein JE. Immediate fixed interim

prostheses supported by two-stage threaded implants: methodology and results. *J Oral Implantol.* 1990;16:96-105.

19. Henry D, Rosenberg I. Single stage surgery for rehabilitation of the edentulous mandible: preliminary results. *Practical Periodont Aesthetic Dent.* 1994;6:15-22.

20. Biglani M, Lozada JL. Immediately loaded dental implants—influence of early functional contacts on implant stability, bone level integrity and soft tissue quality: a retrospective 3 and 6 year clinical analysis. *Int J Oral Maxillofac Implants.* 1996;11:126-127.

21. Tarnow DP, Emthias S, Classi A. Immediate loading of threaded implants at stage one surgery in edentulous arches. Ten consecutive case reports with 1 to 5 year data. *Int J Oral Maxillofac Implants.* 1997;12:319-324.

22. Misch CE. Non-functional immediate teeth in partially edentulous patients: a pilot study of 10 consecutive cases using the Maestro Dental Implant System. *Compendium.* 1998;19:25-36.

23. Misch CE. Non-functional immediate teeth. *Dent Today.* 1998;17:88-91.

24. Wohrle P. Single tooth replacement in the aesthetic zone with immediate provisionalization: fourteen consecutive case reports. *Practical Periodont Aesthetic Dent.* 1998;9:1107-1114.