Immediately restored dental implants for partial-arch applications. A literature update

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Abstract
This article carries out a literature update on immediately restored dental implants in partially edentulous patients. A search was made in Medline of all articles published between the year 2000 and February 2007, including all articles published in both English and Spanish, in which immediate restoration of implants was made of partially edentulous areas with a minimum of 12 implants and six months follow-up.
Certain decisive factors exist for the success of this technique in partially edentulous patients, such as primary stability, a roughened implant surface, and the absence of parafunctional habits in patients acceptable for this type of treatment.
Following the analysis of these studies of immediate restoration of teeth in partially edentulous areas, a weighted mean survival of 95.39% was observed. In spite of the high success rate, major controversy still exists on this subject resulting in few studies and short follow-up periods, making the routine use of this technique questionable.

Key words: *Immediate restoration in partially edentulous areas, immediate loading, dental implants.*

Introduction
Immediate restoration is defined as the placing of the prosthesis within 48 hours of implant insertion, but without occlusion with the antagonist arcade (1). Immediate loading or restoration of implants in partially edentulous maxilla or mandible is not well-documented. The consensus statement produced by Cochran et al (1), states that a series of factors for the planning and successful completion of these type of restorations must be taken into account, such as the absence of parafunctional habits, a roughened implants surface, and primary stability.
A literature update was made following a search in Medline of articles published between the year 2000 and February 2007 (Table 1), using the following keywords: 'immediate loading', 'immediate loading partial arch', 'immediate restoration partial arch', 'immediate loading partial edentulism'. Studies published in both English and Spanish with a minimum of 12 implants and six months follow-up were included, with the immediate replacement of teeth in partially edentulous areas. In all cases the provisional prosthesis was placed within 48 hours of surgery, except in some studies (2-5) where for prosthetic reasons there was a delay of some days.
The aim of this study is to carry out a literature update on immediate restoration of dental implants in partially edentulous patients.

Implant surface
Rocci et al. (6) obtained a 95% success in roughened surface implants (TiUnite, Nobel Biocare®), and 85.5% with Nobel Biocare® machined surface implants. These differences are more evident in implants placed in Type IV

AUTHOR	Number of patients	Number of implants	Nº of implants per prosthesis	LOCATION implants	Type of implants	SURFACE	LENGTH	DIAMETER	TIME UNTIL LOADING	FOLLOW-UP	SUCCESS
Jaffin et al. 2000 (2)	27	149(27 partial-arch, 149 full-arch)	-	Mx.Md. Posterior	-	MTS TPS/SLA	10 mm Md 6 mm Mx	-	3 days	5 years	95%
Meyer et al. 2003 (4)	8	32	-	Md. Posterior	-	-	10 mm	4,1 mm	Same day	14 days	87.5%
Barone et al.2003 (8)	4	12	-	Mx.Md. Posterior	ITI® SLA (Sweden & Martina, Padova, Italy)	Sandblasted/ SLA	13 mm	3.75/4/5 mm	1 day	6 months	100%
Glauser et al.2004 (3)	23	81	-	Md. Posterior	Branemark System MK IV, Nobel Biocare	-	7/18 mm	3.75/4/5 mm	from 0 to 11 days	1 year	88.8%
Nikellis et al. 2004 (5)	40(18 partial)	190 (46 partial-arch)	2/3	Mx.Md. Posterior	Southern Implants, Irene, South Africa	Sandblasted/ SLA	10 mm	3.75 mm	3 days	1-2 years	100%
Nedir et al. 2004 (20)	18	43(conventional loading) 63 (immediate loading)	2-3	Mx and Md	SLA ITI® Straumann AG, Waldenburg, CH)	SLA	8-13 mm	4.1/4.8 mm	48 hours	1 year	98.4%
Luongo et al.2005 (25)	36	82	3	Mx and Md Posterior	-	Sandblasted/ SLA	-	-	from 0 to 11 days	1 year	98.8%
Akkocaoglu et al. 2005 (26)	4	16	2	Md Posterior	ITI® TE® synOcta® Straumann Institute, Waldenbur, Switzerland	-	12 mm	4.1/4.8 mm	-	-	100%
Glauser et al. 2005 (11)	102	38	-	Mx and Md	Brånemark System MK IV TiUnite, Nobel Biocare	-	-	-	-	4 years	97.1%
Cornelini et al. 2006 (18)	40	20	3	Md posterior	SLA ITI® Straumann AG, Waldenburg, CH)	SLA	10/12 mm	4.1/4.8 mm	24 hours	1 year	97.5%
Yoo et al. 2006 (15)	174	347	-	Mx and Md	Bicom Implants (Bicom, Boston, MA)	SLA, TPS, HA	5.7/11 mm	3.5/6 mm	Same day	1 year	93.1%
Schincaglia et al. 2007 (7)	42	10	2/3	Md posterior	Brånemark System MK IV, and TiUnite Nobel Biocare	TIO/ machined	10-13 mm	-	24 hours	1 year	100% (TiO) / 95% (machined)

Table 1. Studies on immediate restoration in partial arch applications.
SLA: sandblasted and acid-etched surface; Mx: maxillae; TPS: titanium plasma-sprayed; Md: mandible; MTS machined titanium screw; HA: hydroxyapatite; TiO: titanium oxide.

bone, where 45% (5 of 11) of the implants with machined surface failed, and 8% (1 of 11) with roughened surface also failed. These results are similar to those obtained by Jaffin et al. (2), who observed a higher success rate in implants with a modified surface (TPS/SLA titanium plasma-sprayed) (99%) than in implants with a machined surface (88%), on placing 149 implants with immediate loading in partially and completely edentulous areas. Glauser et al. (3) observed a low success rate for machined-surface implants in low quality bone, and in contrast, obtaining better results when using roughened surface implants in the same type of bone. Schincaglia et al. (7) found no significant differences between machined implants and titanium oxide implants (TiO), with respect to bone loss and to the ISQ (implant stability quotient), but did find a 95% success in machined implants, and 100% success in roughened surface implants.

Barone et al. (8) placed 12 sandblasted, acid-etched surface (SLA) implants (Sweden & Martina, Padova, Italy), with immediate loading in half of these. Six months later, the implants were analyzed using a new volumetric computed tomographic scanner CT: the radiographic measurements showed a mean densitometric profile (mean of the mineralized bone), to be greater in the group with immediate loading, with statistically significant differences ($p<0.05$).

Bone quantity and quality

Bone density is implicitly related to primary stability of the implant and correct osseointegration. An implant placed in compact bone (anterior mandible), will probably have better primary stability and greater capacity to support immediate masticatory forces. In contrast, low-density bone (normally posterior maxillary bone) impedes rigid fixation, independently of the implant used. This type of bone therefore, is not adequate for immediate loading techniques (9). Herrera et al. (10) concluded that the only parameter that appears to influence success of immediate loading is bone quality, advising that this be of Type II.

Rocci et al (6), observed 81% success for machined surface implants placed in soft bone, and 94% in hard bone, being statistically significant. Likewise, Glauser et al. (11) obtained 66% survival for implants inserted in Type IV bone, and 91% in other types of bone. In a subsequent study, the same authors (12) placed 51 immediate fixed prostheses, 88% in posterior areas of the maxilla or mandible and 76% in soft bone, observing a success rate of 97.1% after 4 years of follow-up, they concluded that immediate loading is a suitable alternative in areas of soft bone.

Ormianer et al. (13), in a study of 338 partially edentulous patients evaluated the survival of 1065 implants placed in atrophic ridges which required bone regeneration treatment with grafts; 136 of these implants were placed with immediate loading, of which 3 failed. The authors concluded that immediate loading in implants in grafted bone is a predictable procedure.

Location

The implant location (anterior or posterior, maxillary or mandibular), plays an important role in the success of immediate restorations (9). Horiuchi et al. (14) found no significant differences between arcades when placing implants with immediate loading; after placing 44 implants in the maxilla and 96 in the mandible, they observed a success rate of 95.5% and 97.9% respectively. Yoo et al. (15) measured bone loss in 347 immediately loaded implants, observing that at 12 months of surgery 95.5% of the implants had lost less than 1.5 mm of crestal bone; concluding that their mandible demonstrates a greater risk of crestal bone loss than the maxilla.

The posterior maxillary area, being bone Type III and IV, is a high risk area for immediate loading (10); Salvi et al. (16) and Glauser et al. (3) consider that in posterior sectors this technique can only be successful in certain patients: bone Type I-III, non-smokers, good oral hygiene, no relevant medical pathology (uncontrolled diabetes, blood dyscrasia), with no signs of active infection in the maxilla or sinus, etc. Calandriello and Tomatis (17) placed 60 angulated implants in posterior atrophic maxilla, observing a success rate of 96.7%, presenting this technique as a good alternative for the immediate treatment of atrophic maxilla, simplifying the treatment, reducing surgical invasion, and reducing time and cost. Barone et al. (8) placed 12 implants in posterior areas, 8 in the maxilla and 4 in their mandible with immediate restoration in half of these, observing 100% success at six months. Schincaglia et al. (7) on loading 42 implants in 10 patients with bilateral posterior mandibular edentulism, concluded that this area is a suitable option for immediate positioning, provided that this is always done with an ISQ>60, in bone without grafts and limited occlusal contact. Cornelini et al. (18), placed 20 three-unit provisional fixed prostheses in posterior areas of mandible in 20 patients, obtaining a success rate of 97.5% after 12 months follow-up. Likewise, Romanos and Nentwig (19) compared the success rates of immediate loading and deferred loading in posterior mandibular implants, observing the same success in both.

Implant length and diameter

Nedir et al. (20) observed a higher failure rate in 8 mm long implants located in Type III bone, independently of whether they were immediate loading or not.

Gapski et al. (9) indicated that a 3 mm increase in the length of the implant, increases the surface area by 20-30%. These authors recommended using wide-diameter implants (>4 mm), and longer than 10 mm, for immediate loading.

Contraindications

Immediate prosthetic restoration is a risky procedure and may even be contraindicated in situations where adequate primary stability cannot be obtained (21).

In a study by Glauser et al. (11), implant failure with immediate positioning was significantly higher in patients with bruxism (41%), than in those without this parafunction (12%); concluding that occlusal overloading is a risk factor.

Ganeles et al. (22) in their study did not include smokers of more than 10 cigarettes a day or with parafunctional habits such as bruxism, as these have a greater risk of failure. On the other hand, they treated well-controlled diabetic patients indicating that Type II diabetes is not an absolute risk factor in immediate loading protocols in partial arch. Lekholm et al. (23) also included Type II controlled diabetic patients, and considered as risk factors systemic diseases such as: rickets, osteoporosis and Sjögren's syndrome. Salvi et al. (16) obtained a 100% survival after one year of loading, in 67 ITI® implants (Straumann, Walderburg, Switzerland) placed in 27 patients in posterior mandibular areas with immediate prosthetic placement; they did not place implants in patients with uncontrolled diabetes, osteoporosis, blood dyscrasia, patients who had been exposed to head or neck radiation, smokers of more than 20 cigarettes a day, or patients with clinical signs of bruxism. Rocci et al. (24) placed 97 implants in partially edentulous maxilla, in 46 patients; including 8 smokers and excluding patients with bruxism, the success rate was 92% at eight weeks.

Conclusions

Following the analysis of these studies on immediate restoration on dental implants in partial arch, a mean weighted survival of 95.39% was observed. Certain decisive risk factors exist for the success of immediate loading in partially edentulous sectors, such as primary stability, roughened implant surface, and the absence of parafunctional habits in patients suitable for to this type of treatment. A greater tendency towards using wide-diameter implants and lengths of greater than 10 mm for treatment with immediate loading was observed, although few studies support this.

In spite of the high success rates, published studies are few in number, always with short follow-up periods, few implants and few patients, using very specific inclusion criteria and subject to very strict clinical conditions. More studies are needed in order to be able to demonstrate the long-term success of immediate restorations in partial arch.

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