Survival of Immediately Provisionalized Dental Implants: A Case-Control Study with up to 5 Years Follow-Up

Amir Laviv, DMD;* Liran Levin, DMD;† Yeffet Usiel, DMD;‡ Devorah Schwartz-Arad, DMD, PhD§

ABSTRACT

Purpose: The aim of this study was to evaluate the survival rate of immediately provisionalized implants with up to 5 years follow-up.

Materials and Methods: The study consisted of 226 patients, 113 consecutive patients with immediately provisionalized dental implants (cases) and 113 randomly selected, age-, gender-, and implant position-matched controls with conventional late implant loading. Survival rate and incidence of complications were recorded.

Results: Follow-up ranged from 6 to 60 months. Smoking was reported by 20.8% of patients. Maxillary incisors and mandibular lateral incisors were the most common areas for implant placement. Conventionally loaded implants were narrower ($p = .03$) and shorter ($p = .001$). Immediate implantation into a fresh extraction socket was performed in 69% of the cases and in 36.3% of the controls ($p = .001$). Implant survival rate was 96.5%. Of the eight failed implants, six were immediately provisionalized and two were conventionally loaded. No statistically significant difference was found in survival rates between groups ($p > 0.05$). Five of the failed implants (case group) were immediately loaded implants placed in fresh extraction sockets.

Conclusion: Immediate implant provisionalization achieved similar high success rates compared with the conventional, delayed approach. As immediate implant provisionalization is mainly desired in the anterior region, the high success rates are encouraging.

KEY WORDS: implant dimensions, implant success, smoking, survival, tobacco, wide implants

INTRODUCTION

In clinical investigations, loading time has been rigidly controlled to allow implants to heal under unloaded conditions. The reason for this is in the critical association between achieving osseointegration and the absence of loading. In the past, immediate loading on dental implants resulted in fibrous encapsulation.[1] However, some clinicians immediately loaded implants for provisionalization, thus obtaining positive results with a higher percentage of osseointegration of the implants. At first, a few implants were immediately loaded with a bar overdenture in the mandible.[2,3] Then the concept of immediate loading evolved to loading multiple implants with a fixed prosthesis in the mandible[4–7] and maxilla.[7–10]

Immediate loading can be applied in some clinical cases and is certainly another treatment modality for the implant patient. Once the success parameters are defined, immediately loaded implants prove as successful as implants placed under a standard protocol.[9,10] Controlling micromotion is the key issue to obtain osseointegration of the immediately loaded implants. A reduction in micromotion is achieved through a wide anteroposterior distribution of the immediately loaded implants and cross-arch stabilization of the edentulous

*Resident, Department of Oral and Maxillofacial Surgery, Hadassah Medical Center, Jerusalem, Israel; †Clinical Instructor, Department of Oral Rehabilitation, The Maurice and Gabriela Goldschleger School of Dental Medicine, Tel Aviv University, Tel Aviv, Israel, and Unit of Periodontology, Department of Oral and Dental Sciences, Rambam Medical Center, Haifa, Israel; ‡Dental Clinician, Israel Defense Forces, Israel; §Head and Senior Surgeon, Schwartz-Arad Surgical Center, Ramat-Hasharon, Israel.

Reprint requests: Dr. Devorah Schwartz-Arad, Head and Senior Surgeon, Schwartz-Arad Surgical Center, 62 Harishonim Road, Ramat-Hasharon 47243, Israel; e-mail: dubi@dsa.co.il

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arches with a rigid prosthesis. Stability of the individual implant is also important. Anchorage of the bone cortical may be necessary to increase implant stability, especially in the maxilla.

In the edentulous mandible, Tarnow and colleagues[7] immediately loaded 35 implants (20 machined-surfaced and 15 textured-surfaced) in six patients. Two machined-surfaced implants failed, yielding a success rate of 94.3%. In the edentulous maxilla, 34 implants (14 machined-surfaced and 20 textured-surfaced) were immediately loaded in four patients with a 100% success rate. In another study, Horiuchi and colleagues[11] immediately loaded 96 machined-surfaced implants in the mandible of 12 patients: two implants failed, yielding a success rate of 97.9%. In the maxilla, 44 machined-surfaced implants were immediately loaded in five patients: two implants failed, yielding a success rate of 95.5%. In these two studies, the decision to immediately load an implant depended on its initial stability at placement, which was assessed by an electronically controlled and reproducible percussion value[7] or torque value.[11]

The purpose of this case-control study was to evaluate the survival rate of immediately provisionalized dental implants with a follow-up of up to 5 years.

MATERIALS AND METHODS

The study consisted of 226 patients, 113 consecutive patients with immediately provisionalized dental implants (cases) and 113 randomly selected, age-, gender-, and implant position-matched controls with conventional late implant loading. Patients ranged in age from 18 to 81 years (average 51.3 ± 15.2 years). All implants were placed between the years 2000 and 2006.

There were 93 (41.2%) men and 133 (58.8%) women. One surgeon (D.S.-A.) performed all operations following the standard protocol.[12,13] Immediate provisional restorations were provided only if an appropriate initial insertion torque had been applied (>40 N). Where possible (i.e., in cases of single implants or short-span bridges), implants were provisionalized out of occlusion. Complete medical and dental history, smoking habits, and clinical and radiographic evaluation were recorded.

Survival rate of these implants and incidence of complications were recorded and analyzed. Data were analyzed according to one implant randomly selected from each patient to overcome statistical bias because of patient-related factors (individual effect of smoking, healing ability, bone quality, and remodeling). This results in a smaller implant sample but with better statistical accuracy and reliability. Descriptive statistics, Student's *t*-test, and two-tailed Pearson's correlation test were performed using statistical software (SPSS® 10.0, SPSS Inc., Chicago, IL, USA).

RESULTS

Follow-up ranged from 6 to 60 months (mean 37.1 ± 23.1 months). Smoking was reported by 20.8% of patients. Average time of smoking was 23.8 ± 10.9 years, and average amount of cigarettes per day was 16.5 ± 8.9. No significant difference was found between cases and controls regarding age, gender, diabetes, and smoking habits. The most common areas for implant placement were the maxillary incisors and the mandibular lateral incisors (Table 1). Most implants were longer than 13 mm and 3.75 mm in diameter or wider (Table 2). Conventionally loaded implants were narrower ($p = .03$) and shorter ($p = .001$) than immediately loaded implants.

TABLE 1 Implant Distribution According to the Tooth Replaced in Each Group (Note – Controls Were Matched for Implant Location)

Tooth	Maxilla Number (%)	Mandible Number (%)
Central incisor	20 (17.7)	5 (4.4)
Lateral incisor	20 (17.7)	13 (11.5)
Canine	9 (8)	5 (4.4)
First premolar	13 (11.5)	7 (6.2)
Second premolar	12 (10.6)	6 (5.3)
First molar	1 (0.9)	1 (0.9)
Second molar	0 (0)	1 (0.9)
Total in each group	113 (100)	

TABLE 2 Implant Dimensions

Dimension	Loaded – Number (%)	
	Immediately – Case	Conventionally – Control
Length		
<13	1 (0.9)	7 (6.2)
13	15 (13.3)	25 (22.1)
14	1 (0.9)	4 (3.5)
15	20 (17.7)	30 (26.6)
16	76 (67.2)	47 (41.6)
Mean ± SD*	15.37 ± 1.1	14.68 ± 1.54
Diameter		
<3.75	9 (8)	7 (6.2)
3.75	58 (51.3)	79 (69.9)
3.8–4.2	10 (8.8)	14 (12.4)
4.3	10 (8.8)	5 (4.4)
4.5	4 (3.6)	1 (0.9)
4.7	20 (17.7)	4 (3.5)
5–6	2 (1.8)	3 (2.7)
Mean ± SD**	4.00 ± 0.43	3.84 ± 0.31

*$p = .001$.
**$p = .03$.

Immediate implantation into a fresh extraction socket was performed in 69% of the cases and in 36.3% of the controls ($p = .001$; Table 3). Bone augmentation was required more frequently in the controls (see Table 3).

Implant complications, such as swelling, inflammation, and pain, were observed in 33 (14.6%) patients. No relationship was found between complications and failure. The present study failed to show a relationship between implant survival rate and smoking, implant dimensions, and area of implantation.

Overall, implant survival rate was 96.5% (eight implants failed) (Table 4). Of the failed implants, six were immediately provisionalized and two were conventionally loaded. No statistically significant difference was found in the survival rates between groups ($p > 0.05$). Five of the six failed implants in the case group were immediately loaded implants placed in fresh extraction sockets.

DISCUSSION

The high success of dental implants has changed the quality of life for many patients. Clinicians have recognized that the challenge of providing anterior tooth replacement is in preserving the hard and soft tissue components that exist around natural teeth. For many patients, immediate implant loading is an obvious advantage. Long-term treatment that involves wearing a temporary prosthesis may be inconvenient and the reason for not choosing implant-supported restorations. The concept of immediate implant loading has recently become popular because of reduced overall treatment time, decreased patient anxiety and discomfort, high patient acceptance, and better function and esthetics.[14] Nonetheless, research and understanding in this area are confusing and sometimes contradictory.[14] The previously stipulated necessary healing time before implants can be loaded in the mandible and maxilla has been proposed as a result of clinical observations rather than biological documentation.

TABLE 3 Implantation Parameters in the Case and Control Groups

Parameter	Loading		
	Immediate – Case No. (%)	Non-Immediate – Controls No. (%)	*p* Value
Loading			
Single	60 (53.1)	35 (33.3)	= .004
Splinted	53 (46.9)	70 (66.7)	
Immediate	78 (69)	41 (36.3)	<.001
Augmentation			
Sinus/onlay	14 (12.4)	42 (37.2)	<.001
Bovine bone	32 (28.3)	52 (46)	= .009
Complications	22 (19.5)	11 (9.7)	= .058 (NS)
Failure	6 (5.3)	2 (1.8)	= .111 (NS)

NS = not significant.

TABLE 4 Failed Implants (Nonsmokers)

Case/Control	Age/Gender	Jaw (Tooth)	Implant Dimensions	Time of Failure (Months)
Case	62/F	Man (central incisor)	3.75/16	21
Case	49/F	Max (first premolar)	3.75/15	8
Case	67/F	Man (lateral incisor)	4.3/16	9
Case	74/M	Max (lateral incisor)	3.75/15	4
Case	35/F	Max (lateral incisor)	3.75/15	3
Case	30/M	Max (central incisor)	4.7/16	6
Control	56/F	Man (first molar)	3.75/10	49
Control	34/F	Max (lateral incisor)	3.75/15	20

F = female; M = male; Man = mandible; Max = maxilla.

Immediate loading protocols are becoming frequently used in implant dentistry, but the prerequisites for achieving good results and the limitations of such protocols are not fully known.[15] In a recent consensus meeting on immediate loading, it was concluded that multiple independent investigators have demonstrated that immediate/early implant loading is possible in many clinical situations. However, additional documentation is required.[15]

Histologically, immediately loaded implants placed in soft spongy bone after 2 months of healing can present mineralized tissue at the interface.[16] In a study using minipigs,[17] histomorphometric data showed that after 6 months of functional loading in the maxilla, successful immediately loaded implants performed the same as implants subjected to an unloaded healing period prior to loading. Implants loaded immediately postoperatively have a high long-term success rate of the implant-supported reconstruction. Histologic observations from different animal studies show that the interface of immediately loaded implants can have a direct bone-to-implant connection without any fibrous tissue formation.[18]

Moreover, in our recent study,[12] the survival rate of immediately provisionalized dental implants immediately placed into fresh extraction sockets was 97.6%. Thus, immediately provisionalized immediate implants can serve as a predictable procedure with a high survival rate.

There are reports that indicate that immediate loading might be a risk factor for failure of specific dental implants.[19] Successful immediate loading is based on several clinical parameters. Therefore, this treatment concept can be used successfully in daily clinical practice in properly selected cases that include only sites where good primary stability is achieved. Immediate provisional crowns should only be proposed with early loading if an appropriate initial insertion torque has been applied (>40 N).[20,21]

In the present study, immediate provisionalization was performed mostly in the anterior maxilla and mandibular incisor area. This is the result of the high esthetic demands in these regions and the need for an immediate solution for tooth loss.[22] The anterior region poses a challenge in terms of esthetic rehabilitation, especially when single implant rehabilitation is performed.[23,24] Thus, it is particularly important to preserve the bone and soft tissue.[12]

One should notice that the results of this retrospective case-control study highlight two important issues regarding the decision for immediate provisionalization: esthetics and bone quality. Most of the total tooth replacements were performed in the anterior areas that are characterized by high esthetic demands and rather good bone quality.

Although not statistically significant, a higher occurrence of failures was found in the case group, especially when provisionalized implants were immediately placed into fresh extraction sockets. This highlights the importance of case selection and the careful planning and performing of these procedures. Immediate provisionalization is a viable alternate in the right circumstances. Additional large scale, randomized controlled studies are warranted.[25,26]

CONCLUSION

In conclusion, immediate implant provisionalization achieved similar high success rates compared with the conventional, delayed approach. As immediate implant

provisionalization is mainly desired in the anterior region, the high success rates are encouraging.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare. [Correction added after online publication 24 May 2010: Conflict of Interest Statement added.]

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