Immediate Loading of Dental Implants in the Completely Edentulous Maxilla: A Clinical Report

Robert A. Jaffin, DMD[1]/Akshay Kumar, DMD[2]/Charles L. Berman, DDS[3]

Purpose: *The purpose of this article was to determine whether clinical success can be achieved with immediate loading in the completely edentulous maxilla with endosseous screw-type implants.* ***Materials and Methods:*** *The study sample consisted of 34 patients who were edentulous or about to lose all remaining maxillary teeth. The patients underwent an extensive presurgical and prosthetic workup to determine whether they qualified for the study. Sufficient osseous structure to place 6 to 8 implants with a minimum length of 8 mm was required. Provisional prostheses were fabricated either chairside on the day of implant placement or in a laboratory from an impression. The abutments and temporary restorations were placed 48 to 72 hours postsurgery.* ***Results:*** *A total of 236 implants were placed in 34 patients. Sixteen implants were lost in 11 patients; thus the survival rate was 93%. All patients subsequently received definitive maxillary restorations.* ***Discussion:*** *The major cause of implant failure appeared to be micromotion during healing. This was the result of either a non–passively fitting restoration or noncompliance (eg, eating chewing hard foods before the implants had integrated).* ***Conclusions:*** *This clinical report suggests that immediate loading of implant-supported restorations in the completely edentulous maxilla was a viable treatment alternative for this patient population.* INT J ORAL MAXILLOFAC IMPLANTS 2004;19:721–730

Key words: *dental implants, early loading, immediate loading, osseointegration*

The predictability of endosseous implants in the oral cavity has been well documented. If the implants are allowed to heal in an undisturbed fashion, bone will attach to the titanium surface.[1,2] These implants may then be restored with single-tooth prostheses or as abutments for fixed prostheses or overdentures and should function without sequelae for many years.

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Recently, animal studies and patient case series have revealed that in certain circumstances, implants may be placed into function at the time of placement, before osseointegration occurs.[3] The protocol for such cases includes placing a sufficient number of implants in bone of good density followed by rigid splinting of the implants. This procedure can prevent excessive micromotion. Brunski has shown that an endosseous implant may tolerate up to 150 μm of motion while healing.[4] However, if this threshold is exceeded, clot stability may be disrupted, leading to a fibrous attachment. In a review article, Szmukler-Moncler and colleagues stated that delayed loading was empirically based and that micromotion of less than 150 μm was well tolerated by the bone. They stated that mechanical stimulation increased bone growth and that splinting the implants decreased mechanical stress.[5]

Case series in humans have demonstrated success using immediate functional loading. Schnitman and coworkers[6] placed extra implants in the edentulous mandible and loaded them with a fixed prosthesis to protect the healing implants from the forces of a complete denture. Only 3 of 20 posterior 8-mm implants failed in later years. Tarnow and associates[7] loaded 69 implants placed in 10 completely edentulous jaws and lost only 2. Jaffin and coworkers[8] loaded machined titanium screw-type implants (Implamed, Attleboro, MA), titanium plasma-sprayed (TPS) implants (Straumann, Waldenburg, Switzerland), and sandblasted, large–grit, acid-etched (SLA) implants (Straumann) in 27 arches, 4 of which were completely edentulous maxillae. Seven of the 27 machined titanium screws placed in mandibular sites were lost. Ninety-four of 95 TPS and SLA implants placed in 19 completely and partially edentulous mandibles were successfully osseointegrated; all 27 TPS and SLA implants placed in the 4 maxillae were successfully osseointegrated.[8] Ganeles and colleagues demonstrated similar success in the completely edentulous mandible.[9] However, the literature contains few reports of immediate loading in the edentulous maxilla.[10]

The high survival rates of implants placed in the completely edentulous mandible can be attributed to numerous factors. The density of the bone is generally quite good in the anterior mandible. The anatomy of the mandible generally allows for placement of parallel implants. Splinted screw-type implants usually offer mechanical stability when placed.

Bone density is usually lower in the maxilla than in the mandible.[11] In addition, the palatal resorptive pattern of the maxilla makes good axial alignment and the parallel placement of right and left implants difficult.

The purpose of this investigation was to determine if the same predictability seen in the mandible could be achieved in the maxilla using Straumann SLA screw-type implants immediately loaded with full-arch provisional restorations.

MATERIALS AND METHODS

The study sample consisted of 34 patients ranging in age from 47 to 82 years who were referred for implant therapy in the maxilla. To be included in the study, the patients had to be in good health. Patients with diabetes were not excluded if their diabetes was under control. Although smoking was discouraged, neither smokers nor bruxers were excluded from the study.

Of the 34 patients, 2 had completely edentulous maxillae; they presented with complete dentures. The remainder had some maxillary dentition; however, because of caries and/or periodontal disease, these teeth were considered hopeless. Once it was determined that the remaining dentition was hopeless, various treatment options were considered. The risks and benefits of complete dentures, implant-supported fixed prostheses, and immediate loading were discussed with the referring clinician and patient. If periapical radiographs did not clearly establish that sufficient bone density and volume were available for immediate loading, interactive computerized tomography (CT) scans (Materialise, Columbia, MD) were obtained. Each implant had to be secured in a minimum of 8 mm of bone. If a CT scan was utilized, a minimum density of 400 Hounsfield units was considered necessary for each implant site. The CT scans also provided a 3-dimensional (3-D) view to determine the anticipated axial alignment of each implant.

Once information on the available bone had been gathered, the patient returned to the restorative dentist for a diagnostic waxup and fabrication of a surgical template and provisional restoration. Almost all patients required 6 to 8 SLA screw-type implants. If it was determined through 3-D CT analysis or by diagnostic waxup that parallelism could not be achieved, the implants were indexed and impressions were made at the time of surgery. In these cases, the laboratory selected the appropriate abutments, indexed them, and fabricated the provisional restoration. Within 2 to 3 days, the abutments, index, and provisional restoration were returned to the office of the surgeon, where the abutments were transferred and the restoration seated. The patient then returned to the restorative dentist's office for refinement of the prosthesis, occlusal adjustment, and cementation. When the implants could be placed parallel, the abutments were connected at time of surgery, and the provisional restoration was fabricated by the restorative dentist and seated on the day of surgery.

On the day of surgery, the patient was premedicated with 1 g amoxicillin unless it was contraindicated because of allergy. The mucoperiosteal tissues of the maxilla were infiltrated with a local anesthesic agent, and the teeth were extracted atraumatically. In some cases, certain teeth were left in place to help retain the surgical template or maintain the vertical dimension of occlusion. The mouth was then prepped with chlorhexidine, and the patient was surgically draped for implant placement. The implants were placed using a standard surgical protocol. First, using the surgical template, the anterior

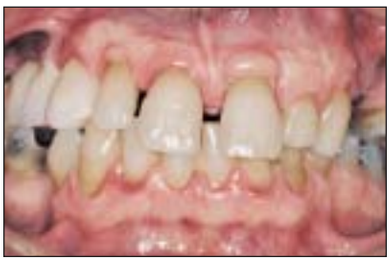


Fig 1a Hopeless maxillary dentition at presentation.

sites were drilled; care was taken to place the right and left implants parallel to one another. The posterior sites were then prepared with the template in place to ensure that the implants were parallel. At least 8 mm of the implant had to be engaged in bone, even if an extraction site was selected. Apical preparation or widening of the socket was necessary in some cases to ensure that at least 8 mm of each implant were engaged in bone. All sites were threaded. Types 1 and 2 bone were tapped to the depth of the socket.[12] Type 3 bone was tapped to within 5 mm of the apex. If abutments were placed immediately, the provisional restoration was fabricated chairside. A typical case followed through placement of the provisional restoration can be seen in Fig 1.

In cases in which the laboratory selected the abutments and fabricated the provisional restoration (ie, cases in which parallelism could not be achieved), occlusal registration was carried out prior to tooth extraction. All implants were examined, and any bone that covered the implant shoulder was removed. Impression and positioning copings were hand tightened, and the impression was made. The restorative dentist had the option of an open- or closed-tray technique (Fig 2). Long cover screws were lubricated with petroleum gel and placed. The patient was then discharged.

The impression and occlusal record were sent to the laboratory. Using a clear template of the tooth position and the articulated mounted casts, abutments were selected. They were indexed with an acrylic jig. The provisional restoration was then fabricated on the master cast (Figs 3a and 3b).

The cast with the abutments, the abutment transfer, and the provisional restoration were returned within 2 to 3 days. At this time, the patient returned to the office for the removal of the cover screws and the placement of the abutments. Any straight or solid abutments were positioned first so that the jig would have a positive seat. After the abutments were seated, they were hand tightened. No attempt was made to torque to 35 Ncm. The provisional restoration was then placed. The patient returned to the restorative dentist for refinements, occlusal adjustment, and cementation (Fig 3b).

The sutures were removed after 1 to 2 weeks. The patients were instructed to eat a soft diet for 4 weeks postsurgery. Biting anything hard or tearing food was strongly discouraged. At 1 month the patients were converted to a harder diet.

At 12 weeks the provisional restorations were removed. The abutments were torqued to 35 Ncm and radiographs were obtained to verify osseointegration. Fabrication of the definitive restoration commenced.

The data were analyzed with life tables. The data were entered manually into SPSS version 10.1 (SPSS, Chicago, IL) and checked for accuracy.

RESULTS

A total of 236 implants were loaded in 34 patients, 19 men and 15 women, between 43 and 82 years old (mean ± SD 60.03 ± 9.00) (Table 1). Sixteen implants were lost in 11 patients (Table 1); typically, the most distal implant in the arch was lost. Of the 121 placed in fresh extraction sites, 7 failed. In only 1 case did the patient lose the fixed provisional restoration during the healing phase and need to revert to a conventional complete denture. When implant loss occurred, it was usually determined at the second postoperative visit, which was 3 to 4 weeks after surgery.

Life table analyses were performed using 3-month intervals to determine survival rates of the implants. They were performed on the total population (Table 2) as well as the immediate (ie, postextraction) and nonimmediate placement groups (Tables 3 and 4). Any implants removed during the study were considered failures. Although only 7% of the implants were lost, the life table analysis demonstrated a 92% survival rate starting at 3

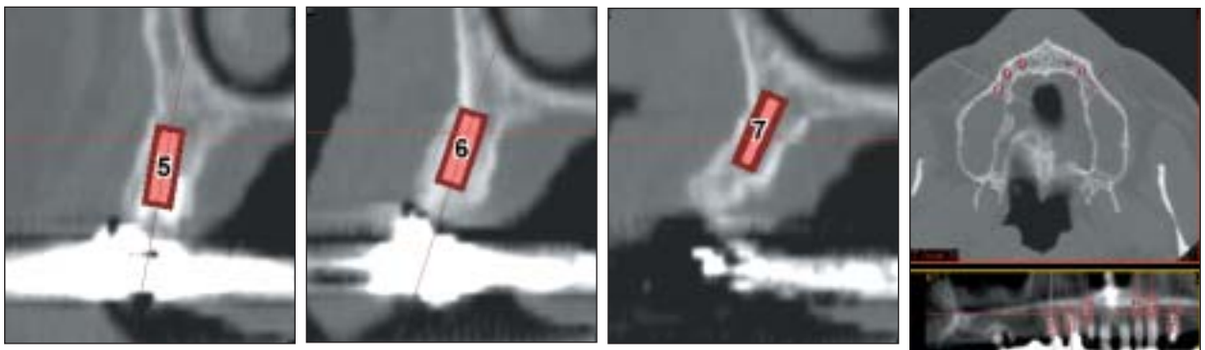


Fig 1b Axial view and reformats of right-side implant sites.

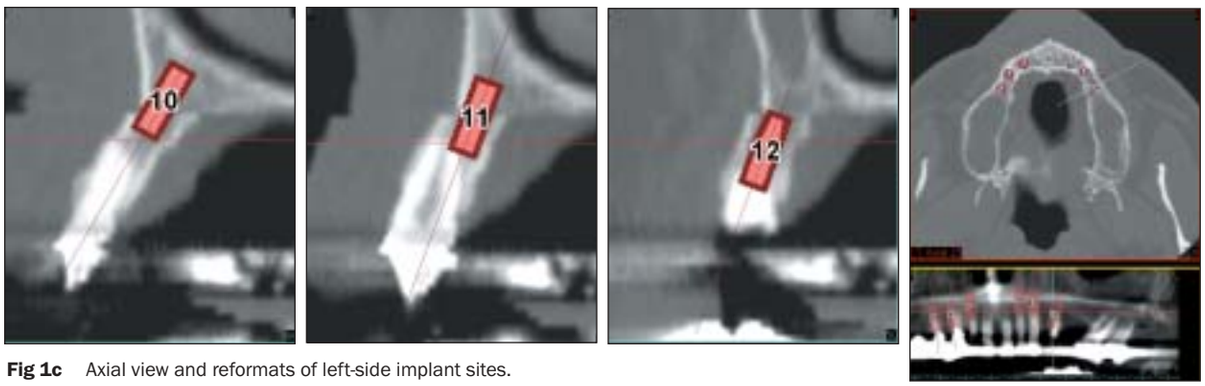


Fig 1c Axial view and reformats of left-side implant sites.

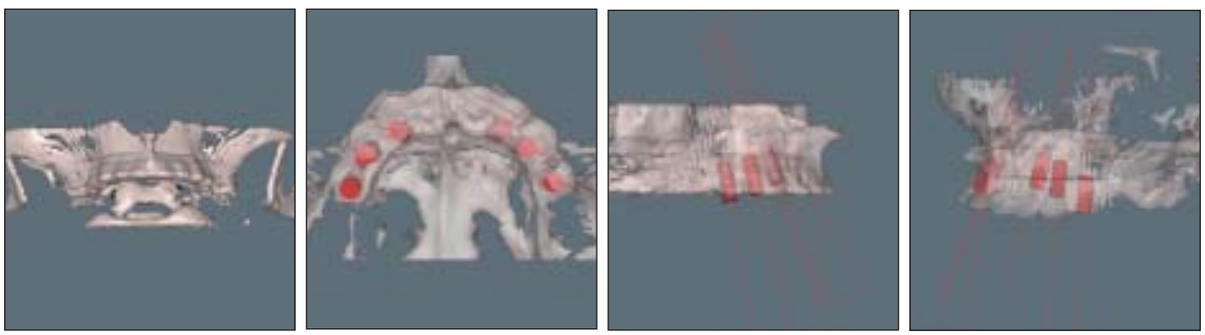


Fig 1d 3-D views of the maxilla.

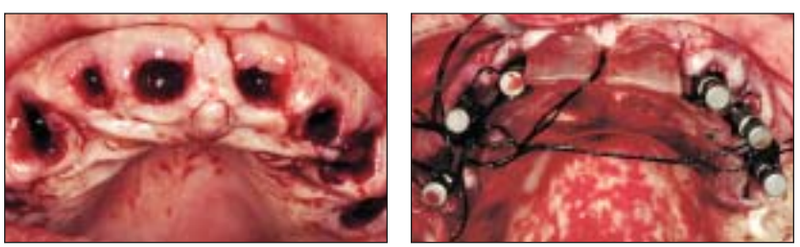


Fig 1e *(Left)* Tooth extraction sites.

Fig 1f *(Right)* Osteotomies were completed using the lingual surgical template.

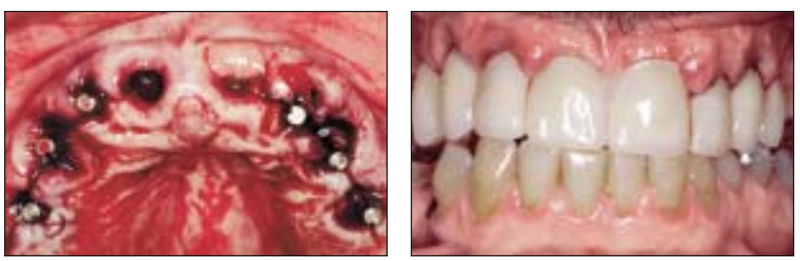


Fig 1g *(Left)* Abutments were placed on the implants.

Fig 1h *(Right)* The completed provisional restoration, which was placed in 2 sections and luted at the midline.

Fig 2a Open-tray technique.

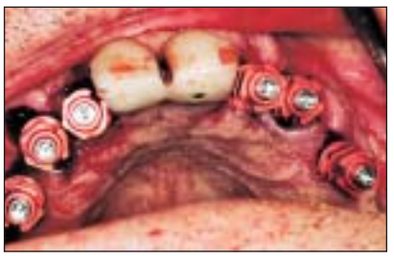
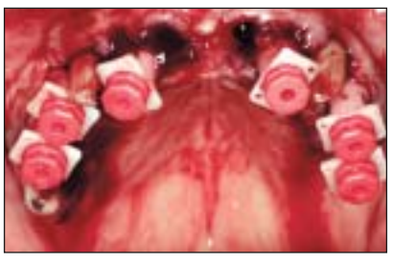


Fig 2b Closed-tray technique.



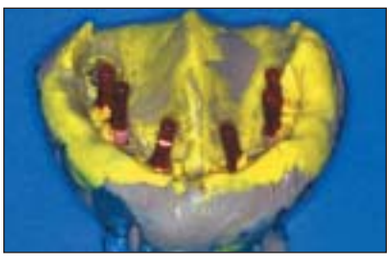
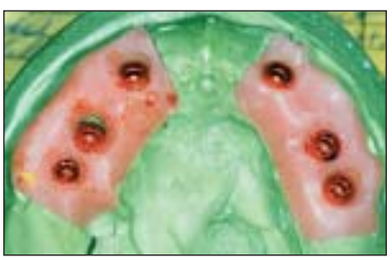
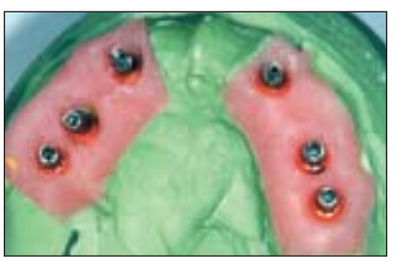


Fig 3a Impression, master cast, abutment placement, transfer guide.





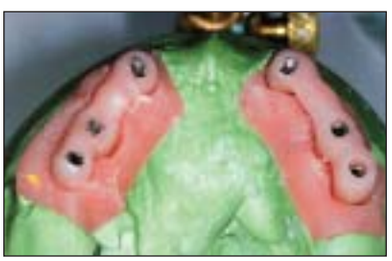
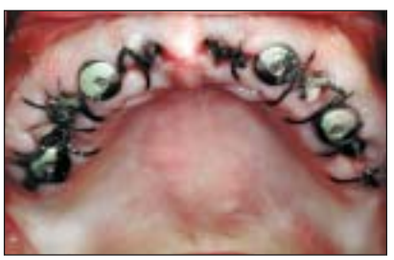
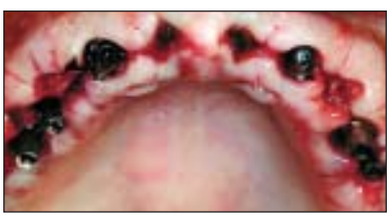


Fig 3b Forty-eight hours after implant placement. Cover screws, abutment placement, and the cemented provisional restoration.





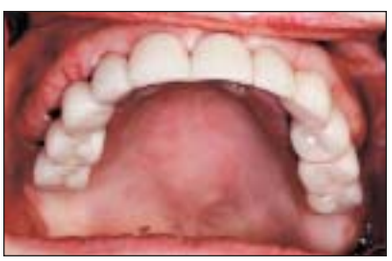


Table 1 Patient Data

Patient	Age	Sex	No. of implants	Implant sites	Extraction sites	Sites of lost implants
JS	50	M	6	5 (14), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24)	—	—
MP	55	M	8	4 (15), 5 (14), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24), 13 (25)	4 (15), 5 (14), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24), 13 (25)	—
AR	54	M	8	3 (16), 4 (15), 5 (14), 6 (13), 10 (22), 11 (23), 12 (24), 13 (25)	10 (22), 11 (23)	—
DG	49	M	7	4 (15), 5 (14), 6 (13), 8 (11), 10 (22), 12 (24), 14 (26)	12 (24)	—
KB	70	M	6	4 (15), 5 (14), 7 (12), 10 (22), 12 (24), 13 (25)	5 (14), 7 (12), 12 (24)	13 (25)
CW	52	F	8	3 (16), 4 (15), 5 (14), 7 (12), 10 (22), 12 (24), 13 (25), 14 (26)	5 (14)	7 (12)
AB	75	M	8	4 (15), 5 (14), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24), 13 (25)	5 (14), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24)	—
BF	58	F	8	4 (15), 5 (14), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24), 13 (25)	—	—
LK	64	F	8	3 (16), 4 (15), 5 (14), 6 (13), 9 (21), 10 (22), 12 (24), 13 (25)	4 (15), 5 (14), 6 (13), 9 (21), 10 (22), 12 (24)	—
EH	71	M	6	4 (15), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24)	—	—
AL	82	M	6	4 (15), 5 (14), 7 (12), 10 (22), 12 (24), 13 (25)	7 (12), 10 (22)	—
RU	67	F	8	4 (15), 5 (14), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24), 13 (25)	4 (15), 5 (14), 6 (13), 7 (12), 10 (22), 11 (23)	—
NV	66	M	8	4 (15), 5 (14), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24), 13 (25)	6 (13), 7 (12), 11 (23), 12 (24)	—
UY	59	F	8	4 (15), 5 (14), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24), 13 (25)	4 (15), 5 (14), 6 (13), 7 (12), 11 (23), 13 (25)	7 (12)
AP	47	F	6	4 (15), 5 (14), 7 (12), 10 (22), 12 (24), 13 (25)	—	10 (22), 12 (24), 13 (25)
VS	53	F	6	4 (15), 5 (14), 7 (12), 10 (22), 11 (23), 12 (24)	7 (12)	—
DD	55	M	8	3 (16), 4 (15), 5 (14), 7 (12), 9 (21), 11 (23), 12 (24), 13 (25)	—	—
KN	60	F	7	3 (16), 4 (15), 5 (14), 7 (12), 10 (22), 12 (24), 13 (25)	10 (22)	—
GC	58	M	6	4 (15), 5 (14), 7 (12), 10 (22), 11 (23), 12 (24)	4 (15), 5 (14), 7 (12), 10 (22), 11 (23)	4 (15), 5 (14)
RN	59	M	8	4 (15), 5 (14), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24), 13 (25)	4 (15), 5 (14), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24), 13 (25)	13 (25)
EC	50	F	6	6 (13), 7 (12), 8 (11), 9 (21), 10 (22), 11 (23)	6 (13), 7 (12), 8 (11), 9 (21), 10 (22), 11 (23)	—
AE	59	F	5	4 (15), 5 (14), 8 (11), 10 (22), 11 (23)	8 (11), 10 (22), 11 (23)	4 (15)
SC	55	F	6	4 (15), 5 (14), 7 (12), 10 (22), 12 (24), 13 (25)	4 (15), 7 (12), 10 (22)	—
PL	54	M	6	4 (15), 5 (14), 7 (12), 10 (22), 12 (24), 13 (25)	4 (15), 5 (14), 7 (12), 10 (22), 12 (24), 13 (25)	4 (15), 5 (14)
CR	43	F	7	4 (15), 5 (14), 6 (13), 7 (12), 10 (22), 12 (24), 13 (25)	4 (15), 5 (14), 6 (13), 7 (12), 10 (22), 12 (24), 13 (25)	—
PS	59	F	8	3 (16), 4 (15), 5 (14), 6 (13), 11 (23), 12 (24), 13 (25), 14 (26)	3 (16), 4 (15), 5 (14), 11 (23), 12 (24)	—
GE	67	M	8	3 (16), 5 (14), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24), 14 (26)	6 (13), 11 (23)	—
JC	72	M	6	4 (15), 5 (14), 7 (12), 10 (22), 11 (23), 12 (24)	7 (12), 10 (22)	—
SC	71	M	6	5 (14), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24)	6 (13), 7 (12), 11 (23)	—
LR	57	F	6	4 (15), 5 (14), 7 (12), 10 (22), 12 (24), 13 (25)	4 (15), 5 (14), 7 (12), 10 (22), 12 (24), 13 (25)	—
RP	52	M	6	5 (14), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24)	5 (14), 6 (13), 7 (12), 10 (22), 11 (23), 12 (24)	5 (14)
SA	58	F	8	4 (15), 5 (14), 6 (13), 7 (12), 9 (21), 11 (23), 12 (24), 13 (25)	5 (14), 6 (13), 11 (23), 13 (25)	9 (21)
CC	70	M	6	5 (14), 6 (13), 7 (12), 9 (21), 10 (22), 11 (23)	7 (12), 9 (21)	4 (15), 5 (14)
LS	70	M	8	3 (16), 4 (15), 6 (13), 7 (12), 10 (22), 11 (23), 13 (25), 14 (26)	4 (15), 6 (13), 7 (12), 10 (22), 11 (23), 13 (25)	—

Table 2 Life Table Analysis Using 3-month Intervals

Interval (mo)	No. of implants at start	No. of dropouts	Implants at risk	No. of failures	Interval failure rate (%)	Interval survival rate (%)	CSR (%)
0 to 3	236.0	21.0	225.5	9.0	3.99	96.01	96.01
3 to 6	206.0	59.0	176.5	7.0	3.97	96.03	92.20
6 to 9	140.0	10.0	135.0	0.0	0.00	100.00	92.20
9 to 12	130.0	13.0	123.5	0.0	0.00	100.00	92.20
12 to 15	117.0	8.0	113.0	0.0	0.00	100.00	92.20
15 to 18	109.0	11.0	103.5	0.0	0.00	100.00	92.20
18 to 21	98.0	23.0	86.5	0.0	0.00	100.00	92.20
12 to 24	75.0	8.0	71.0	0.0	0.00	100.00	92.20
24 to 27	67.0	15.0	59.5	0.0	0.00	100.00	92.20
27 to 30	52.0	6.0	49.0	0.0	0.00	100.00	92.20
30 to 33	46.0	11.0	40.5	0.0	0.00	100.00	92.20
33 to 36	35.0	0.0	35.0	0.0	0.00	100.00	92.20
36 to 39	35.0	5.0	32.5	0.0	0.00	100.00	92.20
39 to 42	30.0	6.0	27.0	0.0	0.00	100.00	92.20
42 to 45	24.0	8.0	20.0	0.0	0.00	100.00	92.20
45 to 48	16.0	0.0	16.0	0.0	0.00	100.00	92.20
48 to 51	16.0	0.0	16.0	0.0	0.00	100.00	92.20
51 to 54	16.0	0.0	16.0	0.0	0.00	100.00	92.20
54 to 57	16.0	8.0	12.0	0.0	0.00	100.00	92.20
57 to 60	8.0	8.0	4.0	0.0	0.00	100.00	92.20

CSR = cumulative survival rate.

Table 3 Life Table Analysis Using 3-month Intervals for Immediate Placement

Interval (mo)	No. of implants at start	No. of dropouts	Implants at risk	No. of failures	Interval failure rate (%)	Interval survival rate (%)	CSR (%)
0 to 3	121.0	13.0	114.5	3.0	2.62	97.38	97.38
3 to 6	105.0	32.0	89.0	4.0	4.49	95.51	93.00
6 to 9	69.0	6.0	66.0	0.0	0.00	100.00	93.00
9 to 12	63.0	3.0	61.5	0.0	0.00	100.00	93.00
12 to 15	60.0	2.0	59.0	0.0	0.00	100.00	93.00
15 to 18	58.0	10.0	53.0	0.0	0.00	100.00	93.00
18 to 21	48.0	19.0	38.5	0.0	0.00	100.00	93.00
12 to 24	29.0	6.0	26.0	0.0	0.00	100.00	93.00
24 to 27	23.0	5.0	20.5	0.0	0.00	100.00	93.00
27 to 30	18.0	6.0	17.5	0.0	0.00	100.00	93.00
30 to 33	17.0	1.0	15.0	0.0	0.00	100.00	93.00
33 to 36	13.0	4.0	13.0	0.0	0.00	100.00	93.00
36 to 39	13.0	0.0	11.5	0.0	0.00	100.00	93.00
39 to 42	10.0	3.0	10.0	0.0	0.00	100.00	93.00
42 to 45	10.0	0.0	10.0	0.0	0.00	100.00	93.00
45 to 48	10.0	0.0	10.0	0.0	0.00	100.00	93.00
48 to 51	10.0	0.0	10.0	0.0	0.00	100.00	93.00
51 to 54	10.0	0.0	10.0	0.0	0.00	100.00	93.00
54 to 57	10.0	2.0	9.0	0.0	0.00	100.00	93.00
57 to 60	8.0	8.0	4.0	0.0	0.00	100.00	93.00

CSR = cumulative survival rate.

Table 4 Life Table Analysis Using 3-month Intervals for Nonimmediate Placement

Interval (mo)	No. of implants at start	No. of dropouts	Implants at risk	No. of failures	Interval failure rate (%)	Interval survival rate (%)	CSR (%)
0 to 3	115.0	8.0	111.0	6.0	5.41	94.59	94.59
3 to 6	101.0	27.0	87.5	3.0	3.43	96.57	91.35
6 to 9	71.0	4.0	69.0	0.0	0.00	100.00	91.35
9 to 12	67.0	10.0	62.0	0.0	0.00	100.00	91.35
12 to 15	57.0	6.0	54.0	0.0	0.00	100.00	91.35
15 to 18	51.0	1.0	50.5	0.0	0.00	100.00	91.35
18 to 21	50.0	4.0	48.0	0.0	0.00	100.00	91.35
12 to 24	46.0	2.0	45.0	0.0	0.00	100.00	91.35
24 to 27	44.0	10.0	39.0	0.0	0.00	100.00	91.35
27 to 30	34.0	5.0	31.5	0.0	0.00	100.00	91.35
30 to 33	29.0	7.0	25.5	0.0	0.00	100.00	91.35
33 to 36	22.0	0.0	22.0	0.0	0.00	100.00	91.35
36 to 39	22.0	2.0	21.0	0.0	0.00	100.00	91.35
39 to 42	20.0	6.0	17.0	0.0	0.00	100.00	91.35
42 to 45	14.0	8.0	10.0	0.0	0.00	100.00	91.35
45 to 48	6.0	0.0	6.0	0.0	0.00	100.00	91.35
48 to 51	6.0	0.0	6.0	0.0	0.00	100.00	91.35
51 to 54	6.0	0.0	6.0	0.0	0.00	100.00	91.35
54 to 57	6.0	6.0	3.0	0.0	0.00	100.00	91.35

CSR = cumulative survival rate.

months. The survival rates for the immediate and nonimmediate placement groups were very similar.

All 34 patients successfully completed implant therapy and were restored with fixed prostheses. Thirty patients received either 6 or 8 implants (15 in each group), 3 patients received 7 implants, and 1 patient received 5 implants (see Table 1). The implants were evenly spaced throughout the maxilla. The most distal site was either the second premolar or first molar. No teeth were cantilevered in the provisional phase.

DISCUSSION

This investigation demonstrated that when 6 to 8 implants are placed in the completely edentulous maxilla and loaded at the time of placement, integration can occur. Certain criteria must be met to achieve this result. The most important are bone quality and a passively fitting provisional prosthesis. If implants are placed in soft bone, initial stabilization can be compromised, leading to micromotion and failure. Immediate stabilization and splinting of the implants help reduce excessive micromotion of the implants.[4] A prosthesis that is ill-fitting may become loose, resulting in increased stress on the implants. This can also lead to excessive micromotion and loss of an implant.

An unbalanced occlusal scheme or a noncompliant patient (eg, one who masticates on hard foods) can contribute to the loosening of the prosthesis, which can result in implant loss. Screw-retained passively fitting restorations may be superior to cement-retained ones in respect to this problem, because they are less likely to loosen. If a cemented restoration is desired, the abutments should be long enough to provide adequate retention.

The ability of implants to function in bone depends on numerous factors. For years it was thought that implant length was vital for integration and establishing a proper "crown-to-root ratio." However, it has been demonstrated using finite element analysis that both vertical and horizontal forces are received in crestal bone and are not transmitted down the length of the implant.[4,13,14] In fact, ten Bruggenkate and associates showed a 93.8% success rate using 6-mm ITI implants over 6 years.[15] Therefore, it was presumed that only 8 mm of bone were necessary before a site could be considered for immediate loading. This factor played a key role in the decision to place implants into extraction sockets and load them before bone filled the site.

Implant surfaces have changed over the years. Initially, the machined surface was accepted as the gold standard. However, roughened surfaces such as Straumann's TPS or SLA surfaces can osseointegrate faster,

with subsequent higher torque removal values, greater bone-to-implant contact, and shorter healing times.

One could hypothesize that rough-surfaced implants would be a good choice for immediately loaded implants to speed osseointegration and help ensure restoration success.[16]

Smoking was not defined as an exclusion criterion because surface-modified implants were selected. Kumar and colleagues demonstrated no difference in success rates between smokers and nonsmokers in achieving osseointegration with Straumann SLA and TPS screw-type implants.[17]

The implant/abutment interface can play a role in bone loss below the microgap and in the loosening of components. Hansson demonstrated the differences between a flat-top (external-hex) and conical (internal-fit) implant/abutment interface.[18] With the flat-top interface, both horizontal and vertical forces are received at the crest of bone. In a conical interface, the horizontal forces are received at the crest, but the vertical forces are absorbed in the implant/abutment interface. This separation of forces creates a strong system.

Extensive preoperative planning and treatment coordination are necessary for treatment success. In this series of patients, the surgeon determined through interactive CT whether sufficient bone volume was present to anchor 6 to 8 implants. It was decided that the implants should be placed in at least 8 mm of bone of adequate density while maintaining an optimal axial inclination. The restorative dentist determined proper tooth position at the appropriate vertical dimension in a diagnostic waxup. This was translated to the surgeon with a surgical template. Because of the difficulty in obtaining parallelism between left and right sides, it was decided during the planning phase whether the restoration would be screw retained or cemented and also whether the provisional restoration would be fabricated chairside or in the laboratory.

Since obtaining parallelism of the implants in the edentulous maxilla was not possible in many patients, provisional prostheses were fabricated and luted in the midline. The provisional prostheses remained in place until the status of osseointegration was checked at 12 weeks. Twelve weeks was considered the standard healing time for SLA screw-type implants because most of the patients had implants placed in extraction sockets.

Among the benefits of immediate loading of dental implants are patient satisfaction and shorter treatment time. In addition, patients do not have to wear removable prostheses. Serial extractions, multiple surgical visits, and conversion from denture or tooth-supported provisional prostheses to implant-supported provisional protheses are no longer necessary. It has also been demonstrated that mechanical stimulation to the bone around healing implants can lead to increased bone-to-implant contact at earlier intervals—ie, that immediate loading can stimulate faster healing.[4]

CONCLUSION

This investigation demonstrated that when 6 to 8 SLA screw implants are placed in the maxilla and are loaded immediately, osseointegration can occur predictably. Extensive presurgical planning and precision in implant placement and provisional restoration fabrication are necessary to achieve these results.

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