Retrospective Multicenter Evaluation of Tapered Implant With a Sandblasted and Acid-Etched Surface at 1 to 4 Years of Function

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Purpose: *The aim of this retrospective study was to evaluate the cumulative survival rate of tapered implant with a sandblasted and acid-etched surface placed in edentulous patients.*

Materials and Methods: *A retrospective study was performed by evaluating MIS seven implants consecutively placed from December 2004 to January 2008. Patient records were reviewed to determine gender, age at implant placement, implant location, prosthesis type, marginal bone loss according to treatment procedure, number of implants, and number of failed implants. The survival rate of the implants was analyzed, and radiographic evaluation was performed.*

Results: *A total of 294 implants were placed in 92 patients at the 3 centers. The observation period after implantation ranged from 22 to 59 months, with a mean of 38 months. The cumulative survival rate of MIS seven implants was 97.3%. After 1 year of functional loading, the mean marginal bone loss was 0.33 mm.*

Conclusion: *This retrospective, multicenter study demonstrates that this dental implant system gives clinically reliable results. (Implant Dent 2011;20:280–284)*

Key Words: implant survival rate, implant failure, retrospective multicenter analysis

Osseointegrated implants have become a predictable treatment alternative in partially or fully edentulous patients and for single tooth replacements. Many studies have reported between 95% and 98% survival rates using various rough-surfaced implant systems, including the Brånemark System (Nobel Biocare AB, Göteborg, Sweden), ITI (Straumann Institute, Waldenburg, Switzerland), 3i (Implant Innovations, West Palm Beach, FL), and Astra Tech (Astra Tech AB, Mölndal, Sweden).[1–8]

However, reports on the MIS seven implant system (MIS Implants Technologies Ltd., Shlomi, Israel) are rare.[9,10] The MIS seven implant used in this study is a tapered, self-tapping implant with a sandblasted and acid-etched (SLA) surface. Tapered and self-tapping implants can improve primary stability by compressing bone during insertion and simplify the surgical technique because of the elimination of the tapping procedure. The implant body that is used in this study has microthreads that are located in the implant's neck. These microthreads can provide better primary stability in the crestal area. Bratu et al[10] reported that implants with a roughened neck surface and microthreads are more resistant to marginal bone loss during the first phases of healing, as compared with implants with polished necks. The aim of this retrospective study was to evaluate the cumulative survival rate of MIS seven implants placed in edentulous patients.

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MATERIALS AND METHODS

Patient Selection

A retrospective study was performed by evaluating MIS seven implants consecutively placed from December 2004 to January 2008. The study included 92 patients (41 men and 51 women), aged from 27 to 71 years (average age of 42 years), who were treated with a total of 294 implants at the Department of Oral and Maxillofacial Surgery, Daegu Catholic University Hospital and 2 private practices (Table 1).

The patient's medical history was recorded, and patients with immunological diseases, uncontrolled diabetes

Table 1. Patient Characteristics

Characteristics	Men	Women
No. of implants	117 (38.8%)	177 (60.2%)
No. of patients	41 (44.6%)	51 (55.4%)
Mean age (y)	43	41
Range of age (y)	29 to 71	27 to 68

mellitus, or significant cardiac disease were excluded from this study. Because most patients had inadequate quality and quantity of alveolar bone to maintain implant stability, hard tissue augmentation techniques, such as horizontal augmentation including guided bone regeneration (GBR) and ridge splitting as well as vertical ridge augmentation including GBR and maxillary sinus augmentation, were needed in the implantation areas. Patients who needed veneer (block bone) grafting, interpositional inlay grafting, or distraction osteogenesis were excluded. The hard tissue augmentation techniques used in this study were performed simultaneously with implant placement in all cases.

Surgical Procedure

The operative protocol for implant placement was as follows. Three clinicians, each with >10 years of implant experience, performed all surgical procedures. The same operative protocols applied at all 3 centers. An intravenous antibiotic or intramuscular antibiotic (Flumarin, 500 mg i.v.; Ildong Pharmaceutical Co., Korea) was injected 1 hour before surgery, and all patients were placed under local anesthesia (Septanest with adrenaline 1:100000; Septodont, Saint Maur Des Fosses, France). Implants were placed into both fresh extraction and healed edentulous areas. Implant sites were prepared with a controlled speed drilling, using sterile saline irrigation. Implants were then inserted using a handpiece or by manual force.

If insertion torque values were ≥30 Ncm, healing abutments were placed using a 1-stage procedure, and an immediate provisional restoration, without occlusal or lateral contact, was performed on implants placed in anterior dentition. If not, cover screws were placed using the conventional 2-stage surgical technique.

Prosthetic Procedure

After a healing period of 3 to 4 months in the mandible and 5 to 7 months in the maxilla, functional loading was done using provisional restoration. The final restoration was performed on an individual basis after clinical osseointegration and soft tissue maturation (Fig. 1). Implants were used to support single tooth prosthesis, fixed partial prosthesis, and overdenture.

Radiographic Evaluation

Periapical radiographs were taken, using the standardized long-cone paralleling technique, at the initial time of loading and at 1 year of functional loading (Fig. 2). Two radiographs were compared to evaluate the marginal bone level and the distance from the interface between the implant body and the abutment to the level of the bone on the mesial and distal implant surfaces. The marginal bone loss was calculated using the following formula: marginal bone loss = radiographic bone loss × known implant length/radiographic implant length.

Criteria for Implant Survival and Date Analysis

The survival of the implants was evaluated by Buser's criteria.[11]

1. Absence of persistent subjective complains such as pain, foreign body sensation, and/or dysesthesia.
2. Absence of periimplant infection with suppuration.
3. Absence of mobility.
4. Absence of continuous radiolucency around the implant.

Data collection was performed by a single investigator, who was not involved in the treatment of patients. Patient records were reviewed to determine gender, age at implant placement, implant location, prosthesis type, marginal bone loss according to treatment procedure, number of implants, and number of failed implants.

The survival rate was analyzed using the χ^2 test. All statistical analysis was performed using SPSS/PC+ (version 14.0; SPSS Inc., Chicago, IL), and a cutoff P value of 0.05 was adopted for all the statistical analyses.

RESULTS

The observation period after implantation ranged from 22 to 59 months, with a mean of 38 months, and the average loading time was 31 months. The overall cumulative survival rate of the implants was 97.3%. The cumulative survival rate is presented in Table 2. Among the 8 failed implants, 6 failed in the first year after placement, and early failures (before functional loading) were more common (n = 6) than late failures (n = 2). Implant site distribution is shown in Table 3. Among the 294 implants, 175 were placed in the maxilla and 119 in the mandible. The survival rate was 96% in the maxilla and 99.2% in the mandible. The most frequent implant placement site in the maxilla and the mandible was the molar area. The lowest survival rate was observed in the maxillary molar site (94.9%). However, no statistical difference was observed between maxillary and mandibular implant survival rates ($P > 0.05$). Implant length and diameter are shown in Table 4. The most frequently used lengths of implants were 11.5 and 13 mm. The majority of the implants were 3.75 mm in diameter (69.7%). In this study, a correlation between implant length and diameter to implant survival rate was not recognized ($P > 0.05$). Implants were used to support 74 single tooth prostheses, 203 fixed partial prostheses, and 9 overdentures. There was no statistical difference between survival rate and prosthesis type, because only 2 implants failed after final restoration ($P > 0.05$).

Two hundred and fourteen implants (72.8%) were placed in regenerated defective bone and 7 of these failed (96.7% survival). Among the 7 failures, 5 implants were placed after maxillary sinus augmentation (94.1% survival) and 2 after horizontal ridge augmentation (98.1% survival). No failure was observed after vertical ridge augmentation. Twenty-six implants were placed immediately after extraction; 100% survival rate was observed. Fifty-four implants (18.4%) were placed in normal bone and 1 failed (98.1% survival) (Table 5). However, treatment procedure did not

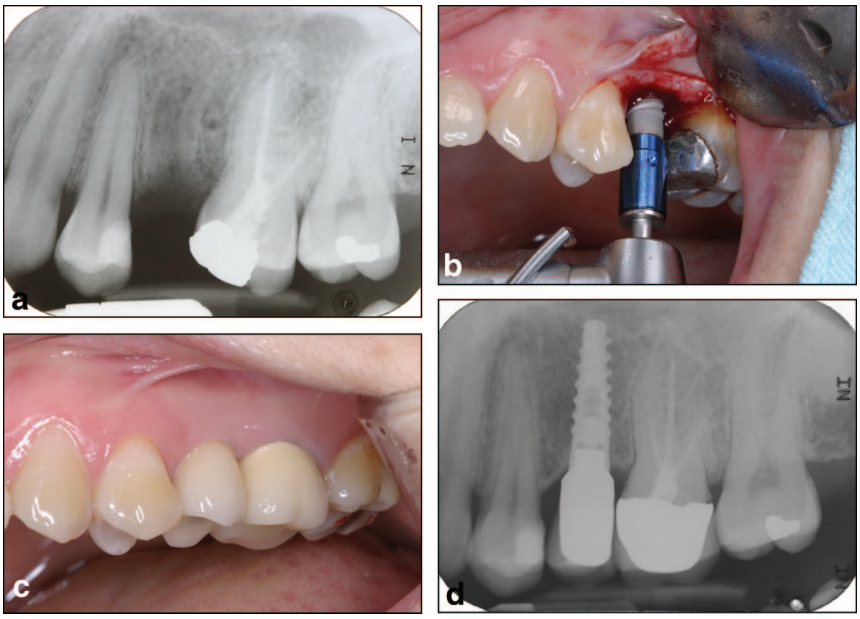

Fig. 1. a, Initial periapical radiograph. **b,** Implant placement using handpiece. **c,** The final prosthesis was fabricated with the porcelain-fused to metal crown. **d,** Periapical radiograph taken 12 months after loading.

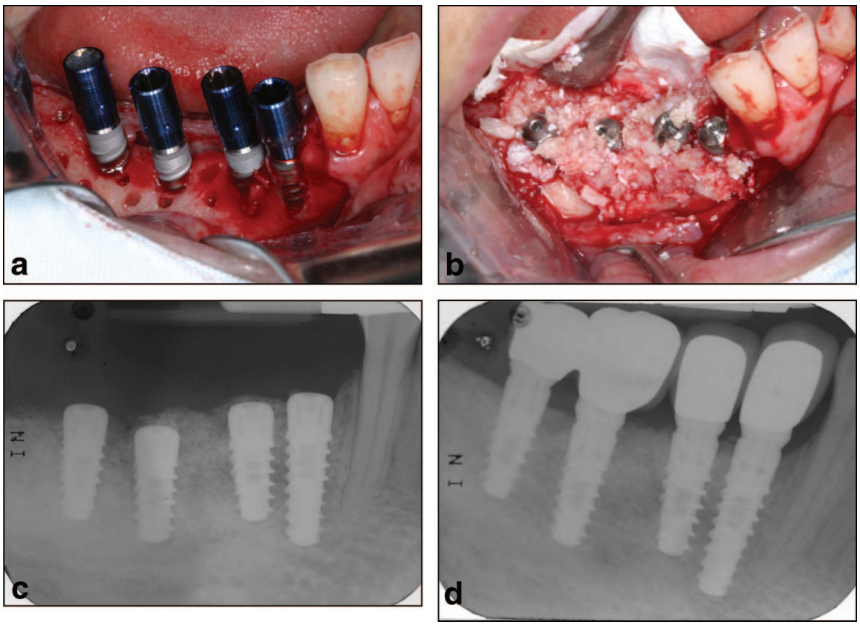

Fig. 2. a, Clinical view of MIS implants in atrophic posterior mandibular area. **b,** Allograft and resorbable membrane were used for vertical ridge augmentation. **c,** Periapical radiograph at implant placement. **d,** Periapical radiograph taken 12 months after loading.

Table 2. Cumulative Survival Rates

Interval (mo)	Implants at Start of Interval	Failed Implants	Cumulative Survival Rate (%)
1 to 12	294	6	97.9
12 to 24	288	2	97.3
24 to 36	286	0	97.3
36 to 48	286	0	97.3
48 to 60	286	0	97.3

Table 3. Survival Rates by Anatomic Location

Implant Location	Total No. of Implants	No. of Failures (Survival Rate)
Maxilla		
Anterior	14 (4.8%)	0 (100%)
Premolar	43 (14.6%)	1 (97.7%)
Molar	118 (40.1%)	6 (94.9%)
Mandible		
Anterior	9 (3.1%)	0 (100%)
Premolar	34 (11.5%)	0 (100%)
Molar	76 (25.9%)	1 (98.7%)

Table 4. Implant Characteristics

Implant Characteristics	Total No. of Implants	No. of Failures (Survival Rate)
Length		
10 mm	45 (15.3%)	1 (97.8%)
11.5 mm	76 (25.9%)	3 (96%)
13 mm	114 (38.7%)	3 (97.4%)
16 mm	59 (20.1%)	1 (98.3%)
Diameter		
3.75 mm	205 (69.7%)	4 (98%)
4.20 mm	69 (23.5%)	2 (97.1%)
5.0 mm	20 (6.8%)	2 (90%)

appear to influence the survival rate ($P > 0.05$). After 1 year of functional loading, the mean marginal bone loss was 0.29 ± 0.9 mm for implantation in normal bone, 0.32 ± 1.3 mm for immediate placement after extraction, 0.30 ± 1.7 mm for horizontal ridge augmentation, 0.43 ± 1.8 mm for vertical ridge augmentation, and 0.37 ± 1.5 mm for maxillary sinus augmentation. However, treatment procedure did not appear to influence the marginal bone level ($P > 0.05$).

DISCUSSION

In this study, no statistical difference was observed between maxillary and mandibular implant survival rates. However, several studies have reported lower survival and success rates for implant placement in the posterior maxilla compared to that in other areas of the mouth.[12,13] Early machine-surfaced implants showed lower cumulative implant survival rates in the maxilla.[14] In recent years, various rough surface implants have been improved to increase bone-

Table 5. Survival Rates by Treatment Procedure

Treatment Procedure	Total No. of Implants	No. of Failures (Survival Rate)
Implantation in normal bone	54 (18.4%)	1 (98.1%)
Immediate placement after extraction	26 (8.8%)	0 (100%)
Horizontal ridge augmentation	105 (35.7%)	2 (98.1%)
Vertical ridge augmentation	23 (7.8%)	0 (100%)
Maxillary sinus augmentation	86 (29.3%)	5 (94.1%)

implant contact, and many studies have reported higher survival and success rates with rough surface implants in the maxilla.[5,15]

According to the treatment procedure, failure rates in normal bone and in the ridge augmentation sites were similar (1.9% and 1.6%, respectively). The highest failure rate was observed after maxillary sinus augmentation (5.9%). Two of these 5 failures occurred in 1 patient, who had a history of other implant failures. The majority of failed implants were placed in insufficient residual bone, so it was impossible to achieve sufficient implant stability. However, there was no statistically significant difference between these groups. The results of this study were similar to other studies reporting high survival rates (93%–98%) after maxillary sinus augmentation.[16–18] Aghaloo et al[19] reported that the long-term clinical success/survival of implants placed, regardless of graft material used, compared favorably to implants placed conventionally, with no grafting procedure.

After 1 year of functional loading, the mean marginal bone loss was 0.33 mm, and the highest marginal bone loss was observed after vertical ridge augmentation. However, there were no statistically significant differences between marginal bone loss and treatment procedure. The results of this study were comparable to other studies reporting high success rates. Simion et al[20] reported a cumulative success rate of 97.5% for 123 implants placed at the time of, or after, vertical ridge augmentation. Similar findings were reported by Urban et al[21] who also reported that success and survival rates of implants placed in vertically augmented bone with the GBR technique appear similar to implants placed in native bone under the same loading conditions. However, because the number of implants was low in this study, further evaluation may be necessary to achieve optimal treatment results.

No failure was observed for MIS seven implants placed in immediate extraction sites. Immediate implantation in extraction sites can no longer be considered an experimental technique. Various studies have reported high success rates that are comparable to delayed implantation.[22,23] Grunder et al[24] reported that there was no difference whether an implant was placed immediately after tooth extraction or after allowing several weeks of soft tissue healing. In this study, immediate prosthetic restoration without occlusal contact was preferred in the anterior dentition. Crespi et al[25] reported that immediate and delayed loading of implants placed in fresh extraction sockets in the maxillary esthetic zone showed no significant clinical or radiographic differences.

The MIS seven implant used in this study is a tapered, self-tapping implant with a SLA surface. Tapered designs can facilitate immediate implantation after extraction of teeth, as the design more closely approximates natural tooth root morphology than do cylindrical implant designs.[26–28] Also, when the tapered implants were placed in low-density bone, such as in fresh extraction sockets, the bone was compressed and the primary stability of the implant increased.[29] Primary implant stability is a prerequisite for successful osseointegration.[30,31] Lack of primary stability will result in fibrous encapsulation of the implants, leading to implant failures.[32] Also, rough surface implants lead to enhanced osseointegration when compared with machined titanium surfaces.[33] Various studies have reported high survival rates with the SLA surface implants.[34–36] Nelson et al[37] reported that SLA implants allowed osseointegration for a shortened unloaded healing period of 6 weeks for mandibular implants and 12 weeks for maxillary implants.

In this retrospective study, no standardized follow-up protocol was implemented at the 3 centers. Within the limitations of this study, the cumulative survival rate of MIS seven implants was similar to other studies that report high survival rates with other implant systems.

CONCLUSION

A total of 294 implants were placed in 92 patients. The overall cumulative survival rate of the MIS seven implants was 97.3%. Favorable clinical outcomes were observed for up to 59 months of follow-up. Therefore, this retrospective study demonstrates that this dental implant system gives clinically reliable results.

Disclosure

The authors claim to have no financial interest in any company or any of the products mentioned in this article.

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