

ITI Implant Use in Private Practice: Clinical Results with 5,526 Implants Followed Up to 72+ Months in Function

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Purpose: To evaluate the success and failure rates over time of ITI implants placed in 3 private practices and used in a variety of clinical situations. **Materials and Methods:** ITI solid-screw implants ($n = 5,526$) were placed in 3 private practices and restored by a variety of clinicians. Numerous clinical scenarios were treated with the implants, which were in function for between 0 and 72+ months. **Results:** After 72+ months the cumulative success rates were 94.8% for maxillary implants and 97.5% for mandibular implants. The overall cumulative implant success rate was 96.1%. Implants that failed to osseointegrate were included in the data as failures in the 0- to 12-month interval. The criteria of Albrektsson and associates were used to assess implant success or failure. **Discussion:** The results, which were achieved in conjunction with numerous restorative clinicians, were comparable to those reported by other authors. The clinical viability of ITI implant use was thus reinforced. **Conclusion:** ITI solid-screw implants were a predictable treatment modality in 3 private practices for a variety of clinical applications. *INT J ORAL MAXILLOFAC IMPLANTS* 2004;19:408–412

Key words: dental implants, implant-supported dentures

The predictability of attaining osseointegration when utilizing titanium basket, cylindrical, or screw-type implants of various designs and surface topographies has been well established in the dental literature.^{1–8} The continued evolution of implant designs, the development of various implant restorative modalities, and the maturation of clinician understanding of the diagnostic and technical prerequisites for predictable long-term implant success have resulted in the successful use of implant-supported restorations for a variety of clinical situations.

The ITI solid-screw implant (Straumann, Waldenburg, Switzerland), based upon the original work of Sutter and colleagues,¹ and modifications to the initial design throughout the years⁹ have demonstrated the capacity for predictably achieving osseointegration and for successful restorations in various clinical situations.^{7–16} There is a paucity of large-scale studies reporting the success and failure rates

of implants placed in a clinical practice setting and restored by a variety of clinicians. This article retrospectively examined implant success and failure rates following therapy carried out in 3 private practices under such conditions.

MATERIALS AND METHODS

Patients

Following a thorough review of the patients' medical histories, patients were deemed unsuitable to receive implant therapy if they met any of the following criteria:

1. Uncontrolled diabetes, immune diseases, or other contraindicating systemic conditions
2. Radiation therapy in the head and neck region in the 12-month period prior to the proposed therapy
3. Chemotherapy in the 12-month period prior to the proposed therapy
4. Uncontrolled periodontal disease and/or unwillingness to undergo needed periodontal therapy around remaining teeth
5. Severe psychologic problems
6. Unwillingness to commit to a long-term post-therapy maintenance program

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Procedure

A complete examination of the oral hard and soft tissues was carried out for each patient, and an overall dental treatment plan was formulated in conjunction with the treating restorative dentists. Panoramic radiographs were obtained for all patients, as were computerized tomography (CT) scans when clinically advantageous. Diagnostic casts, waxups, and surgical guides were also utilized as needed.

The authors placed 5,526 ITI titanium plasma-sprayed (TPS) and sandblasted, large-grit, acid-etched (SLA) implants in patients ranging in age from 17 to 85 years. All surgical therapy and preoperative and postoperative measurements were recorded by the authors. Yearly radiographs were taken by dental assistants and were exposed using a Rinn kit (Dentsply/Rinn, Elgin, IL) to standardize the radiographs as well as possible in a clinical practice setting. The authors assessed bone level maintenance or changes in all instances.

All implants were consecutively placed following accepted ITI protocol. Implants were not counter-sunk but rather protruded approximately 1.8 or 2.8 mm from the crest of the residual ridge following placement. This decision was influenced by tissue thickness and quality and interarch space.

Postoperative management included chlorhexidine rinses (Peridex; Zila, Phoenix, AZ) twice a day for 21 days, 500 mg of amoxicillin 3 times a day for 10 days (400 mg of enteric-coated erythromycin 3 times a day for 10 days was given to penicillin-sensitive patients), 400 mg of ibuprofen or etodolac 3 times a day for 5 days unless medically contraindicated, and pain medication (Tylenol with Codeine III; Ortho-McNeil Pharmaceutical, Raritan, NJ, or Percocet; Du Pont, Wilmington, DE) as needed.

Following surgery, patients were allowed to use removable prostheses only for esthetic purposes. Explicit instructions were given to all patients not to ingest liquids or solids with removable prostheses in place. At the suture removal visit removable prostheses were adjusted, relined, or replaced as necessary. Patients were again told to use these prostheses only for esthetic purposes. Patients were told not to eat or drink with the removable prosthesis in place for 6 weeks postimplant placement.

Table 1 lists the number of implants placed in each private practice. All patients were seen at least every 6 months postsurgery for maintenance care. Radiographs were obtained at yearly intervals and compared to those taken at the time of implant restoration.

Assessment of Osseointegration

Implants were deemed successful if they met the following criteria, first elucidated by Albrektsson and colleagues¹⁷:

Table 1 Distribution of Implant Placement by Practice

Practice	No. of implants placed
PAF	2,609
JV	2,395
BB	522

- The implant was immobile. Splinted prostheses were removed at maintenance visits to assess the immobility of each implant.
- There was no pain or suppuration around the implant.
- There was no evidence of peri-implant radiolucency.

In addition to these criteria, no radiographic evidence of progressive crestal osseous loss could be noted around the implant after the first year in function.

Both absolute and cumulative success and failure rates were calculated. If an implant failed to achieve osseointegration prior to restoration or within 12 months of restoration, it was deemed a failure in the 0- to 12-month group. Cumulative failure rates were calculated and a life table was compiled using the formula of Babbush and coworkers¹⁸:

$$\text{NCFR} = \text{PCFR} + \frac{\text{IFR} \times 100 - \text{PCFR}}{100}$$

where NCFR represents the new cumulative failure rate, PCFR the previous cumulative failure rate, and IFR the interval failure rate (percent failure in the interval). The IFR is defined as the number of failed implants during the interval divided by the number of implants at the beginning of the interval.

RESULTS

ITI implants (n = 5,526) were placed in 3 clinical practices (Table 1), in all areas of the mouth. Of these implants, 31 implants had failed to osseointegrate and were mobile at the time of abutment connection. These implants were removed and were considered failures in the 0- to 12-month interval (Table 2). Eighteen maxillary implants and 13 mandibular implants were mobile at the time of implant uncovering. Six of the 18 failures in the 13- to 24-month period (5 in the maxilla and 1 in the mandible) were associated with untreated parafunctional habits. Significant parafunctional habits were defined as clinical scenarios in which progressive marked occlusal wear was noted, the patient voiced a complaint of muscle

Table 2 No. of Implants Placed and No. of Failures

	Mo. after abutment connection						Total
	0–12	13–24	25–36	37–48	49–60	61–72+	
Maxilla	848 (44)	664 (12)	498 (10)	324 (5)	235 (4)	101 (0)	2670 (75)
Mandible	923 (24)	739 (6)	473 (6)	269 (4)	304 (2)	148 (0)	2856 (42)
Total	1771 (68)	1403 (18)	971 (16)	593 (9)	539 (6)	249 (0)	5526 (117)

The number of failures in a given period is in parentheses. Implants that failed to osseointegrate are included in the failures during the 0- to 12-month interval.

pain in combination with tightness and muscle fatigue upon waking, the patient acknowledged a consistent bruxing habit throughout his or her waking hours, or a combination of the above. Three of the implant failures in the 25- to 36-month period were associated with untreated parafunctional habits. Two of the maxillary implant failures in the 25- to 36-month time period were terminal abutments for long-span fixed splinted prostheses in the maxillary posterior regions. Three of the mandibular failures in the 37- to 48-month period occurred in a patient who began chemotherapy approximately 5 months before implant failure. These implants had demonstrated success under function until this time. Two of the implant failures in the 37- to 48-month period were implants that were clinically stable but demonstrated progressive crestal bone loss. The 4 maxillary failures in the 49- to 60-month period occurred in a patient who was not seen for maintenance care for 18 months because of patient noncompliance. This patient returned with a severe parafunctional habit that had not been discernable previously and heavy plaque and calculus accumulations.

From a clinical application standpoint, the absolute success rates of the implants (Table 3) ranged from 80% for implants used for orthodontic anchorage (10 implants) to 100% for implants supporting screw-retained fixed prostheses, implants supporting screw-retained implant/tooth-supported prostheses, and implants supporting cement-retained pier abutments (56 implants).

The cumulative success rate after 72+ months in function was 94.8% for maxillary implants and 97.5% for mandibular implants—98.8% for all implants placed. If the 31 implants that failed to osseointegrate before restoration were removed from the statistics, the cumulative success rate for implants in function would be 99% for maxillary implants in function, 99.6% for mandibular implants in function, and 99.3% for all implants in function (Table 4). While this calculation should in no way be interpreted as a valid assessment of cumulative success rates when compared with the calculations that include implants mobile at uncovering, the 99.3% success rate of immobile implants, once placed in

function, underscores the predictability and versatility of these implants in a clinical setting. It is important to note that these success and failure rates are only an evaluation of implants in function, ie, implants that attained osseointegration.

No correlation was noted between bone quality or location in the arch and the incidence of implant failure to achieve osseointegration. None of the implants that failed to achieve osseointegration negatively affected adjacent implants.

DISCUSSION

The success rate of these implants with regard to the attainment of osseointegration (99.3%) and remaining in function over time (98.8%) is in agreement with the predictability reported with a number of titanium implant designs from various manufacturers in both partially and completely edentulous patients.^{2–6,13,19–30} As with all retrospective studies documenting success and failure rates and the reporting of clinician experiences from the initial use of a given implant system to the present, the overall success rate would likely be much higher if implants placed during the “diagnostic and treatment planning learning curve” of the authors were excluded. In recent years, understanding of the capabilities and limitations of osseointegrated implants in function has significantly evolved and matured. The role of excessive force in the failure of osseointegrated implants in function is now better recognized than it was during the early clinical utilization of osseointegrated implants. Such an understanding had a significant effect on endosseous implant utilization with regard to the number and distribution of implants placed and the utilization of various restorative protocols.

The advent of predictable regenerative therapeutic procedures has also afforded clinicians the ability to effect more ideal implant placement, theoretically better directing functional forces along the long axis of the implant, and allowing the fabrication of more esthetic and more easily cleansed restorations. The greatly increased number of restorative options has further widened the

Table 3 Absolute Failure and Success Rates for Implants by Clinical Application

Indication	Implants placed	Implants removed	Absolute failure rate (%)	Absolute success rate (%)
Single-tooth	2,717	31	1.1	98.9
Cement retained	2,615	30	1.1	98.9
Screw retained	102	1	1.0	99.0
Implant-supported fixed prostheses	922	9	0.98	99.1
Cement retained	889	9	1.0	99.0
Screw retained	33	0	0.0	100.0
Implant/tooth-supported fixed prostheses	33	1	5.0	95.0
Cement retained	31	1	3.2	96.8
Screw retained	2	0	0.0	100.0
Pier abutments (cement retained)	21	0	0.0	100.0
Orthodontic anchorage	10	2	20.0	80.0
Implant-supported removable partial prostheses	71	6	8.5	91.5
Maxillary overdentures	681	27	4.0	96.0
Mandibular overdentures	482	15	3.1	96.9
Full-arch fixed prostheses	589	27	4.4	95.4
Cement retained	518	19	3.5	96.5
Screw retained	71	8	11.3	88.7
Total	5,526	118	2.1	97.9

Table 4 Cumulative Implant Success and Failure Rates

Mo. after abutment connection	Implants at beginning of interval	Failures during interval	Internal failure rate (%)	Cumulative failure rate (%)	Cumulative success rate (%)
Maxilla					
0-12	2,670	44	1.6	1.6	98.4
13-24	1,822	12	0.7	2.3	97.7
25-36	1,158	10	0.9	3.2	96.8
37-48	660	5	0.8	4.0	96.0
49-60	336	4	1.2	5.2	94.8
61-72	101	0	0.0	5.2	94.8
Mandible					
0-12	2,856	24	0.8	0.8	99.2
13-24	1,933	6	0.3	1.1	98.9
25-36	1,194	6	0.5	1.5	98.5
37-48	721	4	0.6	2.1	97.9
49-60	452	2	0.4	2.5	97.5
61-72	148	0	0.0	2.5	97.5
Total					
0-12	5,526	68	1.2	1.2	98.8
13-24	3,755	18	0.5	1.7	98.3
25-36	2,352	16	0.7	2.4	97.6
37-48	1,381	9	0.7	3.1	96.9
49-60	788	6	0.8	3.9	96.1
61-72	249	0	0.0	3.9	96.1

applicability of implant utilization and enhanced the clinician's ability to deliver prostheses around which patients may more easily exercise appropriate plaque control measures.

Although it is impossible to elucidate the precise reasons for failure of osseointegrated implants in function, unquestionably the magnitude of force application and the ability to appropriately control

bacterial plaque are key considerations in the long-term success of endosseous implants. Interestingly, only 2 implants in this study demonstrated progressive crestal bone loss after the establishment of crestal levels 1 year after abutment connection. Although it has been suggested that such findings may be the result of the placement of the implant-abutment joint 1.8 to 2.8 mm coronal to the crestal bone, resulting in more stable peri-implant soft tissues and greater ease of patient hygiene, this study reports this finding incidentally, not as an absolute claim.³¹

CONCLUSIONS

TPS- and SLA-surfaced ITI implants were deemed successful after placement and restoration in 3 private practice settings for a variety of clinical applications in this patient population.

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