Multicenter Retrospective Analysis of the Solid-Screw ITI Implant for Posterior Single-Tooth Replacements

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Purpose: This report involves the retrospective analysis of ITI implants placed and/or restored by a group of 7 clinicians located throughout the United States (5 periodontists and 2 prosthodontists).

Materials and Methods: Six hundred seventy-five posterior single-tooth implants were restored in 471 patients (average time of loading 21.30 months, with a range of 1 to 78 months). Three hundred seventy implants and 71 implants were placed in mandibular and maxillary molar sites, respectively, and 108 and 126 were placed in mandibular and maxillary premolar sites, respectively. Results: A cumulative survival rate of 99.1% was obtained for all sites (6 failures). The survival rates for individual sites were as follows: 98.4% mandibular molars, 100% maxillary molars, 100% mandibular premolars, and 100% maxillary premolars. "At-risk" implants (1 to 2 mm of radiographic bone loss) were noted at 5 sites. Discussion: Minimal restorative problems were found with either screw-retained (n = 71) or cemented restorations on solid abutments (n = 600); 80.3% of screw-retained and 98.2% of cemented restorations were free of complications, respectively. Patient satisfaction scores were high (97.4%) as determined by the Patient Satisfaction Questionnaire. Conclusion: The data suggest that solid-screw (4.1 or 4.8 mm wide) ITI implants can be a satisfactory choice for posterior single-tooth restorations. (Int J Oral Maxillofac Implants 2002;17:550–556)

Key words: dental prosthesis retention, implant crown, single-tooth dental implant, survival rate

Osseointegrated dental implants have become the standard of care for treatment planning patients who are either completely or partially edentulous, as well as patients who are missing single teeth. Evidence-based studies have confirmed that dental implants have an excellent long-term favorable prognosis when compared to conventional fixed partial dentures.1-4 The benefits of implants over conventional fixed prostheses include caries resistance and the avoidance of removal of tooth structure of adjacent teeth via tooth preparation. The ability to replace single missing teeth with single implants should be the goal if in fact the clinician’s objective is to replace what has been lost. This service enables patients to enjoy the benefits of comfortable function, pleasing esthetics, freedom from marginal caries and concerns involving restorations, and optimal oral hygiene access.5-7

A limitation of early single-tooth implant studies was the lack of molar restorations in the investigated populations.8-10 The molar region could be the ideal area in a patient’s mouth for testing the success of single implants, since a lone-standing implant would be most severely tested under many types of occlusal, masticatory, and parafunctional loads. Becker and coworkers11 reported on 282 implants...
placed in molar positions and found striking differences in cumulative success in the mandibular molar versus the maxillary molar regions (91.5% versus 82.9%, respectively). They attributed this outcome to differences in bone quality and quantity in posterior areas as compared to anterior regions, where success profiles have been reported to be significantly better. Levine and associates\(^1\) reported a 95.5% cumulative success rate for 157 implants, with 135 of them being placed posteriorly (75 in the molar and 16 in the premolar region). The survival rate of the molar population was 92%, whereas the survival rate of the premolar population was 99.98%. Three fractures of hollow-body implants were reported in the mandibular first molar area (12% fracture rate in molar region). This was found to be a result of the implant design being overused in this area of the mouth, where the load is too great for the specific hollow-body design.

The purpose of the present study was to evaluate the survival of 675 solid-screw ITI implants for the replacement of single posterior teeth. In addition, the survival of cemented versus screw-retained single-implant–supported crowns was compared.

**MATERIALS AND METHODS**

Six hundred seventy-five solid-screw ITI implants (Straumann, Waldenburg, Switzerland) were placed in 471 patients (292 women, 179 men). The data were collected from 7 clinical practices throughout the United States (5 periodontists and 2 prosthodontists). Although there was no definite commencement date, the data collection period ended August 1, 1999. Implant selection was based on consecutive placement and followed from the day of surgery to at least 1 month post-restoration. Consecutive periapical radiographs were necessary for inclusion in the study (Fig 1; median 18 months). The distribution of implants placed and/or restored by the included clinicians was as follows (Fig 2):
The patients were considered healthy by their clinicians (only 12.6% of the implants were placed in smokers).

All implants were located in the posterior region of the mouth and delineated as follows: mandibular molar (370), maxillary premolar (126), mandibular premolar (108), and maxillary molar (71) (Figs 3 and 4). Of the implants placed, 615 were 4.1 mm wide (standard width) and 60 were 4.8 mm wide (wide-body). The 10-mm-long implants were the most frequently used (319), followed by the 8-mm (166), 12-mm (131), 14-mm (24), 11-mm (21), 9-mm (9), and 16-mm (5) (Fig 5). Six hundred one implants were titanium plasma-spray (TPS) coated, while 74 were sandblasted/acid-etched (SLA). The implants were examined for successful tissue integration according to success criteria described by Buser and coworkers, with each implant being classified as “early failure” because of recurrent peri-implant infection or implant mobility or “successful” based on the criteria (Fig 6), which depended upon clinical and periapical radiographic examinations of each site. Of the successfully integrated implants, 600 were restored with solid abutments and cemented restorations, and 71 were restored with the octabutment and screw-retained restorations.

After completion of the prosthetic treatment, the majority of patients were placed in a periodontal maintenance program with visits every 3 to 6 months. Complications were recorded as they occurred and included loosening or fracture of solid abutments for cemented crowns, loosening or fracture of crown-retaining screws, loosening of octabutments for
screw-retained restorations, marginal bone loss, implant failure, and implant fracture.

Each patient was given a Patient Satisfaction Questionnaire when treatment was completed. The questionnaire was filled out by the patient, with any additional comments also noted by the patient. The scale ranged from 1 (very unhappy) to 3 (neutral) to 5 (very happy), according to how they felt about the results of their treatment.

RESULTS

Evaluation of the treatment during the healing period of 6 to 8 weeks (for SLA surface only) to 4 months (for TPS surface implants placed in Type 4 bone quality) revealed 4 implants that failed to integrate. In addition, 2 implants demonstrated per-implant infection, with significant bone loss and poor prognosis, and were considered “late failures.” Five implants had pocketing (5 to 7 mm) and minimal (1 to 2 mm as measured radiographically) marginal bone loss and were considered “at risk” but were stable, non-mobile, symptom-free, and in function.

Survival Rates of Posterior Implants by Location

This analysis showed differences among all categories as follows: the mandibular molar survival rate (n = 370) was 98.4% as compared to 100% for maxillary molars (n = 71). In the premolar region 100% survival was noted for both the mandible (n = 108) and the maxilla (n = 126). The overall survival rate was 99.1%. No implant fractures were noted for either diameter used.

Restorative Failure and Problems

Of the 671 implant restorations, 600 were restored as cemented crowns on solid abutments and 71 were restored as screw-retained crowns on octabutments. Problems with the cemented restorations were as follows. In 2 patients, abutment loosening was seen (0.3%); in 3 patients, solid abutments fractured and needed to be replaced and new crowns fabricated (0.5%); 4 crowns loosened because of cement washout and were re-cemented (0.6%); and 2 additional crowns were remade because of porcelain fracture in 1 patient and poor seating and laboratory error in another (both 0.2% occurrence).

Problems associated with screw-retained restorations were as follows. In 12 patients (16.9%) the crown-retaining screw loosened once, in 1 patient (1.4%) the crown-retaining screw loosened multiple times, and in 1 patient (1.4%) the octabutment loosened once. In all patients, either the crown-retaining screw was retorqued at 20 Ncm, or the 1
implant in molar sites now studying the survival rate of the wide-neck implant in a similar molar application. Impaction, which were seen with the use of a standard ITI implant in a similar molar application. Further, the present authors have concentrated on the use of dental implants in the posterior regions of the mouth. The present authors have concentrated on this area; it is believed that the most important area in the mouth to evaluate implant success and strength is the posterior region, since occlusal and parafunctional loads are most concentrated in this region. A recent study followed (mean 40.1 months) 135 posteriorly placed implants in which the cumulative survival rate (CSR) of the molar population was 92%, whereas the CSR of the premolar population was 99.98%. Implant fracture was noted in this previous study, and analysis found that all were in the mandibular first molar area (total of 3 fractures) and all were hollow (3.5-mm-wide) implant bodies. The implant fractures had occurred after a mean service period of 40.3 months. None of the solid-screw (4.1-mm-diameter) implants fractured. It appears that the hollow-body implant does not always have adequate strength to withstand posterior forces of occlusion as a single-tooth replacement, whereas the 4.1-mm solid screw does have the needed strength for posterior application. The authors decided to test the 4.1- and the 4.8-mm wide-body solid-screw implants in posterior areas to evaluate their CSR and prosthetic strengths and weaknesses in single-tooth applications.

A recent study by Becker and associates evaluated 282 implants in molar positions for CSR only. No mention was made of any prosthetic problems as in the present and prior studies. The comparison that can be made with the Becker study would be only in the molar region. The Becker study reported on 70 while the present group reported on 71 maxillary molar implants. The CSR was 100% in the present study for maxillary molars, whereas the Becker study reported a CSR of 82.9%. The 370 mandibular molars followed in the present study and the 212 in the Becker study showed CSRs of 98.4% and 91.5%, respectively. Becker and associates cited bone quality and quantity and variability in achieving bicortical stabilization as reasons for lower success rates in molar positions when compared with the anterior region of the mouth. Machined-surface titanium implants, ad modum Brånemark, have extremely high success rates in the anterior and the intraforaminal region of the mandible because of bicortical stabilization in these regions. However, in posterior areas there is less bone surface available for implant contact, which may account for the differences in CSR between this material and Becker's. This effect has been documented in animal studies.

One interesting finding in a previous study was that a majority of the implants placed in posterior areas were of relatively short lengths, ie, 8 to 10 mm. TPS and SLA surfaces usually do not require bicortical stabilization. The present study seems to confirm this as well as the ability of these surfaces to be successful in significantly reduced ridges with the use of shorter implants, ie, 8 mm, 9 mm, or 10 mm. All failures in the present study were located in the mandibular molar region. Failure rates by implant length were as follows: 3 of 166 (1.8%) for 8-mm implants and 2 of 319 (0.6%) for 10-mm implants. There appears to be a slight increase in failure rates for the 8-mm to 10-mm length; however, survival rates of 98.2% versus 99.4% are both clinically satisfactory.
CONCLUSIONS

The results of the present study have indicated that the use of TPS-coated and SLA solid-screw implants for posterior single-tooth replacement can be a predictable procedure. The cumulative survival rate of 675 implants placed was 99.1%, with only 6 failures recorded. Based on the criteria for success by Buser and associates, the CSR for individual sites was 98.4% for mandibular molars and 100% for maxillary molars and premolars as well as mandibular premolars. One to 2 mm of bone loss was recorded radiographically on an additional 5 implant sites, and these were noted as “at-risk” sites. Minimal restorative problems were recorded, as 80.3% of screw-retained and 98.2% of cemented restorations were complication-free. No implant fractures were noted with the use of either the standard 4.1-mm-diameter or the 4.8-mm wide-body implants.

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REFERENCES


