Evaluation of a Single-Tooth Implant

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Fifty-nine commercially pure titanium implants in 59 subjects were compared with internal control teeth for 3 years. Nineteen coated implants of identical design were placed in 17 of the subjects and compared with the titanium implants. Demographic data, microbial DNA, aspartate aminotransferase levels, Plaque Index, width of adjacent keratinized tissue, probing depths, bleeding on probing, relative attachment levels, mobility, and radiographic bone height were studied. The only statistically significant changes over time were improved plaque scores in the subjects and slight bone loss around the implants. There were no differences between the 2 types of implants. Mobility was less and probing depth and bleeding on probing were greater in the implant sites than in the control sites. (INT J ORAL MAXILLOFAC IMPLANTS 2000;15:396–404)

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A variety of factors apparently can influence success rates of dental implants. Among them are the quantity and quality of bone in the selected site,[1–4] the presence or absence of keratinized tissue around the implant,[5–10] the reason for tooth loss and the overall periodontal status,[11–13] the type of microflora present in the sulci/pockets of the natural teeth and implants,[14–19] the patient's plaque control,[20] and the quality of professional maintenance, including the type of instruments used to clean the implants.[21–28] Smoking[29–32] and parafunctional habits[33–35] have been associated with increased failure rates. The surface characteristics of implants have sparked discussion.[36–39] Another consideration in a clinical investigation is the impact of the actual testing on the supporting tissues.

The objectives of the current study were: *(1)* to evaluate the role of some of the reported risk factors on a commercially pure grade 2 titanium (Ti) single-tooth implant and compare the results with those of a contralateral natural control tooth, and *(2)* to compare the Ti implant with a Ti plasma-sprayed, hydroxyapatite-coated 6/4 titanium alloy implant (HA) of identical design placed at the same time in the same patients.

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METHOD AND MATERIALS

A 3-year prospective study of single-tooth Ti implants was performed at the University of Washington, School of Dentistry, Seattle, Washington. Subjects were selected in accordance with the regulations of the University's Human Subjects Review Committee. To qualify, individuals had to be in good health and have relatively intact dentitions free from active periodontal inflammation. The site had to have adequate mesiodistal space between adjacent teeth and at least 9 mm of vertical bone height. The surgeon was prepared to use ridge augmentation techniques to overcome a thin alveolar housing. A minimum of 4 months had to elapse between tooth extraction and implant surgery.

One periodontist placed all of the implants (Genetics Implant System Inc, Seattle, WA), leaving the head of the implant flush with the crest of the alveolar bone. If more than 1 implant was placed in the patient, the second and third were 6/4 titanium alloy implants coated with 35 μm of Ti plasma followed by 25 μm of porous hydroxyapatite (HA). At the time of the second-stage surgery, the surgeon placed a restorative post and core and modified the emergent core to fit the occlusal scheme. One restorative dentist, using the same dental laboratory, fabricated all of the crowns; the final impressions were made approximately 8 weeks after second-stage surgery. The occlusion of each crown was carefully checked and adjusted if required.

The subjects then reported to the authors to begin the investigation. The subjects were seen 8

times: at baseline and at 3, 6, 12, 18, 24, 30, and 36 months after final restoration. The patients' age, gender, medical conditions, history of smoking, and reason for tooth loss were noted. The time between tooth loss and placement of the implant, placement of the implant and second-stage surgery, and second-stage surgery and final crown cementation were recorded, as were the length and diameter of each implant. Implant placement sites were grouped into maxillary anterior, maxillary posterior, mandibular anterior, and mandibular posterior regions. The type of bone was classified as dense or porous by the surgeon. Complications encountered at the time of the 2 surgeries, during the postoperative healing period, at crown placement, and at any of the 8 data collection visits were noted, along with any corrective intervention. A natural tooth (usually in the contralateral position to the implant) was selected to serve as an internal control.

At each visit over the 3 years, the subjects were asked about any change in health status and medications. They rated their satisfaction with the appearance, the function, and the overall process of receiving their implant(s) and crown(s) on a scale of 0 to 2, where 0 = not pleased, 1 = moderately pleased, and 2 = very pleased. Possible altered sensation at the implant site was reported as none (0), mild (1), moderate (2), or severe (3). Two sets of gingival crevicular fluid samples were collected from each implant and control tooth to determine aspartate aminotransferase (AST) levels[40] and DNA detection of *Bacteroides forsythus*, *Porphyromonas gingivalis*, and *Prevotella intermedia*.[41]

The following clinical data were recorded on the implants and control teeth. Probing depth (PD) and relative attachment level (RAL) were measured on the mesiobuccal (MB), buccal (B), distobuccal (DB), and lingual/palatal (L) using an automated probe and an automated attachment level probe (Florida Probe Corp, Gainesville, FL), respectively, each calibrated to 0.1 mm and a standardized pressure of 0.2 N. Bleeding on probing (BOP), Plaque Index (PI),[42] width in mm of B and L keratinized tissue, and mobility using the Periotest (Siemens, Bioresearch, Milwaukee, WI) were also recorded. Baseline and annual periapical radiographs were taken of the implants and control teeth. Linear measurements were made on digitized images of the radiographs.[43] At baseline and years 1, 2, and 3, the amount of mesial and distal radiographic bone change in mm was calculated by comparing the distance from the apical margin of the crown to the bone crest at implant sites. In the case of control teeth, the measurements were made between the bone crest and either the cementoenamel junction or a crown margin.

Oral hygiene instructions were given to all subjects during the first 2 visits (baseline and 3 months) and then reinforced if needed throughout the 3 years. Each patient received an ultrasoft manual toothbrush. Subjects with anterior implants were given Super Floss (Oral-B Laboratories, Belmont, CA) for interproximal cleaning to protect the height of the papillae. Individuals with posterior implants were instructed in the use of an interproximal brush and sometimes Super Floss. On one occasion in each of 2 patients, a universal scaler for dental implants (Steri-Oss, Yorba Linda, CA) was used to clean around the implant. With these 2 exceptions, the implants and control teeth were not cleaned professionally during the 3 years of the investigation. Polishing agents were never employed.

Statistical Analyses

Descriptive statistics were used to analyze the study material. Differences in change over time between each implant and its control tooth were studied using paired *t* test and Chi-square analyses. Changes over time were studied for implants and teeth separately using 1-way analysis of variance (ANOVA) and Kruskal-Wallis non-parametric ANOVA. SPSS software version 8.0 (Chicago, IL) was used for data analyses.

RESULTS

One hundred ninety-two individuals were screened, from whom 59 subjects were accepted for the placement of a non-coated, commercially pure grade 2 Ti implant. Nineteen HA-coated implants were placed in 17 of the same subjects. The implants were placed in the following sites: 58% mandibular posterior, 26% maxillary anterior, 15% maxillary posterior, and 1% mandibular anterior. Six surgical sites exhibited a bony dehiscence or narrow alveolar housing that required regenerative procedures or splitting and expansion of the ridge. Forty-eight of the implants had a diameter of 4.75 mm; the other 30 were 3.75 mm in diameter. Relative to length, 42% were 10 mm, 37% were 13 mm, and 21% were 16 mm long. An average of 7.3 months (8.2 months for the maxillary sites and 6.5 months for mandibular sites) elapsed prior to surgical uncovering and attachment of the restorative post and core. Temporary crowns were immediately placed on anterior implants; definitive crowns were cemented a mean of 8.5 weeks after second-stage surgery.

Table 1 Distribution (%) of Titanium Implant Sites and Teeth with Bleeding on Probing at Baseline and at Years 1, 2, and 3

No. of surfaces with BOP	Baseline		Year 1		Year 2		Year 3	
	Ti	Tooth	Ti	Tooth	Ti	Tooth	Ti	Tooth
0	57.9	75.9	52.6	74.1	66.1	87.9	58.5	81.8
1	26.3	17.2	33.3	17.2	28.6	6.9	28.3	16.4
2	12.3	5.2	12.3	6.9	5.4	5.2	13.2	1.8
3	1.8	1.7	1.8	1.7	0.0	0.0	0.0	0.0
4	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

BOP = bleeding on probing.

Demographic Data

At the time of implant placement, the mean age of the 59 subjects was 36.4 years (SD 11.8; age range 16 to 71). Females comprised 64% of the patients. All were reasonably healthy, although 11 individuals were being treated for a variety of conditions—diabetes mellitus, high blood pressure, anemia, asthma, duodenal ulcers, hypothyroidism, glaucoma, epilepsy, anxiety, and depression. Five women gave birth during the study. One woman began therapy for breast cancer but attended all 8 of her scheduled visits. Only 2 subjects smoked, 1 of whom was recovering from alcoholism. Twenty-eight subjects identified caries, root canal failure, a dental abscess, or a failed restoration as the reason for tooth loss. In 15 patients the permanent teeth were congenitally missing, and in 2 individuals, impacted teeth had been extracted. Trauma or resorption subsequent to orthodontic treatment was reported by 14 patients. None of the patients listed periodontal disease as the etiologic agent. The estimated duration between tooth loss and placement of the implant varied from 4 to 528 months (ie, 44 years), with a mean of 92.7 months (ie, 7.7 years).

Implant Survival Rate

One of the 59 Ti implants was removed within the first year (3-year survival rate = 98.3%). In preparing the surgical site, the mesial aspect of the drill hole encroached on a prominent nasopalatine canal. Therefore, integration of that side of the implant never occurred. One patient moved away immediately after the crown was cemented and could not be followed. None of the 19 HA implants was lost.

Symptoms and Satisfaction

Significantly more symptoms (0 = none, 1 = mild, 2 = moderate, 3 = severe) were reported at the implant sites at baseline and at the 3-month visit than at later times ($P < .001$, Kruskal-Wallis ANOVA). A score of "1" (mild altered sensation) was reported by 11.7% and 8.6% of the subjects at baseline and 3 months, respectively. Thereafter, the subjects were basically symptom-free; only 4 patients reported mild transitory symptoms at one of the remaining visits.

No difference in the level of satisfaction was found over time. After 3 years, 92% of the participants were "very pleased" with the procedures involved in the placement and restoration of the implant and with the implant's function; 8% were "moderately pleased." All of the patients who received an anterior implant were "very pleased" with the cosmetic results. Of those with a posterior implant, 86.2% were "very pleased" and 13.8% were "moderately pleased."

Clinical Data

Non-parametric Mann-Whitney tests failed to demonstrate a significant difference in plaque scores between implant and control tooth sites at either baseline or year 3. However, both the implant and tooth plaque scores improved significantly during the course of the study ($P < .05$, nonparametric test). At baseline, 71.4% of the implant and 63.5% of the tooth surfaces were plaque-free; at year 3, the values were 86.8% and 80.3%, respectively.

Bleeding on probing was recorded as "present or absent" at each of the 4 sites (DB, B, MB, and L) around the implants and control teeth. Distribution of the proportion of sites presenting with BOP at the annual examinations can be seen in Table 1. The control teeth presented with significantly fewer sites exhibiting BOP at both baseline ($P < .05$, nonparametric test) and 3 years ($P < .001$) than did the implants. No relationship was found between BOP and either gingival width or plaque scores.

The mean width of keratinized tissue on the facial and lingual of the control tooth at baseline was greater than it was on the implant. The implant demonstrated means of 3.0 mm (SD 1.3) and 2.7 mm (SD 1.3) on the facial and lingual, respectively.

Table 2 Clinical and Radiographic Findings, Titanium Implants and Control Teeth

	Baseline		Year 1		Year 2		Year 3	
Parameter	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Implants								
Probing depth MB (mm)	2.8	1.1	3.3	1.1	3.1	1.2	3.3	1.5
Probing depth B (mm)	2.1	1.0	3.2	0.7	3.2	1.2	2.3	1.1
Probing depth DB (mm)	2.8	1.0	3.2	0.7	3.1	1.2	3.3	1.2
Probing depth P/L (mm)	2.2	1.0	2.4	0.9	2.4	0.8	2.2	0.9
Probing depth mean (mm)	2.5	0.7	2.8	1.1	2.7	0.7	2.8	0.8
Bone height M (mm)	3.2	0.9	3.8	0.8	3.8	0.8	3.9	0.9
Bone height D (mm)	3.2	0.8	3.9	0.8	3.9	0.8	3.9	1.1
Control teeth								
Probing depth MB (mm)	2.4	0.7	2.4	0.7	1.9	0.7	2.5	0.8
Probing depth B (mm)	1.9	0.6	1.7	0.7	1.6	0.6	1.6	0.6
Probing depth DB (mm)	2.3	0.6	2.2	0.7	2.0	0.6	2.1	0.8
Probing depth P/L (mm)	1.6	0.6	1.7	0.5	1.7	0.6	1.5	0.5
Probing depth mean (mm)	2.1	0.4	2.0	0.4	1.9	0.4	2.0	0.5
Bone height M (mm)	1.9	0.7	2.1	0.9	2.2	0.7	2.2	0.9
Bone height D (mm)	2.1	0.9	2.1	0.8	2.1	0.7	2.4	0.9

MB = mesiobuccal; B = buccal; DB = distobuccal; P/L = lingual/palatal; M = mesial; D = distal. Bone heights were assessed via digitized radiographs.

For the tooth, the mean was 3.7 mm (SD 1.3) on the facial and 3.9 mm (SD 1.5) on the lingual. Statistical analyses (ANOVA) failed to demonstrate any change in gingival width over time at either the implant or control sites. Statistical analyses failed to demonstrate a relationship among gingival width, plaque scores, and BOP.

Baseline and annual PD data for implants and control teeth are presented in Table 2. At baseline, PD values were statistically significantly greater at the implant sites than at the corresponding control tooth sites (P values varied between .001 and .05; independent t test). The mean PD difference was 0.4 mm ($t = 3.6$, $P < .001$). At year 3, the PDs around the implants were statistically significantly greater than around the control teeth. The mean PD difference was 0.8 mm (standard error 0.1; 95% confidence interval 0.5 to 1.0; $t = 6.2$; $P < .001$). When the changes over time for PD between implants and matched control teeth were compared, the mean paired difference in PD was 0.5 mm (SD 1.1; 95% confidence interval 0.2 to 0.8; $t = 3.0$; $P < .01$), with a greater increase in PD at implant sites. The PD at implant sites increased over time in 43 (73%) of the cases. There was no statistically significant change in RAL at either the implant sites ($F = 1.2$; $P < .3$) or the tooth sites ($F = 0.4$; $P < .9$) between baseline and year 3 (Fig 1). An increase in RAL ≥ 1 mm was found at 9 implant sites (15.3%) and 4 tooth sites (6.8%).

The Periotest has a range between –8 and +50, representing increasing mobility. The scores for the control teeth ranged from –4 to +16. Most of the scores (92.4%) were in the –4 to +9 range, which, when converted to Miller's[44] original classification for tooth mobility, equates with a "0" or "no distinguishable movement."[45] In the remaining 7.6% of the teeth, the Periotest scores of +10 to +16 translate to a Miller's class "1." Mobility scores for the implants ranged between –7 and +6. Thus, 100% of the implants were within Miller's "0" classification. The mean paired difference in the change in Periotest values over time between implants and teeth was 1.6 units (SD 3.3; 95% confidence interval 0.5 to 2.6) and significantly different ($t = 3.5$; $P < .001$) with a lesser degree of mobility for implants (Fig 2). The Periotest data were analyzed to determine whether there was a difference in the mobility scale among implants of different length. In the posterior regions at year 3, the 16-mm implants had a statistically significantly lower Periotest reading than did the 10-mm implants (mean difference 4.2; $P < .001$, one-way ANOVA, Bonferroni test), as well as the 13-mm implants (mean difference 3.1; $P < .01$). Moreover, all of the 16-mm implants had a diameter of 3.75 mm; the shorter implants were a mix of 3.75 mm and 4.75 mm. No differences in mobility were found between the 10-mm and 13-mm implants. Relative to implant width and mobility, implants that were 13 mm long and 4.75 mm in diameter displayed statistically significantly lower Periotest readings than did the implants that were 13 mm long and 3.75 mm in diameter ($P < .0001$).

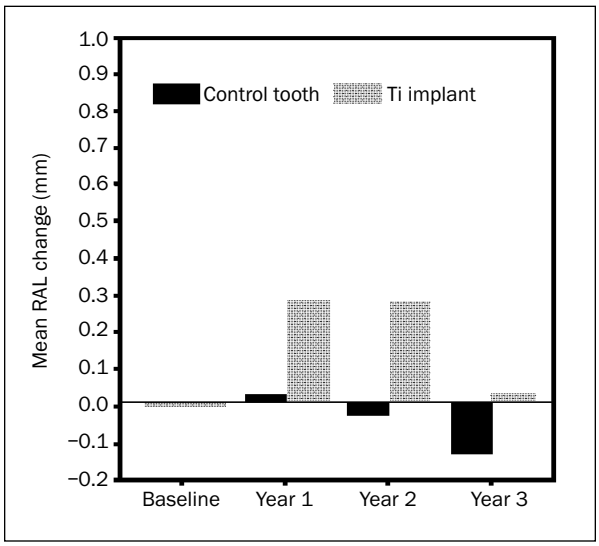

Fig 1 Changes in relative attachment level (RAL) in mm between baseline and years 1, 2, and 3 for titanium implants and control teeth. A positive value indicates a loss of attachment, and a negative value indicates a gain in attachment.

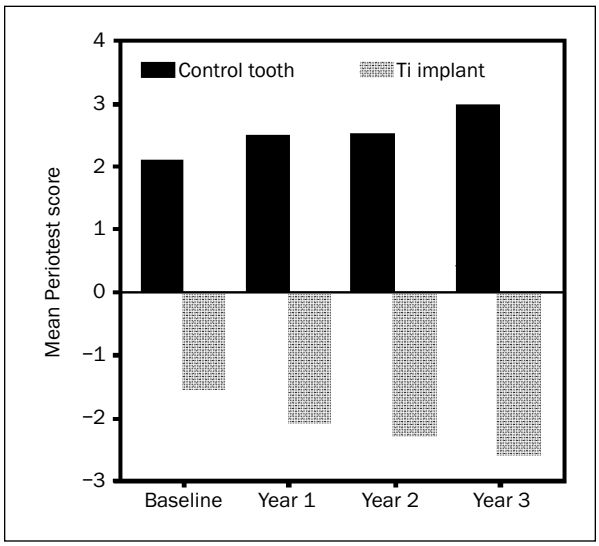

Fig 2 Mean Periotest scores for titanium implants and control teeth at baseline and years 1, 2, and 3. The instrument's range is from −8 to +50. The lower (more negative) the score, the tighter the implant or tooth.

The lack of variation in implant length at anterior sites did not allow for similar comparison.

Radiographic Bone Height

Radiographic bone height values for the implants and control teeth can be found in Table 2. Statistical analysis (one-way ANOVA) failed to demonstrate a difference over time for the control teeth. At Ti implant sites, there was a statistically significant change (loss) in bone height between baseline and year 1 (mean difference at mesial sites 0.6 mm; standard error 0.1; $P < .01$; and mean difference at distal sites 0.7 mm; standard error 0.2; $P < .001$). There was no significant change between years 1 and 2, years 1 and 3, or years 2 and 3.

Laboratory Data

The presence of *P gingivalis*, *P intermedia*, or *B forsythus* was found only once at 4 implants and 3 control teeth from more than 900 samples collected. Mean baseline AST values were 170 µIU (SD 145) for the implant sites and 186 µIU (SD 129) for the control teeth. The corresponding values after 3 years were 263 µIU (SD 213) and 299 µIU (SD 300), respectively. The changes over time were statistically significant ($F = 4.3$; $P < .001$), although not between implants and control teeth. Only 2.4% of the AST samples demonstrated a value greater than 800 µIU, which is considered the threshold value for evidence of disease activity.[40] These values were not consistently found at specific sites and were equally distributed between the implants and control teeth. The AST values failed to identify sites of changed RAL, PD, or radiographic bone height.

Different models were used in regression analyses in an attempt to identify significant explanatory variables (eg, patient's age or gender, reason for tooth loss, time interval between tooth loss and implant placement, surgical site) that were associated with changes over time for radiographic bone height or RAL measurements. No such variables were identified.

Ti Versus HA Implants

Nineteen Ti plasma-sprayed, HA-coated 6/4 Ti alloy implants were placed in 17 of the 59 patients at the time of placement of the commercially pure grade 2 Ti implants. The same clinical and laboratory data were collected from the 19 HA-coated implants over the 3 years of the investigation. The 17 subjects were treated as a subgroup, and statistical analyses were performed to compare all of the variables for the 2 types of implants. All of the coated implants were successfully integrated. Statistical analyses failed to demonstrate any differences in study outcomes between the 2 types of implants for any of the parameters studied.

DISCUSSION

The importance of good plaque control by the patient and judicious maintenance with appropriate devices by the dental health care provider has been stressed.[20–28] Warnings about damaging the surfaces of implants with steel curettes and ultrasonic scalers have been made.[24] Patients may have difficulty cleaning effectively around an implant. Ridge resorption at the surgical site, crown margins, and for some implants, a collar of greater diameter than that of the body of the implant all can complicate a patient's plaque control efforts. In the system being tested, the collar and the threads are the same dimension, which facilitates plaque control. Maintenance therapy in the current study was basically limited to oral hygiene instruction at baseline and at 3 months after cementation of the crown. The subjects accepted the challenge of caring for their own implants. The percentages of plaque-free surfaces at baseline and at year 3 for the implants were 71.4 and 86.8, respectively. At baseline no plaque was detected on 63.5% of facial and lingual/palatal surfaces of the control teeth. The percentage of plaque-free surfaces rose to 80.3% by the end of the study. This excellence in plaque control may have been an important factor for the successful results that were obtained.

Attempts to obtain accurate probing depths around implants may be thwarted if the collar juts out beyond the body of the implant. In the current system, the collar and external threads are the same diameter, which facilitates the taking of these measurements. One might ask if the tests conducted during the investigation could damage the implant's surface and hence potentially influence survival. Sixty-four PD and RAL measurements were made around each implant with a 0.2-N-force stainless steel instrument over the course of the study. Probing sometimes produced bleeding and elicited signs of discomfort from the patients. However, despite the lack of special treatment for subjects or implants, the changes in PD and RAL at both implant and control tooth sites were small, within margin of measurement error, and clinically insignificant.

The results of several investigations indicate that the microflora surrounding implants in partially edentulous mouths is similar to that found around the remaining teeth.[11–17,19,46–49] In the current study, none of the subjects gave a history of periodontitis as the reason for tooth loss. They presented with minimal PD, BOP, and radiographic bone loss. Their personal plaque control was good and improved throughout the course of the investigation. Therefore, one apparent reason for the excellent 3-year survival rate was the healthy periodontal status of the subjects. The laboratory data support this contention. DNA testing revealed a lack of the purported pathogens *P gingivalis*, *B forsythus*, and *P intermedia*. These micro-organisms were identified in less than 1% of the samples, they were equally distributed between implants and control teeth, and they never appeared more than once in any given subject. Similarly, very few crevicular fluid samples reached the threshold AST value which would have indicated the presence of disease activity around the implants or control teeth.

Some authors believe that the quality of bone is the most important determinant in the loss of an implant. Failure rates of 35% have been reported in the presence of Type IV bone.[1] In the current investigation, the surgeon identified those surgical sites in which the bone was "soft and spongy." He then threaded only the coronal half of the bone to permit self-tapping of the final half of the implant. In dense bone, the site was threaded the full length of the implant. Statistical analyses revealed no differences in any of the many variables examined over the 3 years, regardless of the softness of the bone.

The bone in the maxilla is less dense than that in the mandible. Reported survival rates of maxillary implants usually are not as high as those for mandibular implants.[2,37] Some investigators[2] have had better results in the posterior maxilla than in the anterior maxilla, while others[50] claim that the lowest rates of survival occur in the posterior maxilla. In the mandible, more problems and lower survival rates have been reported in the molar region[4,33,34,50] than in the anterior region, which is associated with excellent and predictable results. The fact that only 1 of the 78 implants placed during the current study was in the anterior mandible makes the survival rate of 98.7% even more impressive.

Implants under 10 mm in length have the lowest reported survival rates.[4,37] The shortest implant placed in the current study was 10 mm. Statistically, 16-mm implants, each with 3.75-mm diameters, had lower Periotest readings than either the 10-mm or 13-mm implants, which were evenly divided between 3.75-mm and 4.75-mm diameters. The clinical relevance of this is questionable, because all of the implants, regardless of length, displayed no visible mobility.

There was some bone loss around the implants, especially in the first year, which is consistent with other studies.[51,52] Implants usually are placed so that their coronal surface is left flush with the presurgical level of the alveolar crest. Crestal bone must be removed to accommodate the collar and any coronal projections such as an external hex or a cover screw.

During the healing phase between first-stage and second-stage surgeries, bone can re-form around the collar and even cover the head of the implant. Jung et al[53] have reported that regardless of implant design, rapid alveolar bone loss will occur in the first 3 to 12 months after the placement of the second-stage abutment. This resorption continues until the apical margin of the polished neck or collar of the implant is reached. Bone loss slows dramatically when contact is made with the first thread or area of surface roughness.[51,52] The design and vertical dimension of the collar therefore impacts the amount of initial bone loss. In the system under investigation, there is no external hex. Moreover, the polished collar is the same diameter as the outside dimension of the threads and is only 1 mm in height. Thus the omnipresent bone loss that occurs in the first year should be restricted to 1 mm. The current data support this. The crestal resorption, as measured radiographically, was on average 0.6 mm on the mesial surface of the implant and 0.7 mm on the distal, which is well within the 1-mm range (Table 2).

The radiographs of 6 patients displayed more bone loss on the mesial or distal of the implants than the norm. The person with the most loss was a smoker and a recovering alcoholic and had an allogenic bone graft and expanded polytetrafluoroethylene (e-PTFE) placed at the time of surgery to cover exposed threads resulting from a thin alveolar housing. The only other smoker in the study was also among the 6 subjects with greater bone loss. Two of the 6 were in orthodontic retention, having just completed active treatment to create space for an implant. In both, a facial dehiscence was noted at the time of surgery, and a bone graft and e-PTFE were placed. The fifth subject had undergone orthodontic therapy as a result of a congenitally missing mandibular second premolar. The surgeon described the bone as extremely soft, and a pinhead-sized abscess occurred immediately postoperatively. The sixth patient's implant, replacing a maxillary central incisor that had been lost because of facial trauma 30 years earlier, was in close proximity to a large nasopalatine canal. Thus, all 6 subjects presented with factors that potentially placed the implants at risk[29–32] and may be useful considerations during treatment planning. Nevertheless, the subset of 6 implants displayed no detectable mobility or other clinical signs for concern after 3 years.

The influence of an implant's composition and surface texture on survival rates has been addressed in numerous papers.[36–39,54] In the current prospective investigation, both the commercially pure Ti implants and the 6/4 Ti alloy implants coated with 35 μm of Ti plasma and 25 μm of porous HA were threaded, single-tooth, and the same dimensions. Comparisons were restricted to implants placed in the same patient. No differences were found in any of the clinical or laboratory data. These data are consistent with those of Evans et al,[55] who compared commercially pure Ti threaded implants and HA-coated threaded implants of similar geometric design and dimensions. They found no difference in mobility, PD, percentage of osseointegration, or crestal bone position.

The patients overwhelmingly responded that they were "very pleased" with both the appearance and the overall success of their restored implants. The only reported symptoms were "mild" altered sensation and were restricted to the first 3 months after cementation of the crown. The few subjects who were "moderately pleased" with the surgical and restorative procedures and the function of their implants stated that the process had taken longer than they had expected or that the embrasure spaces between the implant and adjacent teeth were food traps. The only patients who ranked their cosmetic satisfaction as "moderately pleased" had implants placed in mandibular posterior sites and received gold castings rather than ceramometal crowns.

CONCLUSIONS

The 3-year data of this prospective study suggest that both types of implants (Ti and HA) were successful and functional, with a high degree of patient acceptance. The implants were less mobile than the control teeth. The rest of the collected clinical data revealed some statistically significant differences (eg, PD and BOP) when the implants were compared to the control teeth, but none of the differences were considered clinically significant. Radiographically, slight bone loss was recorded on the mesial and distal surfaces of the implants in the first year; minimal loss, if any, was noted over the next 2 years. The tested bacterial flora and AST levels of the periimplant tissues were consistent with healthy gingival conditions. Among the important reasons for the high survival rate of the studied implants were the lack of a history of periodontal disease as the cause of tooth loss and the excellent personal plaque control practiced by each subject.

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