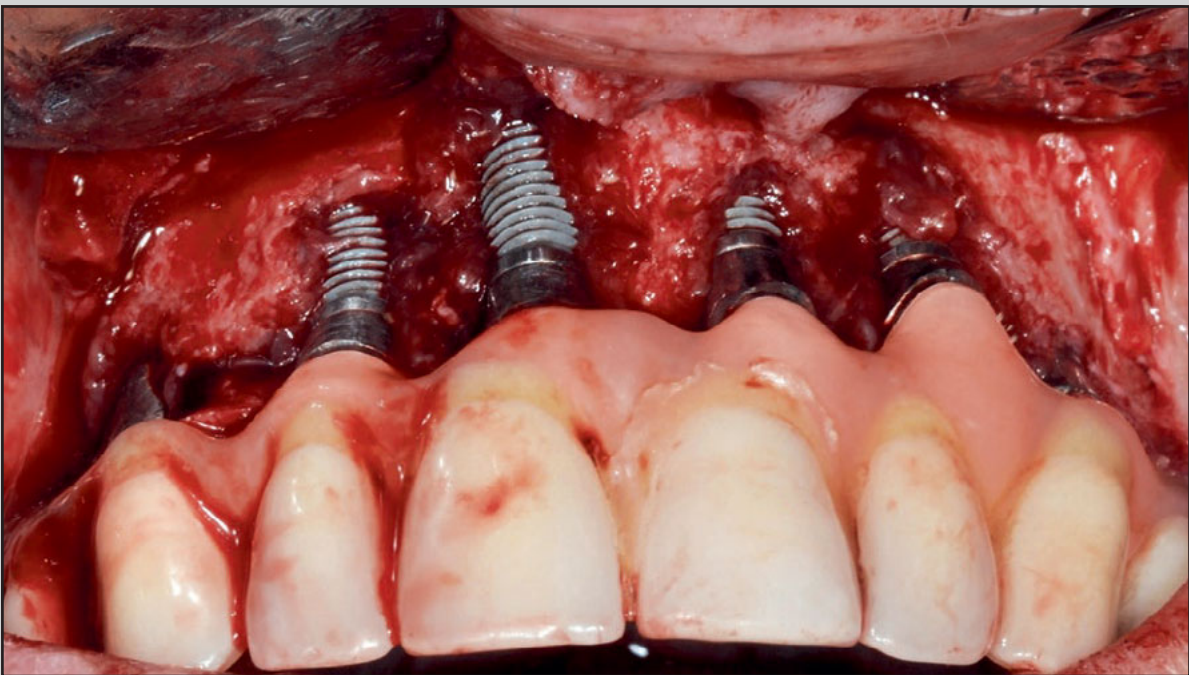
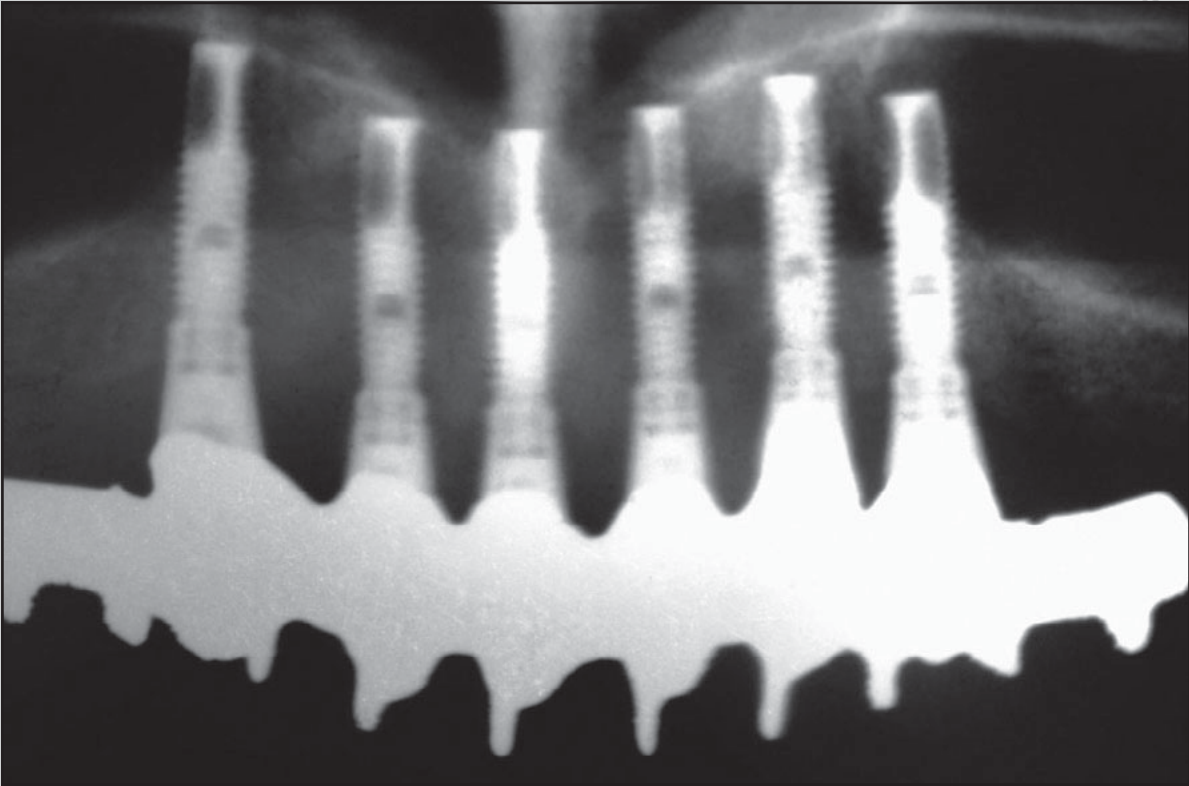
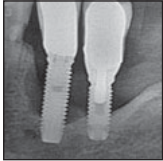




A Clinical and Radiographic Retrospective Study on 223 Anodized Surface Implants with a 5- to 17-Year Follow-up



Luca Ferrantino, DDS, MSc, PhD¹
 Francesco Tironi, DDS²
 Stefano Pieroni, DDS³
 Alessandra Sironi, DEH⁴
 Massimo Simion, MD, DDS⁵

The aim of this study is to evaluate the long-term performance of anodized surface implants placed in native bone and followed-up for up to 17 years. Success and survival rates, prevalence of peri-implantitis, and the correlation between the presence of peri-implantitis and other clinical and demographic variables were calculated. After a mean follow-up time of 10.4 years (range: 5 to 17 years), 91.7% of 223 analyzed implants were still in function. Peri-implantitis affected 63 implants (28.3%) in 26 patients (44%). Eleven implants with peri-implantitis (4.9%) failed. Within the limits of this retrospective analysis, anodized implants appear to be prone to peri-implantitis, mainly in the posterior mandible and in patients with unsatisfactory plaque control. Int J Periodontics Restorative Dent 2019;39:799–807. doi: 10.11607/prd.4330

Titanium is the most widely used material for dental implants. Regarding osseointegration, its features and interactions with native bone are well documented.^{1,2} The Brånemark fixture with its turned surface demonstrated satisfactory results after up to 20 years of function.^{3,4} However, during the last two decades, many changes in the fixture design and different surface modifications—such as anodization, airborne-particle abrasion, and etching—have been proposed in the dental implant field. Such fast developments were broadly accepted because they achieved less marginal bone loss (MBL) and faster osseointegration.⁵ On the other hand, peri-implantitis has grown exponentially,^{6,7} leading to numerous problems regarding the treatment of this pathology and its true prevalence among the population. Moreover, it is documented that biofilm formation occurs more on moderately rough surfaces (such as anodized surfaces) than on smoother ones (such as turned surfaces),⁸ and therefore rougher implant surfaces could be more susceptible to peri-implantitis.^{9–11} Considering the peri-implantitis-onset time is supposed to be around 3 years after implant loading,¹² it could be interesting to have data on the long-term outcome of moderately rough anodized-surface implants and on

¹Department of Aesthetic Dentistry, University of Milan, Istituto Stomatologico Italiano, Milan, Italy.

²Department of Biomedical, Surgical, and Dental Sciences, University of Milan, Istituto Ortopedico Galeazzi, Milan, Italy.

³Private Practice, Milan, Italy.

⁴Private Practice, Milan, Italy.

⁵Department of Periodontology, University of Milan, Fondazione Cà Granda IRCCS Ospedale Maggiore Policlinico, Milan, Italy.

Correspondence to: Dr Luca Ferrantino, Department of Aesthetic Dentistry, University of Milan, Istituto Stomatologico Italiano – via pace 21, Milan, Italy. Email: luca.ferrantino@gmail.com

Submitted February 15, 2019; accepted April 5, 2019.
 ©2019 by Quintessence Publishing Co Inc.

their susceptibility to peri-implantitis when followed-up for more than 5 years.

The aim of this study was to investigate the clinical performance, survival and success rates, MBL, and the occurrence of peri-implantitis on anodized-surface implants placed in native bone after a follow-up of 5 to 17 years.

Materials and Methods

The research protocol of this single-arm retrospective study was approved by the Ethical Committee of the University of Milan (decision no. 47/18). The requirements of the Declaration of Helsinki and pertinent Good Clinical Practice guidelines were fulfilled. Patients involved in this study were informed that data obtained during routine visits would be collected and used in aggregated and anonymous form for statistical analysis; they gave their informed consent to participate.

The present retrospective study was made according to the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) checklist.

Patient Selection

All patients, who were consecutively treated with at least one anodized-surface implant by the same operator (M.S.) in a private practice in Milan, Italy, over a period of 13 years (from 2000 to 2013), were selected for this single-arm retrospective study if they met the following in-

clusion criteria: they did not receive significant bone regeneration procedures, had an absence of active periodontal disease, and were available for a recall visit between January 2016 and December 2017.

Clinical Procedure

Implant therapy was performed only on patients with proper systemic and local conditions for elective oral surgery. The preparation of the patient and the operatory field were carried out in order to obtain sterility. Implant site preparation was performed to achieve optimal primary stability. Implants placed with either a cover screw (two-stage approach) or healing abutment (one-stage approach) were included. Implants placed in fresh extraction sockets and/or with immediate provisionalization were also considered for this retrospective analysis. Control appointments were carried out to assess the healing of the sites. After a healing period of 3 to 6 months, implants were finalized with a fixed restoration.

Clinical Assessment

The follow-up visits were conducted by one operator (A.S.), who collected and recorded the following clinical measurements at the implant site: probing depth (in mm); presence of bleeding on probing, suppuration, peri-implant mucosa recession (in mm), plaque, and keratinized tissue around the implant; and implant position in the mouth (ie, mandible or maxilla, anterior or

posterior). Premolar and molar sites were considered posterior.

Demographic data (age, gender, and smoking status) were also collected from each patient.

The implants still in function were considered surviving, and the Albrektsson criteria were used to calculate the success rate.¹³ The criteria from the consensus report of Working Group 4 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions were used to define peri-implantitis.¹⁴

Radiographic Assessment

The radiographic outcome variable considered in this study was the MBL, defined as the vertical distance (parallel to the implant long axis) between the implant shoulder and the first bone-implant contact.

Baseline MBL (T0) was assessed on both panoramic and intraoral radiographs of the target implant after the adaptive phase, ie, 1 year after prosthetic loading. Final MBL (T1) was assessed on intraoral radiographs taken at the final follow-up visit. For each implant, two MBL measurements were recorded at its mesial and distal aspects and the mean value was considered as the MBL value. All images were digitized in TIFF format and measured using ImageJ software (National Institutes of Health) by one calibrated operator (F.T). Known implant length and distance between implant threads were both used for the image calibration. Measurements were made to the nearest 0.1 mm.

Data Analysis

Data were recorded in Excel (Microsoft), checked for entry errors, and analyzed by an independent operator (L.F.). Statistical descriptive analysis included mean and standard deviation for continuous variables, whereas proportions were calculated for categorical variables. Logistic regression model was fit to analyze the association between the dependent variable (occurrence of peri-implantitis) and demographic variables (gender, smoking status), implant position, treatment procedure (immediate provisionalization, one-stage approach, implants placed in fresh extraction socket), clinical variables (probing depth and presence of keratinized tissue, recession, bleeding on probing, and plaque), with years of follow-up as independent variables. Suppuration was not included in the final regression model, as it perfectly predicted the dependent variable (occurrence of peri-implantitis). Odds ratios (ORs) with 95% confidence intervals (CIs) were determined. $P < .05$ was considered statistically significant. Statistical analysis was performed using STATA version 11.0 for Mac (StataCorp).

Results

Demographic Variables

Fifty-nine patients (21 males and 38 females; mean age: 64 years) received 223 implants between 2000 and 2013 and attended a follow-

Table 1 Association of Peri-implantitis and Demographic and Clinical Factors Using Logistic Regression Model

Independent variables	OR	95% CI		P
		Min	Max	
Demographic variables				
Gender	1.16	0.50	2.72	.72
Smoking status	0.90	0.38	2.13	.81
Implant position	2.00	1.37	2.90	< .001
Treatment procedure				
One-stage approach	2.21	0.91	5.38	.08
Immediate provisionalization	0.74	0.10	5.43	.76
Clinical variables				
Keratinized tissue	0.89	0.38	2.11	.80
Probing depth	1.70	1.21	2.39	.002
Mucosal recession	1.30	0.81	2.07	.27
Plaque	2.86	1.06	7.70	.04
Bleeding on probing	2.34	0.60	9.20	.22
Follow-up (y)	0.92	0.81	1.04	.23

OR = odds ratio; CI = confidence interval.

Statistically significant correlations ($P < .05$) are bolded.

The independent variable "postextraction site" was omitted from the logistic regression analysis because none of the seven cases in fresh extraction sockets were associated with peri-implantitis.

up visit between January 2016 and December 2017. Of the patients, 37% were smokers. Smoking status and gender did not show any statistically significant correlation with the occurrence of peri-implantitis in the logistic regression analysis (Table 1).

Survival Rate, Success Rate, and Prevalence of Peri-implantitis at the Final Follow-up Visit

A total of 205 implants were still in function and available for clinical evaluation at the final follow-up, with a cumulative survival rate of 91.9% (Table 2). Among 18 failed implants, 6 of them had an early failure

due to a lack of integration (2 in the maxilla and 4 in the mandible), and 1 mandibular implant was lost due to fracture after 6 years. Eleven implants (4.9%) were lost or removed due to peri-implantitis.

During the follow-up visits, 52 implants (23.3% of the whole sample) showed both clinical inflammation and radiographic progressive bone loss. Based on these signs, peri-implantitis was diagnosed on all of them (two cases are described in Figs 1 and 2). By adding these implants to those lost or removed for the same pathology, the prevalence of peri-implantitis was 28.3% at implant level. At the patient level, the prevalence increased to 44%.

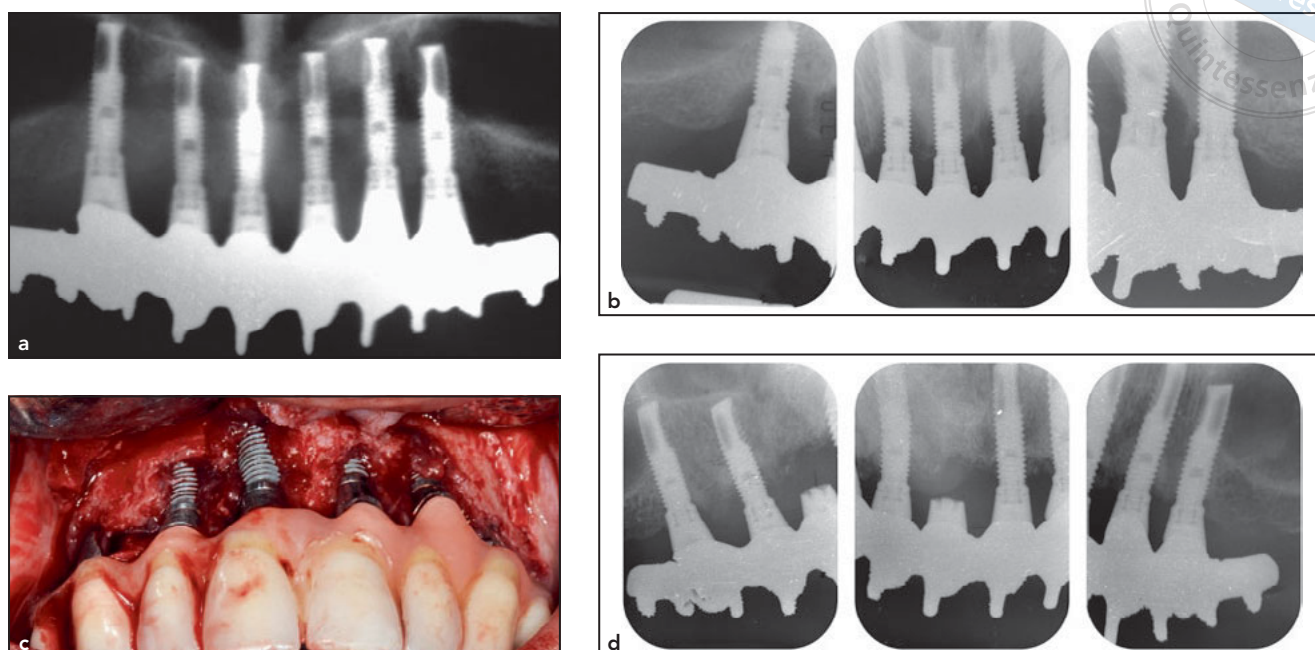


Fig 1 (a) Detail of a panoramic radiograph showing six implants placed in native bone 1 year after final restoration delivery (2007). (b) Radiographic examination 7 years after implant placement (2013) showed that almost all implants suffered advanced marginal bone loss. (c) Intraoperative aspect of the implants affected by peri-implantitis after raising a full-thickness flap. The implant in the right central-incisor position was removed. (d) Radiographic examination 12 months after surgical treatment of peri-implantitis (2014).

Table 2 Survival Analysis and Clinical and Radiographic Variables Recorded During the Final Follow-up Visit

	No. (%)	Mean $\pm$ SD (mm)
Survival analysis (N = 223)		
Lost implants	18 (8.1)	
Fractured	1 (0.4)	
Early failure	6 (2.7)	
Lost due to peri-implantitis	11 (4.9)	
Survived implants	205 (91.9)	
Successful implants	148 (66.4)	
Survived implants with peri-implantitis	52 (23.3)	
Clinical measurements (N = 205)		
Presence of bleeding	167 (81.5)	
Presence of plaque	89 (43.4)	
Presence of suppuration	52 (25.4)	
Presence of keratinized tissue	90 (43.9)	
Probing depth		3.7 $\pm$ 1.3
Mucosal recession		0.5 $\pm$ 0.8
Radiographic measurements (N = 205)		
MBL at T0		1.47 $\pm$ 0.3
MBL at T1		2.28 $\pm$ 1.1
MBL difference between T0 and T1		0.9 $\pm$ 1.0

MBL = marginal bone loss; T0 = baseline (1 year after prosthetic loading); T1 = final follow-up; SD = standard deviation.

No biologic or technical complications were recorded for 148 implants, resulting in an implant success rate of 66.3%. At the patient level, 26 patients (44.8%) experienced no complications in any of their implant-supported restorations.

Implant Position

Among the 223 included implants, 94 of them were placed in the maxilla and 129 in the mandible. In the subgroup of implants with peri-implantitis ($n = 63$), the authors found out that two-thirds (66%) were placed in the posterior mandible whereas the overall proportion of implants placed in the same region was 45% (Figs 3a and 3b).

Of the 11 implants removed due to peri-implantitis, 10 were in

the posterior mandible. Considering the subgroup of implants placed in the posterior mandible, peri-implantitis affected 42% of the implants. This percentage decreases to 32%, 17%, and 11% in the subgroups of implants placed in the anterior mandible, posterior maxilla, and anterior maxilla, respectively (Fig 3c). Logistic regression analysis showed a statistically significant association between the occurrence of peri-implantitis and the position of implants ($P < .001$; OR: 2; 95% CI: 1.4 to 2.9).

Treatment Procedure

71% of the analyzed implants were placed with a cover screw (two-stage approach) and 29% using a healing abutment (one-stage approach). Three percent of implants were placed in fresh extraction sockets, and immediate provisionalization was done on 6% of the implants. Immediate provisionalization, one-stage approach, and implants placed in fresh extraction sockets did not show any statistically significant correlation with peri-implantitis (Table 1).

Clinical Variables

Considering the 205 implants evaluated in the final follow-up visit, 32.2% showed mucosal recession between 1 and 4 mm (mean: 0.56 ± 0.97 mm). The mean probing depth around implants was 3.7 ± 1.05 mm. Bleeding on probing and plaque were assessed in 81.5% and 43.4%

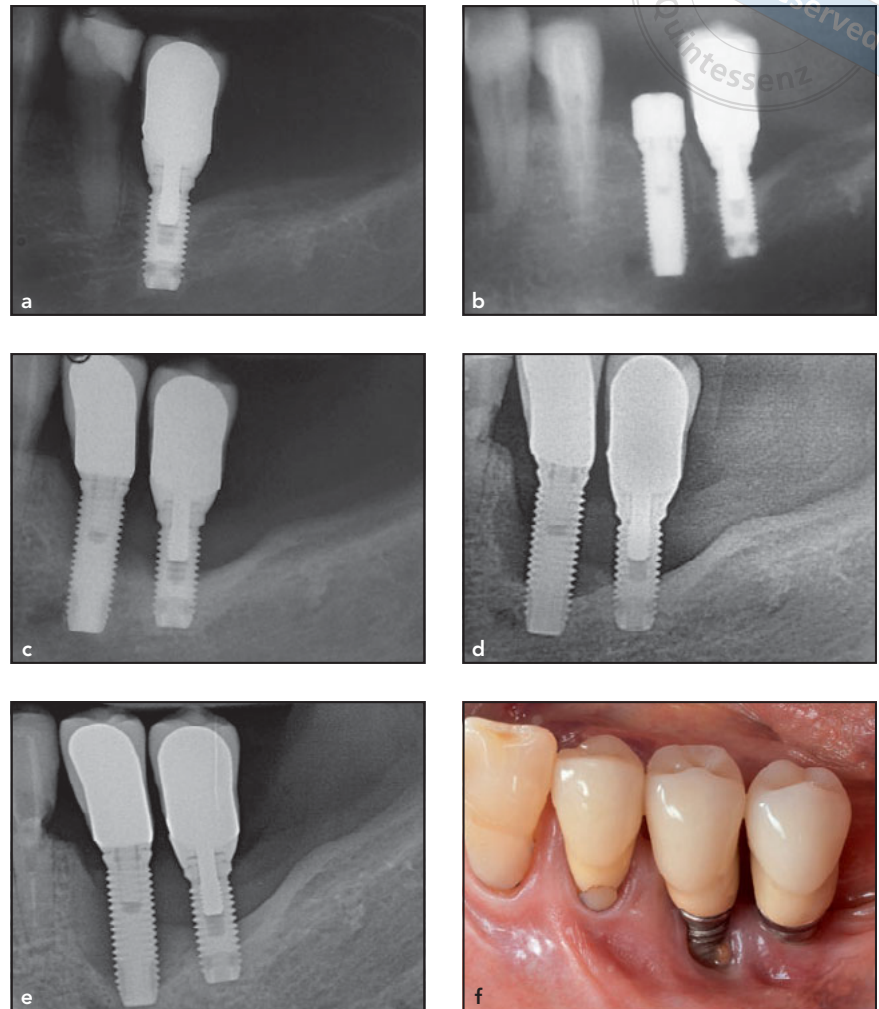


Fig 2 Peri-implantitis progression on different radiographic images. (a) A turned implant was in place for 6 years before the adjacent tooth was extracted (2005). (b) Periapical radiograph after an anodized implant was inserted in the mandibular left second-premolar position. (c) Two years (2007) and (d) 6 years (2011) of follow-up. (e) The implant was still in place at the final follow-up visit (2016). (f) The clinical view of the buccal aspect showing mucosal recession, absence of keratinized tissue and suppuration.

of the implants, respectively. Suppuration was present around 52 implants. Ninety-two peri-implant mucosae (45%) showed an insufficient amount of keratinized tissue. Frequency distribution of probing depth and gingival recession are shown in Figs 4a and 4b. Among

these clinical variables, the probing depth and the presence of plaque showed a statistically significant correlation with the presence of peri-implantitis ($P = .002$; OR: 1.7; 95% CI: 1.2 to 2.4; and $P = .038$; OR: 2.9; 95% CI: 1.1 to 7.7, respectively).

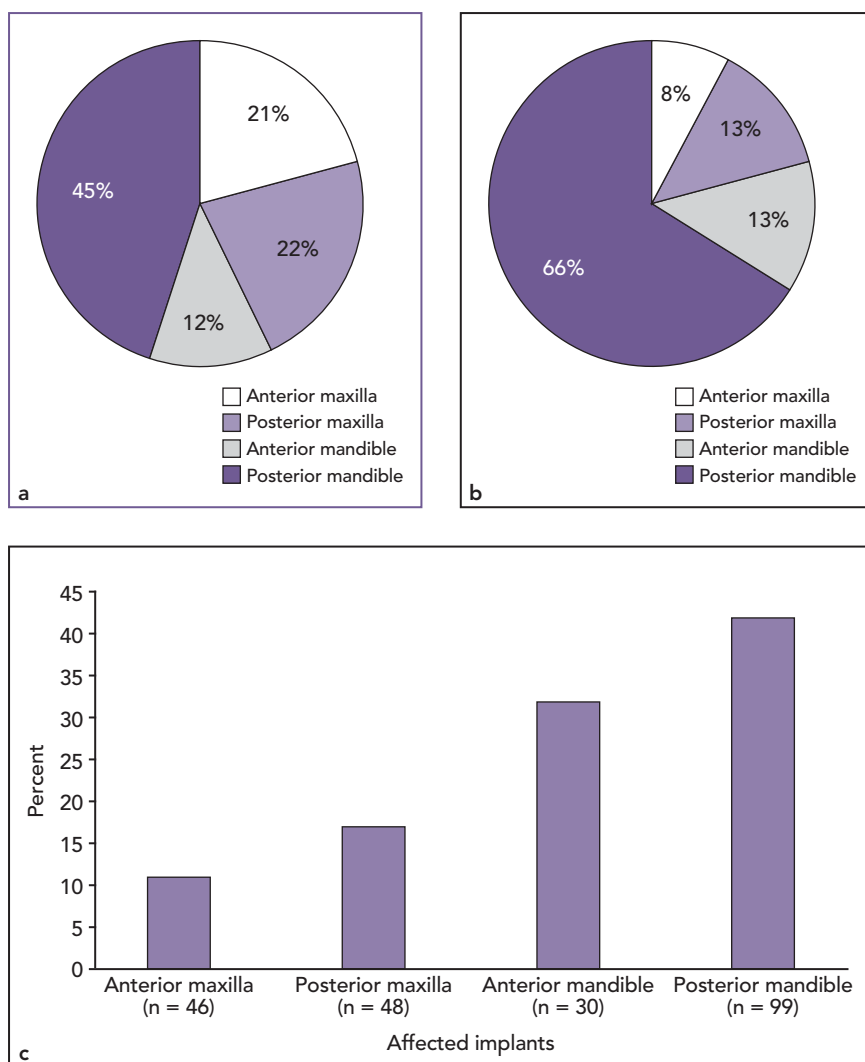


Fig 3 (a) Site distribution of the whole sample (N = 223) and (b) of the implants in the peri-implantitis subgroup (n = 63). (c) Percentage of implants affected by peri-implantitis per oral region.

Radiographic Outcomes

The mean MBLs at T0 and T1 were 1.47 ± 0.3 mm and 2.28 ± 1.1 mm below the implant shoulder, respectively. The difference between mean T0 and T1 MBL was 0.9 ± 1 mm (range: 0 to 6.1 mm). Frequency distribution of marginal bone loss is shown in Fig 4c.

Discussion

This retrospective study provides results of anodized-surface implants placed in native bone after a follow-up period of 5 to 17 years. The patients considered in this study were treated with a fixed implant-supported restoration between 2000 and 2013. Considering

the first anodized-surface implant was proposed to dental clinicians around the year 2000, this led to a rather long follow-up. Not all patients treated during that time were available for a recall visit due to numerous variables: some refused to return, others moved to other cities, and others were deceased within this time frame.

The survival rate of implants analyzed in this study was 91.6% after a mean follow-up of 10.3 years, and the prevalence of implants affected by peri-implantitis was 28.3%. Comparing this result with data from other published studies should be done with extreme caution. Indeed, there are many modifying factors that can contribute to a variation in the results: differences can be found in the definition of peri-implantitis¹⁵ as well as the implant design,¹⁶ surface roughness,⁸ surgical protocol and implant-supported restoration,¹⁷ implant long-term maintenance,¹⁸ and study population.^{19,20}

A retrospective study on turned-surface implants, which was performed by the same research group with more than 20 years of follow-up, reported that the prevalence of peri-implantitis was 1.8%.²¹ Comparing this data with the present study could have the advantage that both investigations were performed in the same environment (same operators and similar patient population, surgical and prosthetic protocols, and supportive periodontal therapy), with only one clear difference: the type of implant surface. The difference in the prevalence of peri-implantitis between anodized- and turned-surface implants (28.3%

vs 1.8%) is noticeable, even moreso considering the different mean follow-up periods (10.3 vs 20.7 years).

Another relevant outcome result is late implant failure. In the present study population, 11 osseointegrated implants (4.9%) were lost due to peri-implantitis. However, in the articles reporting long-term results on turned implants, it is very uncommon to find lost osseointegrated implants. In the aforementioned study by the present group, among 105 analyzed patients with 382 implants placed and follow-ups ranging between 13 and 32 years, only 1 implant was lost after the osseointegration period.²¹ Astrand et al reported, after 20 years of function, again only 1 implant lost (at the 2-year follow-up).²²

A rougher surface is related to a higher susceptibility to peri-implantitis, as reported by some pre-clinical^{10,23} and clinical studies.²² It is, of course, not the only factor that could explain the failure of an implant, but it could play a major role in the long term. Polizzi et al²⁴ found that turned-surface implants have lower survival rates compared to oxidized implants (90.6% vs 96.6%). But after the fifth year of follow-up, 4 oxidized implants and only 1 turned implant were lost in that study. Moreover, 9 out of 10 implants diagnosed with peri-implantitis were oxidized. It could be assumed that a turned-surface implant tends to have a higher failure rate within its first year, but an oxidized-surface implant is more prone to failure in the long term.

In the present study, a higher proportion of implants with peri-implantitis was found in the posterior

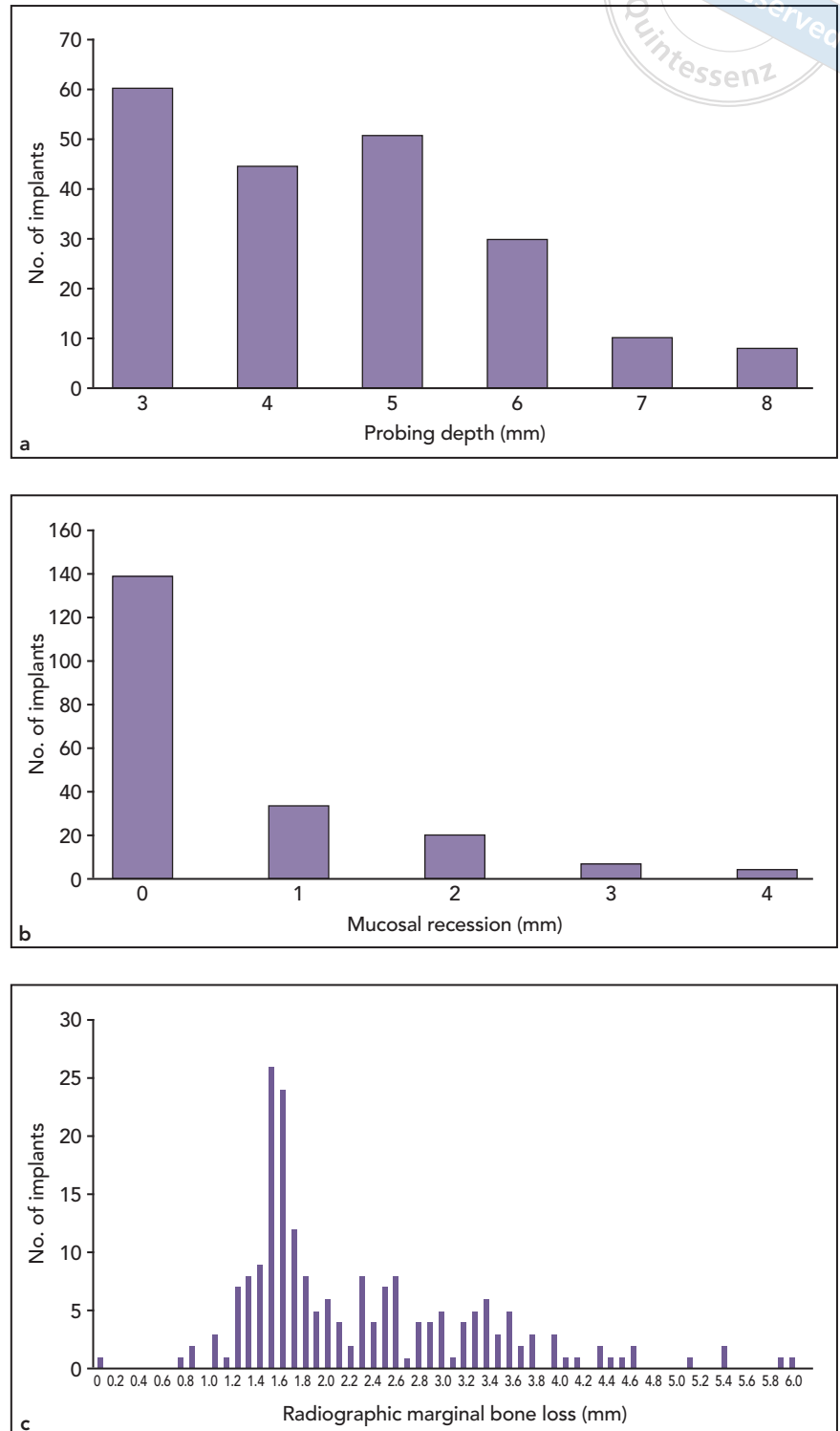


Fig 4 Frequency distribution of (a) probing depth, (b) gingival recession, and (c) radiographic marginal bone loss at the final follow-up visit.

mandible (Figs 3b and 3c), and this difference was statistically significant.

This finding is in accordance with both a previous study published by

the same group on implants placed in vertically regenerated bone²⁵ and with epidemiological data recorded in the Swedish population.²⁶ Interestingly, when turned implants were used in native bone, most early failures were in the posterior maxilla.²⁴ Apparently, different behaviors could be assigned to the turned and the moderately rough surfaces: the former could be a protective factor against the occurrence of peri-implantitis and late failure, whereas the latter appears to be useful in the early phase of healing, mainly when surrounded by an unfavorable bone density (as it is more likely to occur in the posterior maxilla).

As stated in Albrektsson criteria, a successful implant has a MBL of 1.5 mm in the first year of function and thereafter less than 0.2 mm of MBL each year.¹³ Progressive marginal bone loss with clinical signs of mucosal inflammation is a key factor in the diagnosis of peri-implantitis. However, radiographic outcome measurements from the present retrospective study should be interpreted with caution, as baseline MBL was calculated on both periapical and panoramic radiographs; the decision was made considering the best risk/benefit ratio in patient exposure.²⁷ Within this limitation, the mean marginal bone loss of 0.9 mm between T0 and T1 reported herein could be considered a good result if compared with Albrektsson criteria and other studies with similar follow-ups.^{28,29} However, it is also important to note that approximately a quarter of the analyzed implants developed a marginal bone loss greater than 3 mm (Fig 4c). This

extensive exposure of a moderately rough surface to the bacteria in an oral environment could be part of the multifactorial process that leads to an increasing prevalence of peri-implantitis and implant failure. In accordance with this finding, the presence of a deep probing depth is statistically correlated to the presence of peri-implantitis (Table 1). Longer follow-ups of moderately rough surface implants (up to 20 years, as with the turned-implant study) will give the authors a better explanation to this complex biologic process named peri-implantitis.

Conclusions

Within the limitations of this retrospective study, it could be suggested that anodized implants appear to be prone to developing peri-implantitis and to fail in the long-term, mainly in the posterior mandible and in patients with unsatisfactory plaque control around the implant-supported restoration.

Acknowledgments

The authors declare no conflicts of interest.

References

1. Brånemark PI, Hansson BO, Adell R, et al. Osseointegrated implants in the treatment of the edentulous jaw. Experience from a 10-year period. *Scand J Plast Reconstr Surg Suppl* 1977;16:1–132.
2. Simion M, Benigni M, Al-Hezaimi K, Kim DM. Early bone formation adjacent to oxidized and machined implant surfaces: A histologic study. *Int J Periodontics Restorative Dent* 2015;35:9–17.
3. Dierens M, Vandeweghe S, Kisch J, Nilner K, De Bruyn H. Long-term follow-up of turned single implants placed in periodontally healthy patients after 16–22 years: Radiographic and peri-implant outcome. *Clin Oral Implants Res* 2012;23:197–204.
4. Bergenblock S, Andersson B, Fürst B, Jemt T. Long-term follow-up of Cera-One single-implant restorations: An 18-year follow-up study based on a prospective patient cohort. *Clin Implant Dent Relat Res* 2012;14:471–479.
5. Le Guéhennec L, Soueidan A, Layrolle P, Amouriq Y. Surface treatments of titanium dental implants for rapid osseointegration. *Dent Mater* 2007;23:844–854.
6. Rakic M, Galindo-Moreno P, Monje A, et al. How frequent does peri-implantitis occur? A systematic review and meta-analysis. *Clin Oral Investig* 2018;22:1805–1816.
7. Lang NP, Berglundh T, Working Group 4 of Seventh European Workshop on Periodontology. Periimplant diseases: Where are we now?—Consensus of the Seventh European Workshop on Periodontology. *J Clin Periodontol* 2011;38(suppl):s178–s181.
8. Teughels W, Van Assche N, Sliepen I, Quirynen M. Effect of material characteristics and/or surface topography on biofilm development. *Clin Oral Implants Res* 2006;17(suppl 2):s68–s81.
9. Astrand P, Engquist B, Anzén B, et al. A three-year follow-up report of a comparative study of ITI Dental Implants and Brånemark System implants in the treatment of the partially edentulous maxilla. *Clin Implant Dent Relat Res* 2004;6:130–141.
10. Carcuac O, Abrahamsson I, Albouy JP, Linder E, Larsson L, Berglundh T. Experimental periodontitis and peri-implantitis in dogs. *Clin Oral Implants Res* 2013;24:363–371.
11. Berglundh T, Gotfredsen K, Zitzmann NU, Lang NP, Lindhe J. Spontaneous progression of ligature induced peri-implantitis at implants with different surface roughness: An experimental study in dogs. *Clin Oral Implants Res* 2007;18:655–661.

12. Derks J, Schaller D, Håkansson J, Wennström JL, Tomasi C, Berglundh T. Peri-implantitis—Onset and pattern of progression. *J Clin Periodontol* 2016; 43:383–388.
13. Albrektsson T, Zarb G, Worthington P, Eriksson AR. The long-term efficacy of currently used dental implants: A review and proposed criteria of success. *Int J Oral Maxillofac Implants* 1986;1:11–25.
14. Albrektsson T, Buser D, Chen ST, et al. Statements from the Estepona consensus meeting on peri-implantitis, February 2–4, 2012. *Clin Implant Dent Relat Res* 2012;14:781–782.
15. Zitzmann NU, Berglundh T. Definition and prevalence of peri-implant diseases. *J Clin Periodontol* 2008;35(suppl 8): s286–s291.
16. Karoussis IK, Brägger U, Salvi GE, Bürgin W, Lang NP. Effect of implant design on survival and success rates of titanium oral implants: A 10-year prospective cohort study of the ITI Dental Implant System. *Clin Oral Implants Res* 2004; 15:8–17.
17. Pesce P, Canullo L, Grusovin MG, de Bruyn H, Cosyn J, Pera P. Systematic review of some prosthetic risk factors for periimplantitis. *J Prosthet Dent* 2015; 114:346–350.
18. Gay IC, Tran DT, Weltman R, et al. Role of supportive maintenance therapy on implant survival: A university-based 17 years retrospective analysis. *Int J Dent Hyg* 2016;14:267–271.
19. De Bruyn H, Christiaens V, Doornewaard R, et al. Implant surface roughness and patient factors on long-term peri-implant bone loss. *Periodontol 2000* 2017;73: 218–227.
20. Berglundh T, Persson L, Klinge B. A systematic review of the incidence of biological and technical complications in implant dentistry reported in prospective longitudinal studies of at least 5 years. *J Clin Periodontol* 2002;29 (suppl 3):s197–s212.
21. Simion M, Nevins M, Rasperini G, Tironi F. A 13- to 32-year retrospective study of bone stability for machined dental implants. *Int J Periodontics Restorative Dent* 2018;38:489–493.
22. Astrand P, Ahlqvist J, Gunne J, Nilson H. Implant treatment of patients with edentulous jaws: A 20-year follow-up. *Clin Implant Dent Relat Res* 2008;10: 207–217.
23. Albouy JP, Abrahamsson I, Persson LG, Berglundh T. Implant surface characteristics influence the outcome of treatment of peri-implantitis: An experimental study in dogs. *J Clin Periodontol* 2011;38:58–64.
24. Polizzi G, Gualini F, Friberg B. A two-center retrospective analysis of long-term clinical and radiologic data of TiUnite and turned implants placed in the same mouth. *Int J Prosthodont* 2013; 26:350–358.
25. Simion M, Ferrantino L, Idotta E, Zarone F. Turned implants in vertical augmented bone: A retrospective study with 13 to 21 years follow-up. *Int J Periodontics Restorative Dent* 2016;36:309–317.
26. Derks J, Schaller D, Håkansson J, Wennström JL, Tomasi C, Berglundh T. Effectiveness of implant therapy analyzed in a Swedish population: Prevalence of peri-implantitis. *J Dent Res* 2016; 95:43–49.
27. Harris D, Horner K, Gröndahl K, et al. E.A.O. guidelines for the use of diagnostic imaging in implant dentistry 2011. A consensus workshop organized by the European Association for Osseointegration at the Medical University of Warsaw. *Clin Oral Implants Res* 2012;23:1243–1253.
28. Lindquist LW, Carlsson GE, Jemt T. A prospective 15-year follow-up study of mandibular fixed prostheses supported by osseointegrated implants. Clinical results and marginal bone loss. *Clin Oral Implants Res* 1996;7:329–336.
29. Jemt T, Johansson J. Implant treatment in the edentulous maxillae: A 15-year follow-up study on 76 consecutive patients provided with fixed prostheses. *Clin Implant Dent Relat Res* 2006;8(2):61–69.