

Implant Patient Compliance Varies by Periodontal Treatment History

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Background: This retrospective study aims to assess compliance to supportive periodontal therapy (SPT) among patients treated with dental implants with different periodontitis histories and the possible influence of their compliance on peri-implant marginal bone level.

Methods: Dental records of 106 patients treated with at least one dental implant were reviewed. A single operator who did not provide care to the patients recorded the following during the first year of implant function (first year of follow-up), during the first 5 years of follow-up, and during the entire follow-up duration: 1) number of recalls; 2) compliance, calculated from registered attendance; 3) periodontal disease history; 4) peri-implant radiographic bone level from most recent examination; and 5) clinical parameters including probing depth and bleeding on probing. Clinical and radiographic parameters were assessed at site level and analyzed for possible associations among them and with demographic parameters.

Results: Collected data were based on 156 implants with an average of 6.5 ± 3.4 years (range: 1 to 13 years) in function. Patients with periodontitis history demonstrated greater compliance than patients without periodontitis history during the two longer follow-up times. Over time, the majority of patients demonstrated partial compliance (71% to 80% of patients). Peri-implant bone level averaged 0.9 ± 1.1 mm, without significant association with compliance level; however, positive periodontitis history and more years in function were significantly associated with greater peri-implant bone loss.

Conclusions: Patients with implants partially comply with scheduled SPT, regardless of periodontitis history. Patients who had received periodontal treatment demonstrated better compliance than those without prior periodontal therapy experiences. *J Periodontol* 2017;88:846-853.

KEY WORDS

Dental implants; patient compliance; periodontitis.

Periodontal disease prevalence is high, with 47% of adults from a US population diagnosed with chronic periodontitis (CP) and 8.5% with severe disease.¹ If appropriately treated, disease progression can be stopped, and teeth can be maintained long-term.^{2,3} For hopeless teeth, extraction and replacement with dental implants is a common contemporary treatment plan⁴ and constitutes a predictably successful therapy, with survival rates $\geq 95\%$ for implants in function for 10 to 14 years.⁵

Despite predictable success of dental implant therapy, inflammatory disease of peri-implant tissues is a common complication.⁶ Prevalence of peri-implant mucositis and peri-implantitis is reported to be 43% (confidence interval [CI]: 32% to 54%) and 22% (CI: 14% to 30%), respectively.⁷ Peri-implantitis, the peri-implant disease most difficult to treat, occurs in 37% of patients who are periodontally compromised,⁸ which is significantly higher compared with $<2\%$ in patients who are periodontally healthy.⁹ Periodontitis history is positively associated with implant failure risk, even though caution is suggested when interpreting this assertion.¹⁰ More specifically, persistence of probing depths (PDs) ≥ 5 mm after active periodontal therapy¹¹ and non-compliance with a supportive periodontal therapy (SPT) regimen¹² are associated with higher peri-implant bone loss and implant failure risk. Costa et al.¹³ reported that lack of annual SPT in patients diagnosed with peri-implant mucositis was associated with increased

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risk for mucositis conversion to peri-implantitis. Furthermore, a recent clinician survey reported that poor compliance to SPT was one of the most frequently selected risk factors for peri-implantitis.¹⁴

Although the value of SPT has been well established, long-term adherence to SPT remains an apparent challenge; one study reports that less than a third of patients remain completely compliant within 5 years of follow up.¹⁵ Ramseier et al.¹⁶ reported an overall attendance rate of 74.1% after 25.7 years of follow-up, independently of level of compliance. Cardaropoli and Gaveglio¹⁷ suggested that implant placement improves compliance with SPT in patients periodontally treated prior to implant placement.

The present retrospective study aims to investigate compliance with SPT among patients treated with dental implants and to compare SPT compliance among patients with and without periodontal treatment history. Influence of patient SPT compliance on peri-implant marginal bone loss was also investigated.

MATERIALS AND METHODS

Study Design and Study Population

This is a retrospective, university clinic-based study, approved by the Ethics Committee of Sapienza University (Rome, Italy) (ref. 3339/27.11.2014). After giving oral consent, dental records of 180 patients, consecutively treated, who received dental implants by a single operator (CM) and thereafter were maintained with SPT in the same periodontally oriented dental clinic from 1998 to 2013, were reviewed. Data from the dental records of 106 patients (49 males and 57 females, aged 65 ± 11.9 years; mean age: 65 years) were included in the study. An SPT visit schedule was customized for each patient by the same operator. Frequency of recall visits was adapted by CM during the entire follow-up dependent on the periodontal risk of disease recurrence, based primarily on the following: 1) periodontitis history; 2) number of lost teeth; 3) bone loss/age; 4) smoking status; 5) plaque index; 6) number of inflamed sites (bleeding on probing [BOP]); and 7) number of pockets ≥ 5 mm. Motivational reinforcement, supra- and subgingival scaling and debridement, and polishing were the typical treatments provided during the SPT visit. Worsening of self-performed oral hygiene, increase of full-mouth bleeding scores, recurrence of PDs > 5 mm, and/or deepening of previously stable pockets were the criteria used to decide on further active periodontal treatment and/or increased frequency of SPT visits. Patient dental records were screened by a second operator (BZ) not involved in providing any therapy. Data collection was randomly checked by the treating periodontist (CM) to ensure quality control.

Patient dental records were excluded and data not collected when patients met the following exclusion criteria: 1) started SPT < 12 months prior to chart

screening; 2) deceased or relocated during the maintenance program; and 3) patient chart data were insufficient (incomplete/not clearly understandable) for complete data collection.

Data Collection

Collected data included demographic, diagnostic, and treatment information. Specifically, the data collected were as follows: 1) age; 2) sex; 3) periodontal diagnosis (CP or aggressive periodontitis [AgP]); 4) extent and severity of periodontitis according to the 1999 World Workshop classification;¹⁸ 5) implant treatment details (date of placement, number of implants, position in dental arch, placement in native bone/with simultaneous bone regeneration/in previously augmented site, number of years in function until last SPT visit); and 6) SPT visit details (all visits attended by the patient).

For each patient, compliance level with SPT attendance was calculated based on the total number of recall visits attended and the individually prescribed follow-up interval(s). Compliance was assessed for three distinct time periods: 1) first year of implant function (loading); 2) first 5 years of implant function; and 3) > 5 years, for all implants with a follow-up > 5 years. Based on compliance levels proposed by Checchi et al.,¹⁵ patients were divided in three groups: 1) insufficient compliance (IC; $< 50\%$ of prescribed recall visits attended); 2) partial compliance (PC; $< 100\%$ and $> 50\%$ of prescribed recall visits attended); and 3) complete compliance (CC; attended all prescribed recall visits).

Patients were well instructed and motivated in the importance of regular SPT. They were recalled in a systematic way, based on immediately fixing a subsequent recall appointment and by reminding the patient by phone call a few days prior to the scheduled appointment.

The individually prescribed SPT frequency for patients who were treated was decided by a single experienced periodontist (CM), who was the only operator involved in providing periodontal and implant therapy. The frequency judgment was based on evaluation of clinical disease indices, periodontal history, smoking, systemic health status, and personal oral hygiene performance and adapted throughout the follow-up period if changes in the aforementioned parameters were detected.

Mesial and distal marginal bone level was recorded for each implant. Conventional periapical radiographs were taken using the long-cone paralleling technique at permanent restoration delivery and on the most recent SPT visit. Acceptable radiographs were scanned in gray scale, and the obtained image was imported to the software[§] used for bone-level

§ CSN Image Database, Version 3.14, ArchiMed, Turin, Italy.

measurements. Scanned radiographs were considered acceptable for bone-level measurements when the full length of the implant was visible and implant threads were clearly distinguishable. Following image and measurement calibration, based on actual implant length as recorded in the chart, the original image size was enlarged $\times 1.5$, and the implant platform shoulder was used as a reference point for bone-level measurements. Mesial bone level (mbL) and distal bone level (dbL) measurements (in millimeters), performed by a trained and calibrated examiner (BZ), were recorded and analyzed separately. Sites with bone level located coronal to the implant platform were recorded as mbl+ and dbL+ for mesial and distal sites, respectively. Examiner reliability was assessed by performing duplicate measurements, 1 week apart, on 40 randomly chosen distinct radiographs;¹⁹ the difference between duplicate measurements was <0.5 mm. Implants were diagnosed with peri-implantitis if the radiographic distance between bone crest and implant platform was >2 mm.⁷

The following clinical parameters were recorded from follow-up visits: 1) mean percentage of recalls with BOP sites and 2) number of sites with PD ≥ 4 mm at mesial and distal levels (either vestibular or lingual) at permanent restoration delivery. Clinical parameters were assessed on six sites per implant (mesio-buccal, buccal, disto-buccal, disto-lingual, lingual, and mesio-lingual) and recorded by a single operator with 21 years of experience in periodontology (CM).

Statistical Analyses

The primary parameter was level of SPT compliance, expressed as percentage of recall visits attended relative to total number of recall visits prescribed during the specific follow-up period. Clinical and radiographic parameters were assessed at site level and analyzed for possible associations among them and with demographic parameters. Descriptive statistics were calculated and reported. Between-group differences were analyzed by parametric and non-parametric tests depending on data normality, as appropriate. Student *t* test and Mann-Whitney *U* test were used to determine level of statistical significance (set at $\alpha < 0.05$). Frequency distribution analyses among patient groups were performed using Fisher exact test (Freeman-Halton extension). Uni- and multivariable linear and logistic regressions were fitted to explore association of demographic and clinical data (periodontal history, presence of PD ≥ 4 mm, frequency of positive BOP over SPT, years in function, and recall visits) with the primary parameter and peri-implant bone level. Mixed (linear and logistic) models were used to take account of clustering

of patients/implants. Data analysis was performed using commercially available software.^{||}

RESULTS

Population and Compliance

Population, periodontal history, and prevalence of peri-implantitis. Demographic information of the study population is reported in Table 1. Reasons for exclusion of 74 patient dental records were related to patient death ($n = 8$), relocation to different city ($n = 26$), or insufficient/unclear clinical or radiographic chart data ($n = 40$). From the 106 patient dental records, data on 156 implants with 6.5 ± 3.4 years in function (range: 1 to 13) were analyzed. Implants inserted and evaluated in this study were of different brands; however, most were implants with blasted[¶] or laser-textured[#] surface.

Almost two-thirds of the patients (61%) had a periodontitis (P) diagnosis; of those, 86.2% were diagnosed with CP and 13.8% with AgP (Table 1). Distribution of smokers in the P and non-periodontitis (NP) groups was similar, with 50% of patients in the P group and 42% of patients in the NP group being smokers. Mean number of implants per patient was 3.0 ± 2.4 ; this number was significantly greater in patients in the P group (3.8 ± 2.6) than in those without periodontitis history (NP; 1.9 ± 1.6 ; $P = 0.001$). The majority of implants (57%) replaced maxillary teeth. The two most frequently replaced teeth were mandibular first molars and maxillary first premolars (18% and 16% of implants, respectively). Simultaneous bone augmentation was performed in 26% of the implants placed.

Prevalence of peri-implantitis, based on radiographic bone level >2 mm apical to implant platform, was 9.4% at patient level, 10.9% at implant level, and 10% at site level. All patients with peri-implantitis were in group P and were systemically healthy; 40% of those with peri-implantitis were smokers, and seven of 17 implants had initial PD ≥ 4 mm.

SPT compliance. SPT compliance was $80\% \pm 32\%$ (range: 0% to 100%) in the first year of implant function and decreased to $73\% \pm 23\%$ (range: 10% to 100%) during the first 5 years of follow-up, and to $71\% \pm 24\%$ (range: 15% to 100%) when implants were followed for >5 years. Similarly, the number of patients available for compliance assessment decreased with increased follow-up time, with 63 of the 106 patients having follow-up at >5 years (Table 2). During the first year of implant function, there was no statistically significant difference in SPT compliance

^{||} STATA version 13.1, StataCorp LP, College Station, TX.

[¶] Astra Tech implants (TiOBlast or OsseoSpeed surface), Astra Tech AB, Mölndal, Sweden.

[#] Geass implants (Synthegra surface), Geass srl, Pozzuolo del Friuli, Udine, Italy.

Table 1.
Demographics of Study Population

	Patients, n	Age (years), Mean $\pm$ SD	Smoking Status, n (current/former/never)	Periodontal History, n		
				Healthy or Gingivitis	CP (slight/moderate/severe)	AgP (slight/moderate/severe)
Females	57	64.9 $\pm$ 11.4	18/03/36	21	6/9/20	0/0/1
Males	49	65.1 $\pm$ 12.3	19/08/22	20	2/12/12	0/0/3
Total	106	65.0 $\pm$ 11.9	37/11/58	41	8/21/32	0/0/4

between patients from NP and P groups ($P = 0.50$; Table 2). However, during the two longer follow-up periods, P patients had a significantly higher SPT compliance than NP patients ($P \leq 0.002$; Table 2).

The frequency distribution of compliance levels, according to the Checchi et al.¹⁵ classification, is shown in Table 3. There were no statistically significant differences in compliance level distribution between NP and P groups at any of the three evaluated time periods (Table 3). However, group P consistently had a higher proportion of patients at the CC level, at all three time points (Table 3). For the entire study population, and for each of the two groups (NP and P), the prevalence of CC decreased over time; during the two longer follow-up periods PC became the most prevalent compliance level (62% to 80% of patients).

The number of recall visits per year was patient-based. Table 4 shows the average recall visits per year attended during the first year, 5 years, and overall follow-up period. No significant differences were found between NP and P groups for any of the time periods ($P \geq 0.99$ for each time period). However, when the average annual recalls were compared within each group over time, the NP group showed a statistically significant decrease ($P = 0.001$) at 5 years, whereas in the P group differences were non-significant ($P = 0.06$) (Table 4).

Multivariate regression analysis revealed that, contrary to the number of implants ($P = 0.01$), implant time in function did not have a significant effect on compliance level ($P = 0.20$).

Implant-Related Parameters

Radiographic bone level. When measuring implant marginal bone levels, operator reproducibility was found to be 88%. From the evaluated 156 implants, 311 sites (155 mesial and 156 distal) were measured. One mesial site was not clearly visible due to adjacent anatomic element superimposition. Table 5 shows distribution of bone levels in the entire sample. Mean mbl was 0.9 ± 1.3 mm (range: 0 to 5.8) and mean dbl was 0.9 ± 1.1 mm (range: 0 to 5.0). Only 10% of sites were measured to have bone level >2 mm apical to the implant platform.

Peri-implant marginal bone loss was significantly influenced by time in function and periodontitis history but not by anatomic site (data not shown). Both mbl and dbl were significantly greater at longer time points (mbl, $P = 0.001$; dbl, $P = 0.02$). No significant influence of time in function was found for peri-implant bone levels coronal to the implant platform (mbl+, $P = 0.97$; dbl+, $P = 0.16$).

Patients from group P had significantly greater peri-implant bone loss compared with those without periodontitis (mbl, $P = 0.02$; dbl, $P = 0.02$). Such

Table 2.**Compliance* of Study Population by Time Period**

Time Period	NP (n)	P (n)	P Value	All (n)
1 year	78 ± 34 (41)	82 ± 32 (65)	0.50	80 ± 32 (106)
5 years	63 ± 20 (25)	78 ± 23 (46)	0.002†	73 ± 23 (71)
>5 years	59 ± 22 (21)	77 ± 23 (42)	0.001†	71 ± 24 (63)

Reported values (in percentage) are mean ± SD.

* Compliance calculated as percentage of prescribed follow-up visits attended.

† Statistically significant difference between NP and P groups (Mann-Whitney *U* test).

Table 3.**Compliance Prevalence by Time Period According to Checchi Classification¹⁵**

Periodontal history	Time Period											
	1 year				5 years				>5 years			
	IC	PC	CC	Total	IC	PC	CC	Total	IC	PC	CC	Total
All, % (n)	13 (14)	17 (18)	69 (74)	100 (106)	13 (9)	69 (49)	18 (13)	100 (71)	19 (12)	68 (43)	13 (8)	100 (63)
NP, % (n)	15 (6)	20 (8)	65 (27)	100 (41)	16 (4)	80 (20)	4 (1)	100 (25)	33 (7)	62 (13)	5 (1)	100 (21)
P, % (n)	12 (8)	15 (10)	73 (47)	100 (65)	11 (5)	63 (29)	26 (12)	100 (46)	12 (5)	71 (30)	17 (7)	100 (42)
P value	0.78				0.07				0.10			

P values indicate significance of differences in frequency distribution between NP and P groups for each time point (Fisher-Freeman-Halton test).

differences between P and NP groups were not observed when considering the sites with bone levels coronal to the implant platform.

Clinical parameters. At permanent restoration delivery, 118 sites had PD ≥4 mm in a total of 300 measurements reported. Presence of PD ≥4 mm was associated more prevalently with positive periodontal history, although the difference did not reach statistical significance ($P = 0.15$). Furthermore, correlation between PD ≥4 mm and risk of >2 mm of marginal bone loss around the implant was not statistically significant for either mesial (Pearson $\chi^2[1] = 0.3$, conditional probability [Pr] = 0.6) or distal sites (Pearson $\chi^2[1] = 0.1$, $Pr = 0.7$).

In almost 70% of implants no bleeding was recorded during the entire follow-up. Among the group with recurrent BOP, mean percentage of recalls with BOP sites was 20% (±11%). This recurrence was not associated with periodontal history ($P = 0.57$).

Relationship Between Compliance and Implant-Related Parameters

Compliance level was not significantly associated with mesial or distal bone levels at any of the three time points (data not shown). At the patient level, the focus was on the association of bone loss >2 mm and

compliance level. There were no differences in distribution of bone loss ≤2 and >2 mm among the three compliance levels at any time point (Table 6).

DISCUSSION

Patient education and an individual risk-tailored SPT, essential for long-term success of therapy, cannot be effective without patient compliance. The purpose of the present retrospective, practice-based study is to determine compliance with SPT among patients treated with dental implants with and without periodontal treatment history. With an average implant in function time of 6.5 years, patients with implants showed a high compliance level (71% to 80% on average) during follow-up, whereas patients with a history of periodontitis had significantly higher compliance after the first year of follow-up. These results suggest that implant treatment, despite the required financial and time commitments, and any associated morbidity, fails to motivate properly educated patients to fully comply with maintenance therapy. The significantly higher compliance level by patients with periodontitis history might reflect their prior exposure to and longer education regarding the significance of SPT. However, the fact that both patient groups eventually presented with partial long-term

Table 4.**Average Recall Visits Attended During Each Follow-Up**

Time Period	NP	P	P Value	Total
1 year	1.5 ± 0.8 (0 to 4) (n = 41)	2.2 ± 1.1 (0 to 4) (n = 65)	0.99	1.93 ± 1.02 (0 to 4) (n = 106)
5 year	0.8 ± 0.68 (0 to 2)* (n = 24)	1.9 ± 1.1 (0 to 5) (n = 47)	>0.99	1.5 ± 1.1 (0 to 5) (n = 71)
Entire period	1.28 ± 0.55 (0.3 to 2.7) (n = 41)	1.6 ± 0.7 (0.4 to 3) (n = 64)	>0.99	1.6 ± 0.72 (0.3 to 3) (n = 105)

Values expressed in mean ± SD (range).

* Statistically significant intragroup difference between time periods.

Table 5.**Bone Level Distribution Among the Measured Sites**

Bone Level	>2 mm % (n)	≤2 mm % (n)	0 % (n)	bl+ % (n)	Total % (n)
mbi	10 (15)	46 (71)	37 (57)	15 (23)	100 (156)
dbi	10 (16)	43 (67)	33 (51)	14 (21)	100 (155)
Total	10 (31)	44 (138)	35 (108)	14 (44)	100 (311)

bl+, bone level localized coronally to implant level.

Table 6.**Distribution of Bone Level by Compliance Level and Follow-Up Time Period**

Bone Level	Compliance 1 Year				Compliance 5 Years				Compliance Over 5 Years			
	IC	PC	CC	Total	IC	PC	CC	Total	IC	PC	CC	Total
Bl ≤ 2 mm, % (n)	11 (4)	5 (2)	83 (29)	100 (35)	4 (1)	71 (17)	25 (6)	100 (24)	8 (2)	75 (18)	17 (4)	100 (24)
Bl > 2 mm, % (n)	9 (4)	26 (11)	64 (27)	100 (42)	8 (2)	72 (19)	19 (5)	100 (26)	14 (3)	73 (16)	14 (3)	100 (22)
P value	0.3				0.5				0.6			

Bl = bone loss.

Values expressed in percentage. P value (multivariate analysis).

compliance highlights the real challenges encountered by professionals when trying to deliver effective long-term maintenance care.

The overall compliance level reported in the present study is comparable to Frisch et al.²⁰ (86% to 94% at 3-year follow-up). Despite a decrease in complete compliance over time, over 62% of patients in the present study remained at least in the partial compliance group, even when follow-up exceeded 5 years. Insufficient compliers, known to be at higher risk for implant failure and biologic complications,^{12,17,21,22} represented 11% to 33% of patients, with no significant difference between patients with and without periodontitis history.

Besides periodontal treatment history, implant number and frequency of recalls had a positive impact on compliance level. The impact of previous periodontitis treatment, frequent recalls, and number

of implants on compliance is also in agreement with published results.²⁰ The fact that the majority of patients in the present study had a history of periodontitis, a group that had consistently more recall visits, might explain the overall good compliance level observed in the present study. Implant placement itself seems to improve compliance levels,¹⁷ presumably because of influences related to treatment cost. In patients with periodontitis history, implant maintenance is more expensive than tooth maintenance due to the more frequent recurrence of peri-implant inflammation compared with periodontitis.²³ Given the patient sensitivity toward treatment costs, patient motivation and education should include information on the potential increased treatment costs when maintenance therapy is not adequately followed.

Prevalence of peri-implantitis was relatively low (9.4%), even though a 2-mm bone loss threshold was used. All patients with peri-implantitis had a previous history of periodontitis; assessment of differences between periodontitis diagnosis (CP and AgP) was not possible due to limited sample size in the AgP group. The present study finding of peri-implantitis association with periodontitis history is consistent with previous reports and with the latest systematic review and meta-analysis;²⁴ however, the predictability of previous history of periodontal disease as a risk factor for dental implant loss has been recently questioned.¹⁰ Other risk factors failed to show association with peri-implantitis diagnosis as none of the patients with peri-implantitis presented systemic disease and prevalence of smokers among them was not different than prevalence in the entire study population.

In the present study, the importance of adherence to prescribed SPT on implant marginal bone level was evaluated. The marginal bone loss reported in the present study was almost half of the loss reported by Jemt et al.,²⁵ where mean marginal bone loss was 1.6 mm, but more than double the loss (0.36 mm) reported by Vervaeke et al.²⁶ An additional difference between the present and the aforementioned studies is follow-up time (twice as long in the present study). Collectively, these results suggest that with proper SPT compliance peri-implant bone levels can be maintained over long periods of follow-up, even in patients with periodontitis history, which is in agreement with Tan et al.²⁷ Nevertheless, diagnosis of peri-implantitis based solely on bone level examination by periapical radiographs may lead to underestimation, given that clinical (intrasurgical) determination of peri-implant bone levels often results in detection of greater bone loss than radiographic assessment.^{28,29} Initial PDs ≥ 4 mm were recorded only in 41% of implants radiographically diagnosed with peri-implantitis, failing to show association with radiographic results or a predictive value for bone loss. However, this result should be regarded with caution given the small number of peri-implantitis cases.

Number of years in function and periodontitis history were associated with greater peri-implant marginal bone loss in the present study. Association of periodontal history with greater peri-implant bone loss is not in agreement with previous findings.¹² In the present study, compliance did not have significant association with peri-implant bone level. This finding should be cautiously interpreted to avoid underestimating the importance of compliance to maintenance of peri-implant tissue health. It appears that partial compliance (majority of patients in the present study) might be sufficient for most patients. Realistically, provider efforts should be made to avoid having partially compliant

patients turn into insufficient compliers, a group that is considered at risk for further complications.^{12,15,22}

The present study, given its retrospective nature and single clinic origin, has certain inherent, design-dependent limitations. In addition, the small sample size of some subgroups (e.g., AgP), and the lack of consideration for other possible risk factors²⁶ also constitute limitations. Nevertheless, the study results provide additional information on compliance level of patients treated with implants with and without periodontitis history and on its possible significance for maintenance of peri-implant tissue health. Prospective, large-scale studies are needed to decipher in detail how compliance could impact peri-implant soft and hard tissue health, as well as what constitutes an adequate maintenance schedule for implant patients who have no previous periodontitis history.

CONCLUSIONS

Patients treated with oral implants behaved mainly as partial compliers with respect to supportive periodontal maintenance, whereas those with added periodontitis history complied better. It appears that this level of compliance could be acceptable with respect to maintenance of peri-implant bone levels. Periodontal patients seeking implant treatment is a common occurrence in private practice, and they constitute a risk group for peri-implantitis, despite supportive care.

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