Fixed Prosthodontic Treatment Outcomes in the Long-Term Management of Patients with Periodontal Disease: A 20-Year Follow-Up Report

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Purpose: The aim of this long-term cohort study was to evaluate the efficacy and complications of fixed partial dentures in a convenience sample of 100 patients with periodontal disease who were treated and maintained periodontal patients after 20 years. ***Materials and Methods:*** After active treatment, including periodontal surgery and endodontic and prosthetic treatment, patients were enrolled in a supportive periodontal care (SPC) program with 3- to 6-month recalls. All patients showed clinical data recorded at *(1)* the original consultation (T0), *(2)* the first SPC visit following the completion of prosthetic treatment (T1), and *(3)* at the latest SPC clinical session 20 years after T1 (T2). Multivariate analyses were performed to investigate the influence of clinical variables on the risk of prosthetic abutment (PA) loss after 20 years' visits. ***Results:*** The final sample comprised 100 patients. At T1, a total of 948 PAs represented the original sample of experimental teeth. At the 20-year follow-up, a total of 854 PAs (90.1%) were still in function, while 94 (9.9%) PAs in 41 patients (41%) were lost during SPC; 98% of lost PA were endodontically treated. Vertical root fracture (48%) was the major cause of PA loss, while progression of periodontitis caused 31% of PA loss. Age ($P = .002$), Full-Mouth Plaque Score ($P < .0001$), Full-Mouth Bleeding Score ($P = .0002$), and oral parafunctions ($P = .0083$) were associated with increased probability of PA failure. Among clinical-related factors, endodontic treatment ($P = .0082$), root resection/amputation ($P < .0001$), multi-rooted teeth ($P = .0005$), and abutment associated with parafunction ($P < .0001$) were associated with increased risk of abutment loss after 20 years. ***Conclusions:*** Perioprosthetic treatment in compliant patients is highly successful after 20 years of SPC. *Int J Prosthodont 2015;28:246–251. doi: 10.11607/ijp.3995*

Periodontal diseases are a group of diseases affecting periodontal tissues (ie, alveolar bone, periodontal ligament, cementum, and gingiva). While many different diseases affect these tooth-supporting structures, by far the most common of these are the plaque-induced inflammatory conditions gingivitis and periodontitis.[1] Periodontitis is usually preceded by gingivitis, although, in some sites or individuals, gingivitis never progresses to periodontitis.[2] Albandar et al's data[3] from a large nationally representative, stratified, multistage probability sample in the United States reported that while more than 30% of adults had periodontal disease, periodontitis was not uniformly distributed among various races, ethnicities, and socioeconomic groups.

Tooth loss is a frequent complication of advanced periodontitis. However, long-term studies show a low incidence of tooth loss for patients enrolled in a regular maintenance program.[4] Extractions during active periodontal therapy remain a controversial issue because several clinical factors—amount of bone loss, pocket depth, tooth mobility, and severity of furcation involvement—influence a decision to retain compromised teeth.[5] Furthermore, the retention of severely periodontally compromised teeth does not necessarily affect maintenance of attachment levels of adjacent teeth following therapy.[6]

Current recruitment of implant therapy to replace periodontally compromised teeth is challenged by reports that patients with a history of periodontitis may encounter a higher number of complications and

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lower implant survival.[7] On the other hand, teeth replacement by means of fixed partial dentures (FPDs) remains a viable treatment option that employs a diversity of updated techniques and materials.

Robust, long-term fixed prosthodontic treatment outcome studies in patients with periodontitis are uncommon. This study sought to evaluate the long-term effectiveness of fixed prosthodontic treatment in well-maintained patients with periodontitis over a 20-year follow-up period.

Materials and Methods

This retrospective study comprised a convenience sample of 100 patients—67 women and 33 men—with an age range of 20 to 64 years (42.32 ± 9.47 years) at the time of the original consultation; 24% were confirmed smokers. The consecutive patient selection was recruited from a population receiving routine supportive periodontal care (SPC) in a private office. All patients indicated their acceptance to participate in the study by signing an informed consent. All clinical treatments, including long-term maintenance and data collection, were carried out by two expert operators (GDF and GC).

Following the initial diagnosis (T0), all patients received cause-related therapy, including oral hygiene motivation and instruction, coronal and subgingival scaling, as needed, followed by re-evaluation, and a definitive treatment plan. The latter included periodontal surgery (fiber retentive osseous resective surgery [FibReORS]) and endodontic and prosthodontic treatment. A mouth-guard was prescribed for 45% of the patients with a history of oral parafunction following insertion of definitive restorations. SPC recalls were performed every 3 months in 70% of patients and every 6 months for the other 30%.

The following clinical parameters were recorded for all of the enrolled patients on three separate occasions: *(1)* at the original consultation (T0), *(2)* at the first SPC visit following the completion of prosthodontic treatment (T1), and *(3)* at the latest clinical SPC session, 20 years after T1 (T2).

Clinical Evaluation

Probing depth (PD) was measured at four sites per tooth (buccal, lingual, deepest mesial, and distal) using a UNC-15 periodontal probe; results were recorded in a periodontal chart. Dental plaque and bleeding were also dichotomously evaluated at four sites per tooth. Full-Mouth Plaque Scores (FMPS) and Full-Mouth Bleeding Scores (FMBS) were then calculated. Furcation involvements were recorded by using a Nabers 2 probe according to Hamp classification. All measurements were performed at T0, T1, and T2. A set of updated full-mouth dental radiographs was prescribed for each patient to evaluate residual bone support at T0, T1, and T2.

Data Collection

Information about each participant's sex, age, smoking habits (self-reported as current, former, or never), prosthetic abutment, interval of SPC (average interval in months defined as duration of SPC divided by number of appointments), tooth loss, furcation involvements, FMPS (in percentage) and FMBS (in percentage) was collected at the T2 visit. All records were used for statistical analysis consideration.

Data Management and Statistical Analysis

After proofing for entry errors, the database was locked and loaded in SAS format (Statistical Application Software, SAS Institute). All calculations were performed using SAS version 9.2.

Means, SDs, and frequency distributions were calculated for all variables. The outcome variable was the prosthetic abutment (PA) loss at the last SPC visit. Patients were stratified between two groups: patients who retained all PAs and patients who lost at least one PA.

The significance of differences between groups in term of numerical data was evaluated with the independent samples *t* test. Categorical data were analyzed with the chi-square test; percentage data between two groups were compared with the Mann-Whitney test.

Univariate analysis was performed to evaluate the possible influence of patient-related and clinical variables on the probability of PA loss. Multivariate analysis also was performed to evaluate which factors found significant with univariate analyses remained as such after adjusting for confounding effects between the variables. Adjusted odds ratios and corresponding 95% confidence intervals (95% CI) were generated for all significant variables. Significance level used was $P < .05$.

Results

At the first SPC visit following the completion of prosthodontic treatment (T1), a total of 948 PAs in 100 patients were evaluated, representing the original sample of experimental teeth. Out of this sample, 477 PAs were single rooted, 79 PAs corresponded to bi-rooted elements, while the residual 392 PAs corresponded to multi-rooted teeth. A total of 214 FPDs and 329 intermediate elements were available at T1.

Table 1 Descriptive Statistics

	Groups		Differences between groups *P*
	No tooth loss (n = 59)	At least 1 tooth loss (n = 41)	
Age (y)	40.5 ± 9.28	45.0 ± 9.21	.017
Sex			
Male (%)	16 (27.1)	17 (41.5)	.1335
Female (%)	43 (72.9)	24 (58.5)	
FMBS %	1.03 ± 1.40	2.63 ± 2.14	< .0001
FMPS %	10.47 ± 3.72	15.97 ± 5.47	< .0001
Smoking habits			
Smokers (%)	13 (22.0)	11 (26.8)	.5808
Nonsmokers (%)	46 (78.0)	30 (73.2)	
Supportive periodontal care	44 (74.6)	26 (63.4)	.2309
Every 3 mo (%)	15 (25.4)	15 (36.6)	
Every 6 mo (%)			
Parafunctions			
Yes (%)	20 (33.9)	25 (61.0)	.0074
No (%)	39 (66.1)	16 (39.0)	

FMBS = Full-Mouth Bleeding Score; FMPS = Full-Mouth Plaque Score.

Table 2 Univariate Analysis to Assess the Effect of Some Patient-Related Factors on the Risk for Prosthetic Abutment Loss

	OR	95% CI	*P*
Age (y)	1.056	(1.008–1,105)	.002
Sex			
Male	–		.1358
Female	1.904	(0.817–4.435)	
FMPS	1.315	(1.166–1.482)	< .0001
FMBS	1.682	(1.279–2.212)	.0002
Smoking habits			
Yes	1.297	(0.514–3.273)	.58
No	–		
Supportive periodontal care			
Every 3 mo	–		
Every 6 mo	1.692	(0.713–4.017)	.2329
Parafunctions			
Yes	3.047	(1.332–6.968)	.0083
No	–		

OR = odds ratio; CI = confidence interval; FMPS = Full-Mouth Plaque Score; FMBS = Full-Mouth Bleeding Score.

Considering abutments and intermediate elements, a total of 1,277 prosthetic elements were available at T1. During active treatment, a total of 67 patients were treated with root resection/separation corresponding to a final sample of 170 crowns on root-resected molars. A total of 125 PAs at single tooth was available: 23% were root-resected molars. The number of PAs in the same fixed restoration varied from to 2 to 14 units. In addition, a total of 35 patients showed splinted arches, 24 at the maxilla and 6 at the mandible; 5 patients showed splinted arches at both.

At the latest clinical SPC session, 20 years after T1 (T2), a total of 854 PAs (90.1%) were still in function, while 94 (9.9%) PAs in 41 patients (41%) were lost during SPC; out of this sample, 93 PAs (98%) were endodontically treated. In 18 patients, a single PA was lost, in 12 patients 2 PAs, in 3 patients 3 PAs. The residual 8 patients experienced the loss of 4 to 8 PAs. Twenty-four PAs (2.5%) were lost between 1 to 10 years of follow-up, 37 (3.9%) between 11 and 15 years, and 33 (3.5%) between 16 and 20 years. At T2, the original fixed arch had survived in16 patients. A sample of 38 failed PAs caused the removal of FPDs for a total of 72 prosthetic elements. Dental implants were used in 14 patients to restore an FPD and in one patient to reconstruct a full arch in the maxilla. A total of 28 FPDs (8.5%) supported by multi-abutments showed the loosening of at least one PA: Original FPDs survived in four patients. At T2, the mean FMPS was 12.73 ± 5.26 (range: 3 to 32), while the mean FMBS at T2 was 1.69 ± 1.91 (range: 0 to 8). Both periodontal parameters were associated with the risk of loosening PAs ($P < .0001$).

Vertical root fracture (48%) was the major cause for PA loss while progression of periodontitis caused 31% of PA loss. Caries (11%), horizontal fractures (4%), endodontic failure (3%), and cement wash-out (3%) were associated with the loss of 20 residual PAs; 30% of failed PAs were associated with smoking habits. Failure of PAs during SPC was related also with a loss of 185 intermediate elements: 50 were lost between 1 to 10 years follow-up, 76 between 11 and 15 years, and 59 between 16 and 20 years. Lost PAs were more frequently multi-rooted (56%) than single rooted (36%) teeth. Often, lost PAs were associated with root resection/separation (42%). Lost PAs also were repeatedly associated with oral parafunctions ($P = .0074$). In Table 1, descriptive statistics stratified for the single event of PA loss are presented.

A univariate analysis for exploring potential patient-related factors predicting the event of PA loss is presented in Table 2. Age ($P = .002$), FMPS ($P < .0001$), FMBS ($P = .0002$), and oral parafunctions ($P = .0083$) were associated with increased probability of PA failure. A multivariate analysis was also carried out considering only significant predictors in the univariate analysis (Table 3), confirming that age ($P = .0117$) and FMBS ($P = .0003$) were associated with increased risk of PA failure. When considering in the multivariate analysis the sex variable, a significant association between FMBS ($P = .0011$) and risk of PA failure was detected in the female group but not in males.

A univariate analysis for exploring potential clinical-related factors in predicting the event of PA loss is presented in Table 4. Endodontic treatment ($P = .0082$),

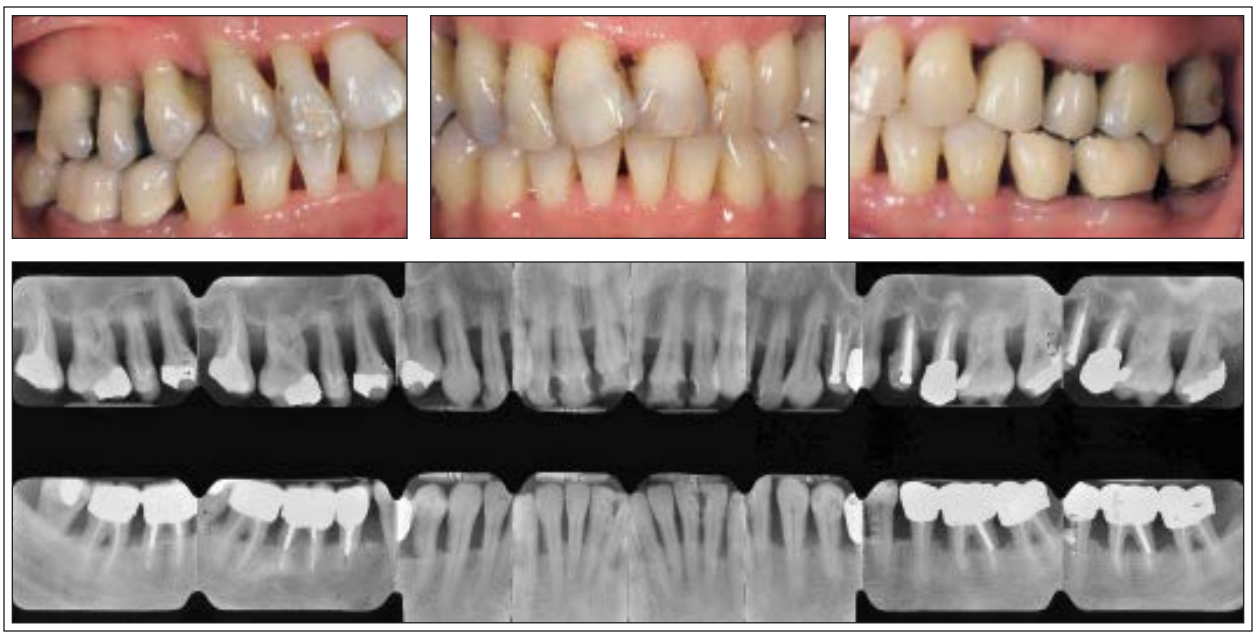

Fig 1 Patient with chronic periodontitis at baseline examination (1990).

root resection/amputation (P = .0001), multi-rooted teeth (P = .0005), and abutment associated with oral parafunction (P = .0001) were associated with increased risk of abutment loss after 20 years. The results of the multivariate analysis confirmed also that endodontic treatment (P = .0229), number of roots (P < .0030), and abutment associated with oral parafunction (P < .0001) predicted higher risk for tooth loss at the final follow-up. A clinical case is presented in Figs 1 to 3.

Discussion

Longitudinal studies in periodontal patients have demonstrated that progression of periodontitis may be prevented or significantly decreased when proper therapy is provided for compliant patients.[8,9] Tooth survival remains the identifiable measure of periodontal therapeutic success[10] as confirmed in long-term studies when an SPC program is carefully followed by compliant patients over the long term.[11,12] On the other hand, information concerning loss of prosthodontic abutments in periodontal patients is very limited, although a higher incidence of biologic and technical complications may be expected.[8]

At the 20-year follow-up point of this report, 90.1% of PAs were still in function, while 9.9% of PAs in 41 patients were lost during SPC. Vertical root fracture (48%) was the major cause for PA loss while progression of periodontitis caused 31% of PA loss. Some patient-related factors such as age (P = .002), FMPS (P < .0001), and FMBS (P = .0002) predicted the risk

Table 3 Multivariate Analysis to Assess the Effect of Some Patient-Related Factors on the Risk for Prosthetic Abutment Loss

	OR	95% CI	*P*
FMBS	1.757	(1.293–2.387)	.0003
Parafunctions			
Yes	4.399	(1.547–12.512)	.0055
No	–		
Age (y)	1.076	(1.016–1.139)	.0117
Sex			
Male	–		.0351
Female	3.174	(1.084–9.293)	

OR = odds ratio; CI = confidence interval; FMBS = Full-Mouth Bleeding Score.

Table 4 Univariate Analysis for Exploring Potential Clinical-Related Factors in Predicting the Event of Prosthetic Abutment (PA) Loss

	OR	95% CI	*P*
Endodontic treatment			
Yes	2.593	(1.280–5.254)	.0082
No	–		
Root resection			
Yes	4.052	(2.586–6.348)	< .0001
No	–		
Number of roots			
1	–		
2	1.352	(0.575–3.179)	.489
3	2.27	(1.435–3.589)	.0005
PAs with parafunctions			
Yes	2.596	(1.654–4.074)	< .0001
No	–		

OR = odds ratio; CI = confidence interval.

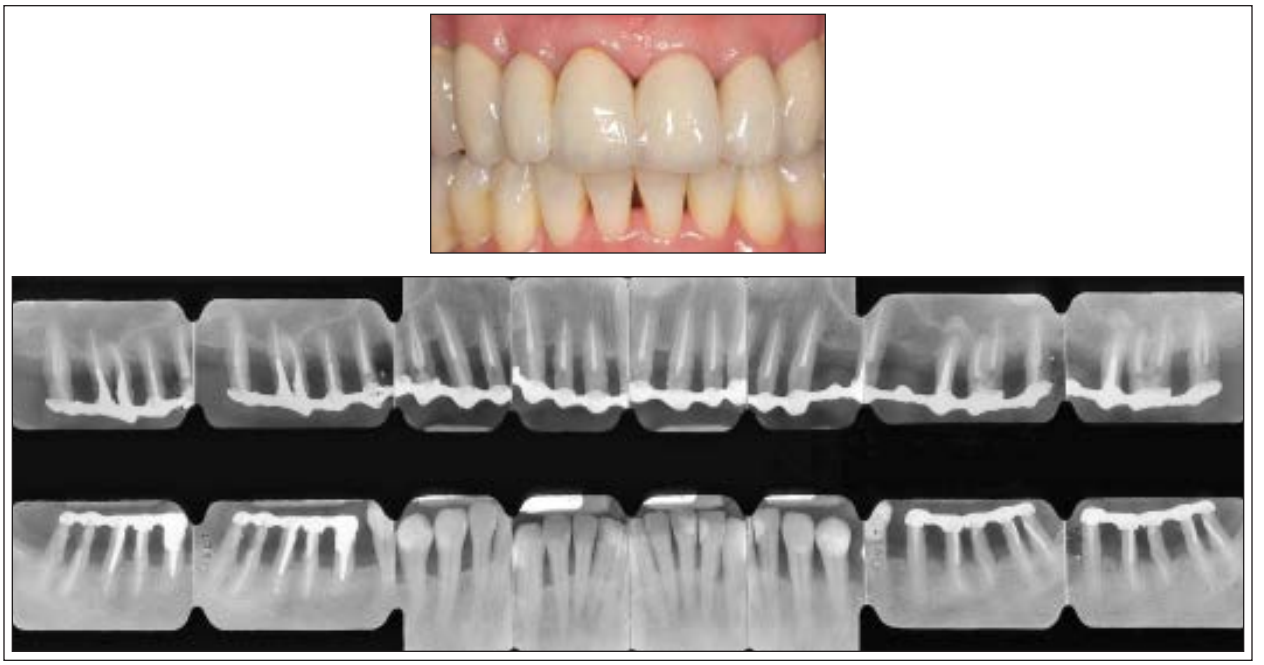

Fig 2 Final outcomes after the end of active treatment (1991).

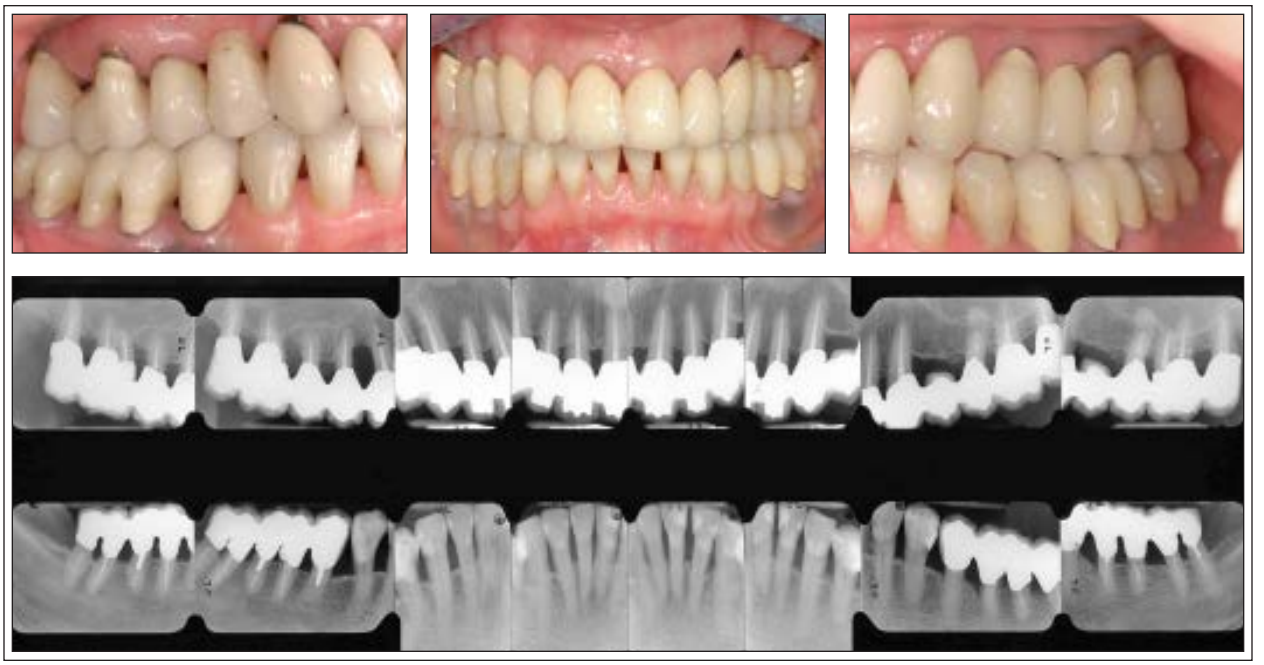

Fig 3 Last follow-up in 2013.

of failure over the long term. Interestingly, the association between gingival inflammation and PA loss was only significant in the female group. These observations confirmed at least in part the critical role of gingival inflammation during maintenance. Long-term studies showed that higher levels of FMPS and FMBS were associated with increased probability of disease progression and tooth loss during SPC.[5] In addition, oral parafunctions ($P = .0083$) also were associated with increased risk of PA loss during 20 years of SPC. Although a number of experimental studies in the 1970s have shown no relation between occlusal trauma and the pathogenesis of periodontitis,[13] oral parafunctions may create a higher level of mechanical

stress to PAs, leading to more incidence of root fracture. This finding also could be related to a very frequent history of endodontic treatment of PAs during active therapy; in fact, in this study, 98% of failed PAs had a history of endodontic treatment. This suggests the need for caution when prescribing endodontic treatment for prosthodontic abutments. It may be suggested that specific clinical indications for endodontic therapy should be seriously considered and that prophylactic root-canal therapy should be limited.

A number of tooth-related factors also were able to predict PA loss after 20 years, including root resection/amputation (P = .0001) and multi-rooted teeth (P = .0005). It was demonstrated that molars with persistent severe furcation involvements at the end of active therapy showed the highest tooth mortality during SPC. In a similar cohort study investigating the long-term effects of SPC treated with FibReORS, molars with persistent furcation involvements had a 7.3 odds ratio for extraction when compared with root-separated/resected molars and 20.6 when compared with molars with no furcation involvements.[5] These data confirm the questionable long-term prognosis of furcated molars and the acceptable long-term survival of resected molars during supportive periodontal care.[14] On the other hand, the findings in this study confirmed that the incidence of root fracture was the major reason for root-separated/resected molars extraction.[14]

This study demonstrated favorable outcomes for fixed prostheses after 20 years, although the frequently reported occurrence of specific biologic and technical complications such as caries, periodontal disease recurrence, loss of retention, and tooth fractures was confirmed. In this report, 91.5% of the original FPDs were still in function after 20 years. This observation supports the merits of using natural teeth as PAs to replace missing teeth. In another retrospective survey with a similar follow-up on 102 FDPs conducted at an undergraduate university clinic for 73 patients, the estimated survival rate was 68.3% after 20 years.[15]

It must be emphasized that the reported outcomes were achieved in a private clinical practice setting and carried out by highly experienced specialists who employed similar stringent and published treatment protocols. In addition, following active treatment, all patients were enrolled in a scrupulous SPC program with 3- to 6-month recalls in order to minimize gingival inflammation and the risk of periodontal disease progression. These observations may partially explain the achieved outcomes after 20 years of SPC.

Conclusions

This treatment outcome analysis for a specific patient cohort suggests that predictable long-term survival of PAs may be achieved in patients undergoing combined periodontic/prosthodontic treatment throughout a 20-year period of scrupulous maintenance and observation.

Acknowledgments

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