J Clin Periodontol 2007; 34: 342–348 doi: 10.1111/j.1600-051X.2007.01052.x

Journal of Clinical Periodontology

Long-term effects of supportive therapy in periodontal patients treated with fibre retention osseous resective surgery. II: tooth extractions during active and supportive therapy

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Carnevale G, Cairo F, Tonetti MS. Long-term effects of supportive therapy in periodontal patients treated with fibre retention osseous resective surgery. II: tooth extractions during active and supportive therapy. J Clin Periodontal 2007; 34: 342–348. doi: 10.1111/j.1600-051X.2007.01052.x

Abstract

Background: Long-term tooth retention is the main objective of periodontal treatment. The aim of this retrospective study was to describe the prevalence and reasons of tooth extraction during active periodontal therapy (APT) and supportive periodontal care (SPC) in periodontal patients.

Material and Methods: Three hundred and four periodontal patients were examined. APT consisted of non-surgical periodontal treatment and fibre retention osseous resective surgery, where needed, to obtain no sites with PD > 3 mm. All patients participated in an SPC programme for 3–17 years (mean time 7.8 years).

Results: At the initial examination, 45% of the patients had moderate periodontitis and 41% severe periodontitis. During APT, 576 teeth were extracted (7.5%). The main reason for tooth extraction during APT was the presence of advanced periodontal lesions (44%). The number of tooth extractions was higher in cases with severe periodontitis. Extracted teeth showed a mean bone loss of 76% of the total root length. During SPT, a total of 67 teeth were removed (0.9%) in a subgroup of 50 patients. The clinical problems were primarily related to the incidence of root fracture (48%) and secondarily to the progression of periodontal disease (30%).

Conclusion: Prevalence of tooth extraction during APT is associated with the severity of periodontal disease. Tooth loss during supportive periodontal care may be negligible when a meticulous SPC programme is performed in patients where minimal probing depth is consequential to APT.

Key words: long-term effects; periodontal therapy; supportive periodontal care; tooth loss; tooth survival

Accepted for publication 13 December 2006

Conflict of interest and source of funding statement

The authors declare that they have no conflict of interest.

The study was self-funded by the authors and their institutions.

In the past few decades, several long-term studies have demonstrated the effectiveness of periodontal therapy in arresting periodontal disease progression and preventing tooth loss (Lindhe & Nyman 1984; Axelsson et al. 2004).

A rational treatment approach aimed to firstly manage periodontal infection with self-performed plaque control and subgingival debridement and secondary to eliminate or reduce anatomic defects has been proposed (Lindhe & Nyman 1984) [Active Periodontal Therapy

(APT)]. Several surgical procedures have demonstrated their efficacy in highly compliant patients (Rosling et al. 1976) or their ineffectiveness in plaque-infected patients (Nyman et al. 1977).

Numerous studies have also demonstrated the importance of maintenance care following active therapy [Supportive Periodontal Care (SPC)]. In a classical study, Axelsson & Lindhe (1981) compared patients strictly recalled every 3 months following active therapy and patients treated and referred back to the general dentist without a definite SPC programme. Patients not well maintained showed greater tooth mortality, recurrent probing depth and attachment loss than those strictly recalled. Similarly, Becker et al. (1984) demonstrated that the prevalence of tooth loss in treated and not maintained patients was comparable with that reported for untreated patients. This evidence is consistent with the concept that professional visits/instrumentations at regular intervals prevent periodontal re-infection in the long term.

Tooth loss is the most tangible effect of periodontal disease for the patient. Tooth extraction may be a treatment modality when teeth with advanced periodontal lesions cannot be managed with therapy, the overall control of the infection being the scope of the treatment (Quirynen et al. 2001). Little information, in terms of tooth mortality during APT, is generally provided. Long-term studies reported a low incidence of tooth loss for patients enrolled in a regular maintenance programme but often omitted the number of tooth extraction during APT or provided a combination of teeth lost during active therapy and SPC (Hirschfield & Wasserman 1978, McFall 1982, Goldman et al. 1986, Wood et al. 1989).

The aims of this retrospective study in periodontal patients were (1) to describe the prevalence of tooth loss during active therapy and long-term maintenance and (2) to investigate on the clinical reasons associated with these extractions.

Material and Methods

Experimental design and population

This was a retrospective longitudinal study on the effect of APT and SPC. Detail of the study design, inclusion criteria and experimental population are described in a companion paper (Carnevale et al. 2007). The population consisted of consecutive patients recruited during routine SPC visits in a private periodontal office and thus consisted of patients referred for the treatment of periodontal disease in a private practice of periodontology. The final sample included 304 patients, 193 females and 111 males, between 25 and 85 years of age (mean 52 ± 11 years), who satisfied the entry criteria. All patients indicated their acceptance to participate in the study by signing an informed consent.

All patients had received APT delivered by a single clinician (G. C.) and had a minimum set of periodontal parameters recorded at least at three time points: the original consultation (T0), the first SPC visit following the completion of APT (T1) and the latest clinical section of SPC (T2). The clinical records were used as the source of data.

Clinical evaluation and treatment

A general (medical history, smoking status, etc.) and a periodontal examination (tooth loss, probing depth, plaque index, bleeding on probing at four sites/tooth, furcation involvements) was performed at T0, T1 and T2 for each patient. All patients were retrospectively classified as suffering at T0 from gingivitis, mild, moderate or severe periodontitis, according to the American Dental Association (ADA) case type classification.

All patients received cause-related therapy, including oral hygiene instruction, coronal scaling and root planing. At the revaluation, surgical procedures were planned where needed to achieve pocket elimination in all sites with probing depth $\geqslant 4$ mm. Periodontal surgery consisted of an apically positioned flap with osseous resective surgery and gingival fibre retention (FibReORS; *Companion paper* Carnevale 2007). All surgical procedures were performed by the same operator (G. C.), who had more than 10 years of experience in periodontology. During active treatment, operative/endodontic and prosthetic therapies were performed in the context of a comprehensive treatment plan.

Following the completion of ACP, the patients were placed in an SPC programme with a dental hygienist and at the first SPC visit, clinical data were re-collected (T1). SPC sessions consisted of a diagnostic phase and re-motivation, full-mouth professional prophylaxis and a cautious subgingival debridement in all sites.

Tooth extraction

The number of teeth present at each time point (T0, T1 and T2) was recorded. The dental pathologies associated with tooth extraction were established using clinical records and charts as the source. Each extracted tooth was classified as having one or more of these pathologies: periodontal disease, carious lesion, endodontic problems and root fracture. Presence or absence of furcation involvements or function as prosthetic abutments was also recorded. If the pathology associated with tooth extraction was unclear, it was marked as unknown.

Radiographic bone loss

Before any tooth extraction during APT, radiographic bone loss was estimated. Briefly, on a parallel intra-oral radiograph (Updegrave 1951), these reference points were identified

(1) *cemento–enamel junction* (CEJ): According to criteria of Schei et al. 1959, where the CEJ was not detectable because of restoration, the margin of that restoration was used as a reference point.
2) *root apex* (RA): For upper molars, the apex of the palatal root was considered; for inferior molars, the median point of a conjunction line between the mesial and distal apex was considered; for single-rooted teeth, the unique apex was considered.
3) *apical extent of bone loss* (ABL): Assessing the most coronal area in which periodontal ligament retained its width (Björn et al. 1969).

A single operator quantified total root length measuring from CEJ to RA. Bone loss was expressed as a percentage of the total root length.

Smoking status

Smoking status was recorded at T2. The questionnaire (Tonetti et al. 1998) collected information about present or previous tobacco smoking habits (cigarettes, cigars, pipe), the duration (years), the dose of the exposure (cigarette/day), the eventual date of cessation.

Table 1. Percentages of teeth extracted in specific ADA groups at T0, distribution of surgically treated teeth and prosthetic abutments at T1

ADA case type at T0	Teeth present at T0	Number of teeth extracted during APT and % of tooth extraction for each ADA	Number of residual teeth at T1 for each ADA group and its % in the total tooth sample at T1	Surgically treated teeth for each group and % respect the original teeth in the specific ADA group*	Prosthetic abutment at T1 and its % respect the original teeth in the specific ADA group
Type 1	55 (0.7%)	2 (0.35%)	53 (0.7%)	14 (26%)	2 (4%)
Type 2	1022 (13.3%)	52 (9%)	970 (13.7%)	370 (38%)	264 (27%)
Type 3	3542 (46%)	155 (26.95%)	3387 (47.6%)	1605 (47%)	1177 (35%)
Type 4	3077 (40%)	367 (63.7%)	2710 (38%)	1521 (56%)	1080 (40%)
Total	7696	576	7120	3510	2523

*Patients requiring surgical treatment for surgical crown lengthening.
ADA, American Dental Association; APT, active periodontal therapy; T0, original consultation; T1, first supportive periodontal care (SPC) visit following the completion of APT.

Data management and statistical analysis

Database was locked and loaded in an SAS format (Statistical Application Software, SAS Institute; Cary, NC, USA). All calculations were performed using SAS version 8.1.

Descriptive statistics included calculation of averages and standard deviations. When data were not normally distributed, medians and inter-quartile ranges (IQ range) were also reported. Significance of difference between groups was performed with unpaired parametric (normally distributed continuous variables) or non-parametric (non-normally distributed data or frequencies) tests. Comparisons within the same group were performed with paired tests. For all analyses, significance was set at 0.05.

A logistic regression was performed in order to evaluate the possible influence of clinical variables on the likelihood of extraction during supportive periodontal care.

Results

The details of the experimental population and the delivered SPC have been presented in a companion paper (Carnevale et al. 2007).

At the initial examination (T0), 7696 teeth were present (teeth/patient 25 ± 4.1). During APT, a total of 576 teeth were extracted. Of these, 214 were molars.

At the first SPT visit (T1), 7120 teeth were still present, which represented the average of 23 ($\pm$ 4.9) teeth/patient. In 74.6% of cases, these were single-rooted teeth, in 25%, multi-rooted and in about 0.4%, teeth with furcation involvements. In 35.4% of cases, teeth present at T1 were prosthetic abutments (2523 teeth), in 64.6% natural teeth (4597 teeth).

During APT, the surgical procedure (apically positioned flap and FibReORS) was performed on 3510 teeth (49%; mean teeth/patient 11 ± 4.9). In this sample of surgically treated teeth, 60% were prosthetic abutments and 40% natural teeth at the completion of the APT. Surgical procedures were performed on single-rooted teeth (62.4%), multi-rooted teeth (37.5%) or furcated molars (0.1%). Teeth treated without surgical procedures (51%; mean teeth/patient 12 ± 6.5) were in 12% of cases prosthetic abutments and in 88% natural teeth; 86.4% were single-rooted teeth, 13% were multi-rooted teeth and 0.6% were furcated molars.

The distribution of surgically treated teeth and prosthetic abutments at T1 considering the original ADA case type at T0 is reported in Table 1.

During SPT, 67 teeth were extracted. At the final examination (T2), 7053 teeth were still present. The mean full-mouth plaque score (FMPS) was 13% ($\pm$ 11.3) and the full-mouth bleeding score (FMBS) was 2% ($\pm$ 3).

Tooth extraction during APT

During APT, a total of 576 teeth were extracted (1.9 ± 2.5 teeth/patient) from the original sample of 7696 teeth present at T0. The number of extracted teeth corresponded to the 7.5% of the teeth present at the initial examination.

Tooth extraction analysis during active therapy was also stratified for ADA type classification.

Two extractions (mean 1 ± 1.4) were performed in ADA type 1 cases (two patients), 52 extractions (mean 1.3 ± 1.8) in ADA type 2 cases (39 patients), 155 extractions (mean 1.1 ± 1.5) in ADA type 3 cases (139 patients) and 367 extractions (mean 2.9 ± 3.2) in ADA type 4 cases (124 patients). In Table 1, the percentages of teeth extracted in specific ADA groups are represented: the odds ratio of tooth extraction was about 2.3 comparing severe with moderate periodontitis, about 7 when comparing severe with mild periodontitis and about 3 when comparing moderate with mild periodontitis.

In the group of teeth extracted during APT, a large sample was represented by wisdom teeth (214 extractions – 37% of extracted teeth). Very frequently the reason for extraction of a wisdom tooth was difficulty in professional instrumentation and/or oral hygiene procedures (124 extractions) or presence of advanced periodontal lesion (76 extractions). In 14 cases, the reason of extraction was recorded as unknown.

The residual 362 extractions during APT were mainly due to periodontal reasons (284 extractions – 44% of extracted teeth) or other reasons such as caries, endodontic and/or technical problems (78 extractions – 19% of extracted teeth).

Considering the sample of 284 teeth extracted for periodontal reasons, 259 extractions were due to advanced bone loss and 25 to periodontal reason associated with other causes (caries, root fracture, endodontic problem). In the group of teeth extracted for pure periodontal lesions, 157 teeth were maxillary and 102 mandibular. The most represented tooth types were lower incisor (64 extractions – 24.7% of cases), upper molars (59 extractions – 22.8% of cases), upper incisors (54 extractions – 20.8% of cases) and lower molars (25 extractions – 9.7% of cases). The less-represented tooth type was the lower

Table 2. Mean bone loss at the time of tooth extraction for tooth type in the group of teeth extracted for advanced bone loss (259 teeth)

Tooth type	Number of extracted teeth	Mean bone loss (in % of the total root length)
Upper molars	59 (22.8%)	82.4
Upper premolars	37 (14.3%)	77.8
Upper canines	7 (2.7%)	64.7
Upper incisors	54 (20.8%)	74.3
Lower molars	25 (9.7%)	73.3
Lower premolars	8 (3%)	63.4
Lower canines	5 (1.9%)	72.8
Lower incisors	64 (24.7%)	82.3

Table 3. Teeth extracted during supportive periodontal care (SPC): clinical causes and mean survival time for each category

Cause	Number of extracted teeth (%)	Survival time for each group in months (mean ± SD)
Root fracture	32 (48%)	80 (± 33.67)
Periodontal lesion	20 (30%)	70 (± 36.70)
Endodontic failure	8 (12%)	74 (± 38.08)
Carious lesion	7 (10%)	78 (± 25.40)

canines (five extractions – 1.9% of cases).

The teeth extracted for periodontal reasons with or without other concomitant problems were further evaluated in terms of radiographic bone loss expressed as a percentage of the total root length. The mean bone loss was 76%, ranging from 48% to 100%. In Table 2, the mean bone loss of teeth extracted for periodontal reasons is reported for each tooth type.

Tooth extraction during supportive periodontal care

At the first SPT visit (T1), 7120 teeth were still present. The mean duration of SPC was approximately 7.8 years (93.8 months ± 38.8), ranging from at least 3 to 17 years.

During SPT, 67 teeth were removed. The mean was 0.22 teeth/patient (± 0.6). The incidence of tooth loss during recall was 0.02 teeth/patient/year of participation in the SPC programme. The total of 67 teeth removed during recall represents 0.95% of the teeth present following completion of APT. During recall, 50 patients (16% of the patients in SPC) experienced at least one tooth loss, ranging from one to six teeth (mean 1.34/patient). In this sub-population, the incidence of tooth loss was 0.17 teeth/year of duration of SPC.

Tooth loss was also analysed considering the three groups of time in SPC. In subgroup 1 (110 patients, mean recall time ~ 4.3 years), the total tooth sample at T1 was 2609, and total tooth loss was eight (0.31%). In the subgroup 2 (102 patients, mean recall time ~ 8 years), the total tooth sample at T1 was 2341 and the incidence of tooth loss was 32 (1.37%). In the subgroup 3 (92 patients, mean recall time ~ 11.6 years), the teeth present at T1 were 2170 and the teeth lost were 27 (1.24%). The clinical problems for teeth extracted during the SPC programme were first related to the incidence of root fracture (32 cases, 48% of tooth extractions during SPC), progression of periodontal disease (20 cases, 30%), endodontic failures (eight cases, 12%) and carious lesions (seven cases, 10%). The mean recall time in which tooth extraction was performed was 76.3 months (± 33.95; ~ 6.3 years). In Table 3, the mean time of survival associated with each clinical problem is reported.

In the sample of 67 teeth lost during maintenance, 60 teeth were prosthetic abutments and represent 2.38% of the total sample of prosthetic abutments observed at T1. In the group of natural teeth, seven were lost at T2 (0.15% of the complete sample of natural teeth present at T1). When comparing these two subgroups, the odds ratio for tooth extraction during SPC was 15.6 for prosthetic abutments (95% confidence interval 7.15–34.11). The difference was statistically significant ($\chi^2 = 86.6$ $p < 0.0001$).

In the total number of teeth lost during maintenance, 50 (74% of teeth lost during SPC) were surgically treated during APT and 17 were non-surgically treated. When comparing these two subgroups, the odds ratio for tooth extraction during SPC was 3.02 for surgically treated teeth (95% confidence interval 1.75–5.23). This difference was statistically significant ($\chi^2 = 17.4$ $p < 0.0001$).

During SPC, 37 of the extracted teeth were single rooted (0.69% on the subtotal of 5334 teeth); 23 were multi-rooted (1.31% on the sub-total of 1760 teeth); seven were furcated (26.92% on the sub-total of 26 teeth). The odds ratio for tooth extraction during SPC was 1.9 for multi-rooted teeth compared with single-rooted teeth and 20.6 for furcated teeth compared with multi-rooted teeth.

In the sample of teeth in SPC, 489 were root-separated/resected (RSR) molars. At T2, 18 RSR molars were lost (3.7%): four were extracted before the limit of 10 years of SPC and 14 after. Furcation-involved teeth showed an odds ratio for extraction of 7.3 when compared with RSR molars.

A logistic regression model was constructed to estimate the influence of clinical variables on the likelihood of extraction during SPC: age ($p < 0.001$), time in SPC ($p < 0.006$), FMPS ($p < 0.04$) and FMBS ($p < 0.01$) at the last SPC appointment were statistically significant (see Table 4). No significant association between the original ADA diagnosis and the risk of extraction during SPC was detected.

Table 4. Logistic regression to evaluate the influence of clinical variables on the likelihood of extraction during SPC

Variable	Parameter estimate	Standard error	Odds ratio	$Pr > \chi^2$	Standardized estimate
Intercept	− 7.33	1.894	0.001	0.0001	–
Diagnosis	0.540	0.301	1.716	0.0735	0.209
Smoking habits	0.398	0.386	1.490	0.302	0.106
Gender	0.511	0.373	1.669	0.170	0.136
Age	0.062	0.019	1.064	0.001	0.353
FMPS	− 0.040	0.020	0.960	0.048	− 0.252
FMBS	0.131	0.056	1.141	0.019	0.220
Time in SPC	0.013	0.004	1.013	0.006	0.286

FMBS, full-mouth bleeding score; FMPS, full-mouth plaque score, SPC, supportive periodontal care.

Discussion

The final goal of periodontal therapy is the retention of teeth during the lifetime. In the past three decades, different longitudinal studies in periodontal patients have demonstrated that tooth loss may be prevented or significantly decreased in the presence of proper

periodontal therapy (Lindhe & Nyman 1984; Axelsson et al. 2004). Several treatment modalities or strategies have been proposed and all depend on patient compliance (Rosling et al. 1976; Nyman et al. 1977).

Tooth survival following therapy has recently gained renewed attention as a most identifiable measure of success in periodontal treatment (Hujoel & DeRuen 1995, Hujoel 2004). This result is considered as the *true endpoint* of therapy as the outcome directly measured by the patient as compared with *surrogate endpoints* (pocket depth, attachment level, etc.) that are intangible to the patient's mind and represent useful proxy outcomes to predict long-term outcomes.

Very few studies have analysed tooth loss both during active therapy and during long-term maintenance in the same group of patients (Tonetti et al. 2000; Konig et al. 2002). These authors reported an overall percentage of tooth loss ranging from 7.9% (Konig et al. 2002) to 8.8% (Tonetti et al. 2000).

The aims of this retrospective study were to evaluate the prevalence of tooth loss during active therapy and long-term maintenance and to investigate the clinical reasons related to tooth extraction. In this survey, a total of 304 periodontal patients were treated and then enroled in a supportive periodontal care programme for a mean of 7.8 years (ranging from at least 3 to 17 years) in a private practice limited to periodontology. Active treatment was aimed to minimize FMPS and FMBS and to achieve no probing depth >3 mm. Cause-related therapy and surgical treatment were applied where needed. Before discussion of the results, it is important to highlight that these data refer to a specific population treated by a periodontist in a highly specialized perio-reconstructive practice (Carnevale et al. 2007). External applicability needs to be further assessed.

During active therapy, a total of 576 teeth were extracted (7.5%; 1.9 teeth/patient). This prevalence is higher than that reported by Tonetti et al. 2000 (4.8%; 1.14 teeth/patient) and by Konig et al. 2002 (4.9%; 1.18 teeth/patient). This may be due to a different patient population at the baseline. For example, this sample of patients demonstrated a higher prevalence of severe periodontal case type (40.8%) when compared with Tonetti et al. 2000 (24.9%), which used a similar periodontal retrospective evaluation. Furthermore, the number of extractions during APT in our study is related to the severity of periodontal disease: over 60% of extractions clustered in cases of severe periodontitis.

In this study, the most important cause for tooth extraction during APT was advanced periodontal or periodontal-combined lesions (44% of extracted teeth). Tooth extraction during active periodontal therapy is still a controversial issue. The definition of ''hopeless tooth'' extensively differs in studies in terms of probing depth, tooth mobility or residual bone support. Machtei et al. (1989) defined ''hopeless'' teeth with class III furcation involvement or when alveolar bone loss exceeded 50%. The authors reported detrimental effect on the attachment level of adjacent teeth in the absence of periodontal treatment when ''hopeless'' teeth were retained. On the contrary, other authors reported that retained periodontal ''hopeless'' teeth did not significantly affect the attachment levels of adjacent teeth following therapy (DeVore et al. 1988) or may be maintained over time (McGuire 1991).

In the present study, the mean bone loss, in terms of percentage of root length, was 76% for teeth extracted for periodontal lesion during APT. This mean bone loss is higher than the 50% threshold value considered by Machtei et al. (1989) or resulting from Tonetti et al. (2000), and similar to that considered by Becker et al. (1979) in the definition of ''hopeless'' periodontal teeth.

In the sample of 576 teeth extracted during APT, 19% were teeth with unpredictable dental treatment, which is a frequent clinical problem in periodontal patients seeking comprehensive care, 37% were wisdom teeth with advanced periodontal lesion or associated with difficulties in professional instrumentation and/or self-administered oral hygiene procedures (third molars were excluded in the tooth loss data of Konig et al. 2002). A controlled clinical trial demonstrated that periodontal lesions on the distal of second molars can be significantly improved following scaling and root planing after extraction of third molars (Ferriera et al. 1997, Leung et al. 2005).

The patient's sample of this study confirms that tooth extraction during APT is part of the treatment when teeth with advanced periodontal lesions cannot be managed otherwise. Moreover, the decision making in terms of tooth extraction during active periodontal therapy is frequently an inter-disciplinary problem and 35% of the treated teeth in this study served as abutments of prosthetic reconstructions. The clinician should establish a comprehensive treatment plan in which the option to extract may be attributable to residual periodontal support, generalized severity of periodontal disease, strategic value of the compromised tooth, feasibility of dental reconstruction, aesthetics, predictability and cost–benefit ratio of the therapy (Tonetti et al. 2000).

Sixty-seven teeth (0.9%) were removed in a restricted subgroup of 50 patients (16.4%) during supportive periodontal care. This finding confirms that tooth loss is limited to a restricted number of patients in maintenance (Tonetti et al. 2000). The overall incidence of tooth loss during recall was 0.02 teeth/year and was not related to the original severity of periodontal disease. A similar tooth loss for subgroup 2 (mean recall time ~ 8 years) and subgroup 3 (mean recall time ~ 11.6 years) is also reported; this probably means that the incidence of tooth loss tends to level out following initial years of SPC. The prevalence of tooth extraction during SPC reported in this study is less than in others with similarly stringent SPC programmes: 4.2% in Tonetti et al. (2000) 3.3% in Cattabriga et al. (2001) and 3.1% in Konig et al. (2002).

In this study, statistical analysis demonstrated a significant association between age, time in SPC, FMPS and FMBS at the last SPC appointment and the risk of extraction. Molars with unresolved severe furcation involvements at the end of active therapy showed the highest tooth mortality during SPC. Their odds ratio for extraction was 7.3 when compared with root-separated/resected molars and 20.6 when compared with molars with no furcation involvements. These data confirm the questionable long-term prognosis of furcated molars (Cattabriga et al. 2000) and the acceptable long-term survival of resected molars (Carnevale et al. 1998) during supportive periodontal care.

Of interest was the observation that surgically treated teeth had a threefold higher chance of being extracted during SPC than non-surgically treated ones. This can be a consequence of an initially worse periodontal support at teeth requiring surgery. Not unexpectedly, teeth used as prosthetic abutments had 16-fold higher odds of being lost with respect to natural teeth. This is likely to

reflect the fact that abutment teeth present specific risks (fracture and technical failures) that are absent in natural ones (Nyman & Lindhe 1979).

In the patients analysed in the present study, the clinical problems related to tooth extraction during SPC were mainly due to root fractures (48%), which might be related to the endodontic/restorative treatment of severe periodontal patients requiring prosthetic reconstructions. A limited amount of extractions was attributable to the progression of periodontal disease (30%). These data are divergent to that reported by Tonetti et al. (2000) and Cattabriga et al. (2001), which reported a high prevalence of tooth extraction related to periodontal disease progression. This difference may be partly attributable to different treatment strategies during active therapy. In this sample of patients, the only surgical treatment performed was the apically positioned flap with FibReORS aimed to restore positive bony architecture for decreasing probing depths to a physiological measure. In other studies (Tonetti et al. 2000, Cattabriga et al. 2001), modified Widman flaps were more frequently utilized.

In conclusion, this study reports a cumulative tooth loss during APT and maintenance of 8.3% similar to that showed by other long-term studies (Tonetti et al. 2000; Konig et al. 2002). The prevalence of tooth extraction during APT was related to the severity of periodontal disease and probably to the comprehensive treatment of the analysed patient population. Tooth loss during supportive periodontal care may be minimal when a meticulous maintenance is performed in patients with a re-established periodontal health.

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Clinical Relevance

Scientific rationale for the study: A reduced number of studies analysed tooth loss during active therapy and long-term maintenance in the same group of periodontal patients.

Principal findings: The number of tooth extractions during APT was associated with the severity of periodontitis at baseline. Tooth loss during supportive periodontal care was minimal and restricted to a subgroup of patients.

Practical implications: This study suggests that tooth loss for periodontal reasons during SPC is infrequent when APT restores minimal probing depth.