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Tooth loss during maintenance following periodontal treatment in a periodontal practice in Norway

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Abstract

Background: Periodontal therapy coupled with careful maintenance has been shown to be effective in maintaining periodontal health; however, a small number of teeth are still lost because of progressive periodontitis.

Aim: To investigate factors associated with tooth loss due to periodontal reasons during maintenance following periodontal treatment in patients in a Norwegian specialist periodontal practice. The study also examined how initial prognosis related to actual outcome as measured by periodontal tooth loss.

Methods: Hundred consecutive patients (68 females, 32 males) who had comprehensive periodontal treatment and attended for 9.8 (SD: 0.7), range: 9–11 years of maintenance care, were studied. All teeth classified as being lost due to periodontal disease over the period were identified.

Results: Only 36 (1.5%) of the 2436 teeth present at baseline were subsequently lost due to periodontal disease. There were 26 patients who lost at least one tooth. Logistic regression analysis showed that tooth loss was significantly related to male gender ($p = 0.049$; adjusted odds ratio: 2.8; confidence interval (c.i.): 1.0–8.1), older age, i.e. > 60 years ($p = 0.012$; adjusted odds ratio: 4.0; c.i.: 1.3–12.0) and smoking ($p = 0.019$; adjusted odds ratio: 4.2; c.i.: 1.4–13.8). The majority 27 (75%) of the teeth lost due to periodontal disease had been assigned an uncertain, poor or hopeless initial prognosis; however, nine teeth (25%) lost had been assigned a good prognosis at baseline. The prognosis for 202 teeth was judged to have worsened over the period of the study.

Conclusion: Compliance with maintenance following periodontal treatment was associated with very low levels of tooth loss in a referral practice in rural Norway. Male gender, older age (> 60 years) and smoking were predictors of tooth loss due to progressive periodontitis.

Key words: initial prognosis; periodontal disease; specialist periodontal practice; tooth loss; treatment outcome

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The objective of periodontal therapy is to maintain the natural dentition in a healthy, functional and pain-free state. A retrospective study by Hirschfeld & Wasserman (1978) found that 83% of patients treated for periodontal disease and subsequently maintained for 15 years or more in a specialist practice lost fewer than four teeth. Hirschfeld & Wasserman (1978) categorised this low tooth loss group as ''well maintained''. Comparable long-term studies of tooth loss from patients treated in specialist practices by McFall (1982) and Goldman et al. (1986) found that 77% and 62%, respectively, of patients were ''well maintained''. Lindhe & Nyman (1984) studied 61 patients who had scaling and root planing combined with elimination of pathological pockets prior to a strict maintenance regimen, which included recall appointments every 3–6 months over a 14-year period. During the entire course of this study, which was based in a specialist hospital clinic, only 30 (2.3%) teeth were lost and since no patient lost more than three teeth they all could have been classified as ''well maintained'' (Lindhe & Nyman 1984).

The importance of maintenance was highlighted by Wilson et al. (1984), who measured tooth loss over a 5-year period in a group who complied with suggested maintenance schedules and compared this with a group who had erratic compliance. All tooth loss occurred in the erratic compliers, and the more often a patient presented for maintenance the

less likely the tooth loss. Recent reports have shown that the absence of maintenance following periodontal treatment is associated with significantly higher rates of tooth loss (Kocher et al. 2000, Checci et al. 2002).

Taken together, these studies indicate that periodontal therapy, combined with adherence to recommended maintenance schedules, is successful in retaining teeth over time. However, not all teeth can be retained despite treatment combined with maintenance and it would be useful to be able to predict as to which teeth might be lost. This would be helpful in treatment planning for example in deciding which teeth can be reliably used as abutments for fixed prosthodontic work. Studies have shown that molar teeth are the most likely to be lost, and the mandibular cuspid is the most resistant to loss (Hirschfeld & Wasserman 1978, McFall 1982, McGuire 1991). McGuire & Nunn (1999) assessed initial tooth prognosis versus actual outcome in terms of tooth loss and reported that clinical factors commonly used to assign prognosis were poor predictors of outcome other than for teeth with initially good prognosis. McGuire & Nunn (1999) also reported that a prognosis could be more accurately assigned to single-rooted than multirooted teeth and that smoking was an important factor in predicting tooth loss.

The aims of the current study were to quantify long-term tooth loss due to periodontal reasons in a group of patients who received periodontal therapy followed by maintenance in a specialist periodontal practice. An additional aim was to relate the initial tooth prognosis to subsequent tooth loss and investigate what other factors could predict the actual outcome of periodontal treatment and maintenance as measured by periodontal tooth loss. This study was one of a series that aimed to develop internal quality control measures that could be applied to specialist periodontal practices (Fardal et al. 2001, 2002, 2003).

Materials and Methods

The case records of 100 consecutive patients who had completed between 9 and 11 years of maintenance care in a specialist periodontal practice in 1997 and 1998 formed the basis of the study. The specialist practice receives referrals from general dental practitioners, community dentists and physicians in a Norwegian rural community with a population of 25–30,000. The area has approximately 25 dentists split evenly between private practice and the community dental service. The principal investigator (O.F.) is a specialist certified by the Norwegian Department of Health and Social Services and is the only periodontal specialist in the area. All the patients had been diagnosed initially as having chronic generalised mild, moderate or severe adult periodontitis, and all the assessments and treatments were completed by the principal investigator. Probing depths were measured at six locations around each tooth. Periapical and bite wing radiographs were recorded. Patients with generalised moderate pocket depths (4–6 mm) and with radiographic proximal bone loss not exceeding 1/3 of normal bone height were given the diagnosis of mild periodontitis. Patients with a mixture of moderate (4–6 mm) and deep pocket depths ($\geqslant$7 mm) and with generalised radiographic proximal bone loss of between 1/3 and 2/3 of normal bone height were diagnosed as moderate periodontitis. Patients with generalised deep pocket depths ($\geqslant$7 mm) and with proximal bone loss $>$2/3 of normal bone height were diagnosed as severe periodontitis.

All the patients completed a similar course of periodontal treatment, which included non-surgical therapy and surgical intervention where appropriate. Initial therapy included oral hygiene instruction, scaling and root planing using standard curettes (Gracey and Colombia patterns). In addition, fine diamond finishing burs (Waerhaug, Viking Dental, Norway) were used to correct overhangs. In the initial phase, scaling and root planing were completed without the use of local anaesthesia. The whole mouth was treated over a series of visits at 2–4-week intervals. Oral hygiene was reinforced repeatedly based on individual needs. Periodontal surgery was prescribed for patients who had sites with bleeding on probing or persistent deep pocketing at reassessment 6 weeks after the completion of initial therapy.

Assigning individual tooth prognosis

After the completion of the active phase of periodontal treatment and prior to placing the patient on maintenance recall, each tooth was assigned a prognosis. The prognosis was based on clinical and radiographic findings with particular emphasis being placed on surgical notes where these existed. It was assumed that all patients would subsequently attend for all scheduled maintenance appointments and would maintain a high standard of plaque control. Each tooth was assigned a prognosis in one of the following categories: good, uncertain, poor or hopeless.

Good prognosis: Residual pocket depths ($<$3 mm) and $<$1/3 loss of proximal bone compared with normal bone height.
Uncertain prognosis: Residual pocket depths 4–6 mm with proximal bone loss of 1/3–2/3 of normal bone height. Inflammation of the tissues, with bleeding on probing. Where furcation involvement was present this did not exceed grade II.
Poor prognosis: Residual pocket depths $\geqslant$7 mm, proximal bone loss $<$2/3 of normal bone height. Inflammation of the tissues with bleeding on probing. Where furcation involvement was present it was at least class II. Horizontal mobility of up to 1 mm elicited at examination.
Hopeless prognosis: Pocket depths $\geqslant$9 mm. Inflammation of the tissues with bleeding on probing. Horizontal mobility of $>$1 mm with apical depressability and where furcation involvement was present it was of class III. If there was a question as to which prognosis a tooth should be given, the operator always assigned the most favourable prognosis.

Maintenance

After the completion of cause-related or corrective treatment, all patients were seen between one and three times per year in the specialist practice for maintenance care. The maintenance visits with the specialist practitioner alternated with visits to the general dental practitioner such that all patients were seen in total between two and four times per year. During each maintenance visit scaling, root planing and polishing of teeth were routinely performed according to the needs of each patient. Individual radiographs were taken as needed with a full-mouth periapical series after 7–8 years. Minor occlusal

adjustments were performed as necessary. The interval between recall visits was shortened or lengthened as appropriate according to the stability of the periodontal condition. During the maintenance period, sites with increasing probing depth were treated with repeated scaling and root planing. Subsequently, if there were clinical signs of residual subgingival calculus or persistent inflammation, surgical intervention was performed. In addition, systemic or topical antibiotic therapy was used in acute exacerbations of periodontal disease.

Tooth loss

During the follow-up period, all tooth loss was monitored. Teeth that were extracted due to root fracture, deep carious lesions that rendered the tooth non-restorable or because of the failure of endodontic therapy were considered non-periodontal extractions. All teeth classified as being lost due to periodontal disease were identified.

Final tooth prognosis

A prognosis was assigned to all teeth that were present after 9–11 years of maintenance care. The same set of criteria was applied to both the initial and final assessments of prognosis. The initial and the final (9–11-year) prognoses were compared to identify each tooth for which the prognosis had changed over the study period.

Oral hygiene and gingival inflammation

Oral hygiene was assessed by the clinician at each of the maintenance visits based on the distribution and abundance of plaque. The presence or absence of bleeding was determined after running a probe along the wall of the pocket/crevice. The oral health status at each visit was determined as follows: good equated to little or no generalised plaque and no gingival inflammation. Moderate equated to the generalised presence of minor amounts of plaque (not covering more than 1/3 of the buccal/lingual surfaces from the gingival margin) with bleeding on probing, or isolated areas of abundant plaque (covering more than 1/3 of the buccal/lingual surfaces from the gingival margin) with bleeding on probing. Poor equated to generalised abundant plaque (covering more than 1/3 of the buccal/lingual tooth surfaces from the gingival margin) with bleeding on probing. The scores were recorded in the charts at every maintenance visit and the overall oral health status represented and the majority score over the 10-year period. For example, if there were five scores with good oral health status and 15 scores with moderate oral health status, the overall 10-year oral health status would be classified as moderate.

Smoking

Smoking habits were recorded in terms of the numbers of cigarettes smoked per day and the strength of the cigarettes smoked. Patients who only smoked on social occasions were not classified as smokers.

Family history

Periodontal disease in the immediate family, i.e. parents, brothers/sisters and children was recorded for each of the patients studied.

Statistical analysis

χ^2 analysis was used as appropriate. Odds ratios were calculated and logistic regression analysis was used to assess factors associated with periodontal tooth loss. The level of statistical significance was set at $p < 0.05$.

Results

After the completion of the periodontal treatment, a total of 2436 teeth in 100 (68 females, 32 males) patients, average age: 46 years, range: 25–69 years, were entered in the study. The age distribution at the reassessment of the patients is shown in Table 1. The mean duration of maintenance was 9.82 (SD: 0.7) years, range: 9–11 years. The initial assessment included 1972 (81%) teeth with a good prognosis, 346 (14.2%) teeth with an uncertain prognosis, 109 (4.5%) teeth with a poor prognosis and nine (0.4%) hopeless teeth. There were 11 (11%) patients with the diagnosis of mild periodontitis, 81 (81%) patients with moderate periodontitis and eight (8%) with severe periodontitis.

Table 1. Frequency distribution of age of 100 patients after 9–11 years of periodontal maintenance in a specialist practice

Age range (years)	Number of patients
30–39	1
40–49	30
50–59	32
60–69	28
70–79	9

Tooth loss

A total of 36 (1.5%) of the teeth present after the completion of active periodontal treatment were lost during the maintenance period due to periodontal reasons, which represented 0.36 teeth per patient. The number and location of the teeth lost during maintenance are shown in Table 2. There were 26 patients who lost at least one tooth for periodontal reasons. The majority 21 patients lost a single tooth, two patients lost two teeth, one patient lost three teeth and two patients lost four teeth. There were 13 patients with stabilising bridges, and no abutment teeth were lost due to periodontal reasons in these patients.

In total, nine (0.46%) of the teeth with a good initial prognosis were lost due to periodontal reasons. The majority (five) of these teeth were second molars, three were premolars and one tooth was a central incisor. One patient with poor oral hygiene lost three teeth with an initially good prognosis, while six patients lost one tooth each. All seven patients were on a maintenance programme that included two visits to the periodontist and two visits to their general dentist per year. Other teeth lost due to periodontitis included 11 (3%) of those with an initial uncertain prognosis, 10 (9%) of those with a poor prognosis and six (67%) of those with a hopeless initial prognosis. Table 3 shows when the teeth were lost during the observation period.

It can be seen from Table 4 that high proportions of males (38%), older participants (38%) and smokers (38%) lost at least one tooth. The smokers also exhibited the highest rate of tooth loss. To correct for confounding effects, independent variables, which included gender, age, maintenance, overall oral health status, family history and smoking, were entered in a logistic regression analysis with the dependent variable being whether a subject had lost at least one tooth due to periodontitis in the study period. Within this analysis, subjects who were under 60 years of age were categorised as young, main-

Table 2. Tooth loss by tooth type. Numbers of teeth lost during 9–11 years of periodontal maintenance

upper		5	3	3	1				1			2	2	2	3		
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8	
lower		5	2	1	1	1								1	3		

Table 3. Tooth loss by years of maintenance and initial prognosis

Years of maintenance	Good	Uncertain	Poor	Hopeless
1				
2			2	1
3				
4	1		1	
5		1	5	4
6	4	2		
7	4	6		1
8		1	2	
9		1		
total and % of total	9 (0.46%)	11 (3%)	10 (9%)	6 (67%)

Table 4. Number of patients losing teeth, number of teeth lost and rate of tooth loss by various factors

	Number of patients	Number losing at least one tooth (%)	Unadjusted odds ratio (confidence intervals)	Teeth lost	Rate of tooth loss
Gender					
male	32	12 (38%)	2.31 (0.92–5.84)	15	0.47
female	68	14 (21%)		21	0.31
Age					
old (>60 years)	37	14 (38%)	2.59 (1.04–6.46)	20	0.54
young	63	12 (19%)		16	0.25
Maintenance annual visits to periodontist					
once	37	6 (16%)	0.42 (0.15–1.16)	10	0.27
twice	63	20 (32%)		26	0.41
Oral health status					
good	33	8 (24%)	0.87 (0.33–2.28)	9	0.27
moderate or poor	67	18 (27%)		27	0.40
Family history					
present	32	11 (34%)	1.85 (0.73–4.68)	13	0.41
absent	68	15 (22%)		23	0.34
Tobacco use					
smoker	26	10 (38%)	2.27 (0.86–5.95)	15	0.58
non-smoker	74	16 (22%)		21	0.29

Table 5. Predictors of tooth loss: results of logistic regression analysis

Factor	Coefficient	Standard error	χ^2	p	Odds ratio	Confidence interval
Gender	1.04	0.53	3.85	0.049	2.84	(1.002–8.08)
Age	1.39	0.55	6.24	0.012	4.02	(1.35–11.95)
Maintenance	−1.01	0.61	2.63	0.1	0.37	(0.11–1.23)
Oral health status	0.38	0.58	0.42	0.52	1.46	(0.47–4.57)
Family history	−0.13	0.55	0.06	0.81	0.88	(0.29–2.55)
Smoking	1.43	0.61	5.51	0.019	4.18	(1.27–13.79)

tenance was dichotomised into those who attended the periodontist once or twice per year and overall oral health status was categorised as good or moderate/poor. The results of the regression analysis are shown in Table 5. Independent predictors of tooth loss in this multivariate analysis, with the effects adjusted for all other variables in the model, were male gender ($p = 0.049$), age of <60 ($p = 0.012$) and smoking ($p < 0.019$). It can be seen from Table 5 that within the multivariate analysis the adjusted odds ratio for age to be associated with tooth loss was 4.02 (confidence interval (c.i.): 1.35–11.95) and for smoking was 4.18 (c.i.: 1.27–13.79). Table 6 shows the distribution of maintenance visits between specialist and general dentist and tooth loss.

Change in prognosis

The prognosis of 202 teeth was judged to have worsened over the period. The major change over the period was the reclassification of 113 teeth from the good to the uncertain category. In addition, 87 were reclassified from uncertain to poor and two teeth from good to poor. The teeth that had a poorer prognosis were predominantly premolars and molars. Ten out of 28 (36%) patients with at least one tooth with a deteriorating prognosis had lost teeth, while 16 out of 72 (22%) of patients with no deterioration in prognosis had lost teeth, $\chi^2 = 1.91$, $p = 0.17$.

Discussion

The main finding of this study was that regular maintenance after periodontal treatment is associated with a low level of periodontal tooth loss. This confirms the results of earlier similar studies that reported low rates of tooth loss in groups of patients treated for periodontal disease and subsequently well maintained (Hirchfield &Wasserman 1978, McFall 1982, Lindhe & Nyman 1984, Goldman et al. 1986, Wood et al. 1989, McGuire 1991, Tonetti et al. 2000, Konig et al. 2002). Only 1.5% of teeth were lost due to periodontal reasons over a period of 10 years, which equated to 0.036 teeth per patient per year. The majority (74%) of patients lost no teeth. In the current study, the teeth lost were almost exclusively premolars and molars. Second molars were the teeth most likely to be lost, in agreement with previous studies (Hirchfield & Wasserman 1978, Wood et al. 1989, McGuire 1991, Konig et al. 2002). Applying the definitions of Hirchfield & Wassermann (1978), almost all (98%) the patients in the present study were ''well maintained'', with only 2% categorised as ''downhill''. This is due to reporting only periodontal tooth loss in the present study, whereas the other studies cited did not identify the specific reasons for

Table 6. Distribution of maintenance visits between specialist and general dentist and tooth loss

visits to periodontist/year	2	2	1	1
visits to general dentist/year	1	2	1	2
patients	4	59	13	24
teeth lost	2	24	5	5
teeth lost/patient	0.50	0.41	0.38	0.21

tooth loss but reported all tooth loss irrespective of cause.

Periodontal therapy is associated with a substantial reduction in tooth mortality (Hujoel et al 2000). However, periodontal treatment in isolation is not effective in maintaining low levels of tooth loss. It has been shown that patients complying erratically with maintenance therapy after periodontal treatment were at almost a 6-fold greater risk of tooth loss than regularly compliant patients (Checci et al. 2002). The current study focused on patients who complied with their prescribed maintenance programmes.

There were substantial differences between various studies of tooth loss during maintenance in relation to the clinicians involved and their location, which ranged from a single periodontist working in a specialist practice (Hirchfield & Wasserman 1978, McFall 1982, Wilson et al. 1984, Goldman et al. 1986, McGuire 1991) to multiple operators working in university dental school clinics (Wood et al. 1989, Tonetti et al. 2000, Konig et al. 2002). In addition, the rate of tooth loss during different phases of treatment depends on treatment philosophy. If a high proportion of the teeth with a questionable prognosis are extracted during active treatment, then there are likely to be fewer teeth lost during subsequent maintenance (McGuire 1991) and vice versa. This makes the direct comparison of the various studies of the tooth loss that occurs during maintenance difficult. Nevertheless, all these studies have supported the findings of the current study that compliance with regular maintenance care, following a course of periodontal treatment, is associated with very low rates of tooth loss.

The reasons for extracting teeth are not always clearcut and in many cases more than one factor is implicated. It is acknowledged that during maintenance therapy, extractions may be for many reasons other than periodontitis. Several other studies have provided data on tooth loss occurring for both periodontal and non-periodontal reasons during maintenance. In these studies, tooth loss due to periodontal reasons varied from 48% (Konig et al. 2002) to 77% (Wood et al. 1989). Tonetti et al. (2000) reported that periodontal problems alone were responsible for 50% of extractions, while a combination of periodontal problems with caries, endodontic or technical problems accounted for another 14% of extractions. The current study only examined tooth loss as a result of periodontitis in a well-maintained group regularly attending a specialist periodontist over a 10-year period. This was because the study aimed to identify factors that were likely to be associated with a higher risk of tooth loss due to periodontal reasons.

Few studies have investigated the factors that might identify individuals who were more likely to experience tooth loss during maintenance. It is unlikely that one factor in isolation was responsible for tooth loss due to periodontal reasons. Accordingly, a multivariate statistical analysis was performed to adjust for the confounding effects of related factors. Within the statistical model, there is support for the view that smoking, older age and male gender were the most powerful predictors of the likelihood of tooth loss in the sample studied. The same factors were identified as three out of the five most potent risk indicators for both tooth loss and attachment loss in the large Erie County study (Grossi et al. 1994, 1995). In the present study, there was evidence of considerable interaction between the factors that predicted an increased likelihood of losing teeth. Logistic regression strengthened the association between smoking and tooth loss with an adjusted odds ratio for smoking of 4.18 compared with the unadjusted value of 2.27 from the bivariate analysis. This was also the case for older age (>60 years), which had an adjusted odds ratio of 4.02 compared with the unadjusted value of 2.59.

Smoking emerged as a factor in tooth loss during maintenance in agreement with other studies (McGuire & Nunn 1999, Konig et al. 2002). All the smokers used Norwegian ''self-rolled'' cigarettes, which have between a two to four times higher chemical content than conventional brands. The smokers consumed more than 10 of these cigarettes per day and therefore could be classified as heavy smokers. These findings were in agreement with other studies that have highlighted the negative effects of smoking on the response to periodontal treatment (MacFarlane et al. 1992, Ah et al. 1994). Smoking is a risk factor for periodontitis and in particular for molar furcation involvement (Mullally & Linden 1996), and this may also have been a factor interfering with achievement of a stable periodontal condition following treatment.

It is surprising that the prevailing oral health status during the maintenance phase had little impact on tooth loss. This may be due to the grouping of patients in good oral health status versus moderate and poor oral health status. Perhaps if the three groups were assessed individually, differences would have been found. However, there is also the possibility that the strict maintenance programme that the patients were placed on did protect the patients with moderate and poor oral health status from tooth loss.

The majority (75%) of the teeth lost for periodontal reasons had been assigned an uncertain, poor or hopeless prognosis at the initial assessment; however, the remainder that equated to nine teeth had been judged to have a good prognosis. This is a small fraction but it does indicate that it is not always possible to identify all teeth that are at risk of being lost due to the progression of periodontitis. It seems that making a prognosis purely based on clinical factors is questionable as it has been shown that periodontal disease can progress in bursts, and rapid progression may occur on a random basis in sites without evidence of severe pre-existing disease (Socransky et al. 1984). However, the loss of teeth assessed as having a good prognosis, even if it only occurs infrequently, may damage a specialist's reputation with both patients and referring dentists. There may also be major consequences if for example a tooth is recommended as a bridge abutment and is subsequently lost for periodontal reasons. The rate of loss was lower for teeth initially categorised as uncertain than poor and was highest for those teeth with a hopeless prognosis. This is in agreement with McLeod et al. (1998) who reported that a hopeless prognosis was more accurate than a questionable prognosis in predicting tooth loss.

Over a 10-year period there was a deterioration in prognosis with 25% of the teeth, with an uncertain prognosis at baseline being recategorised as poor. While in part this may have represented differences in the application of criteria by the examiner, it nevertheless seems to indicate further deterioration in the periodontal status of some teeth in these well-maintained patients. However, the low rates of tooth loss even for teeth with an initially uncertain or poor prognosis would suggest that these teeth were the focus of major efforts during the maintenance period. The corollary is that judging a tooth to have an uncertain or poor prognosis does not mean that it is inevitable that it will be lost in the mid- to long term.

It is possible that cultural and geographical factors could affect tooth retention after periodontal therapy. Novaes et al. (1999) reported on the compliance with maintenance therapy in four different countries in South America and observed a great variation in the behaviour of patients from various practices. They suggested that cultural and economic factors as well differences in the philosophy of dentists were factors responsible for this variability. This would presumably also ultimately affect tooth retention in these patients. It may be useful to report the success rate of therapy in periodontal practices from various geographic areas. These reports could be used as benchmarks against which the success of periodontal therapy could be measured as part of an internal quality control system for use in specialist periodontal practices. An integral part of such a system would be some measure of the effectiveness of periodontal treatment, and in this context, long-term tooth survival could be informative. This would provide a basis for comparisons between practices within regions or on a wider scale between practices in different countries or continents.

Tooth loss represents a true end point of the outcome of periodontal treatment. The results of this study support the conclusion that with regular maintenance, it is possible to obtain a high level of tooth survival after periodontal treatment in a referral practice in rural Norway. The few teeth that were lost were significantly related to male gender, older age (>60 years) and smoking. The results of the present study compare favourably with other international studies. The long-term follow-up of outcomes for individual teeth indicated that it was not always possible to predict future tooth loss accurately, even for teeth that presented with a good prognosis. It is suggested that a system that audits long-term tooth loss is an important component of an internal quality control system in specialist periodontal practice.

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