Effect of supportive periodontal therapy on the prevention of tooth loss in Korean adults

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Purpose: The purpose of this retrospective study was to evaluate the effect of patient compliance with supportive periodontal therapy (SPT) on tooth loss in Korean adults.
Methods: The periodontal records of 134 patients were reviewed for this study. They completed active periodontal treatment from 1999 to 2001 and were placed on a schedule of periodic follow-up visits for SPT. Patient compliance was classified into complete compliance (CC), erratic compliance (EC), and noncompliance (NC) groups. Re-examinations were carried out 11.0±0.8 years after the active periodontal treatment. The prognosis for each tooth was determined as good, questionable, or hopeless according to the bone loss observed in pretreatment radiographs.
Results: The rate of tooth loss of the CC group was significantly lower than that of the NC group. The tooth loss/patient and the tooth loss/patient/year were not significantly different between the three groups. The rates of tooth loss in the good, questionable, and hopeless prognosis groups were 6.7%, 9.5%, and 13.2%, respectively. For the teeth with a good prognosis, the rate of tooth loss of the CC group was significantly lower than that of the NC group (0.4% vs. 5.1%). For the teeth with a questionable prognosis, the CC group showed a significantly lower rate of tooth loss than did the EC group (4.1% vs. 30.7%) or the NC group (4.1% vs. 25.6%). For the teeth with a hopeless prognosis, the rates of tooth loss were not significantly different among the three groups.
Conclusions: Within the limits of this study, the patients who showed a poor compliance with SPT were more likely to lose teeth than were the regularly compliant patients. However, the risk of tooth loss with a hopeless prognosis was high irrespective of the compliance.

Keywords: Maintenance, Patient compliance, Tooth loss.

INTRODUCTION

Chronic periodontitis can be treated effectively using nonsurgical and surgical periodontal therapy [1,2]. It is generally agreed that periodic supportive periodontal therapy (SPT) is important for the maintenance of periodontal health after active periodontal treatment. SPT is defined as procedures that are performed at selected intervals to assist the periodontal patient in maintaining oral health. SPT programs typically include an update of the patient information, a clinical evaluation of the dentition and periodontium, removal of the dental biofilm, and a reinforcement of oral hygiene instruction [3].

Compliance is defined as the extent to which the behavior of the patient (in terms of taking medications, following a recommended diet, or executing other lifestyle changes) adheres to the clinical prescription [4]. Compliance with SPT can be evaluated on the basis of the rate of attendance at the recommended schedule of visits. Many studies have re-

ported low rates (16%–40%) of compliance for patients under SPT, although it is difficult to make direct comparisons because various methods are used to evaluate compliance, depending on the study [5-8].

Park et al. [9] classified Korean periodontal patients as complete compliers, erratic compliers, and noncompliers, according to their compliance with SPT over the previous 5 years. The authors demonstrated that 24.7% of the patients were complete compliers, 45.4% were erratic compliers, and 29.9% were noncompliers. The results of recent studies suggest that the progress and recurrence of periodontal disease can be prevented in complete compliers by using SPT [10,11] and that periodic SPT can prevent the recurrence of periodontal disease even in patients with poor oral hygiene [12]. The correlation between compliance with SPT and tooth loss has been studied in many countries [13-16]. Wilson et al. [17] indicated that a complete complier group retained more teeth than did erratic compliers. Checchi et al. [15] demonstrated that patients who engaged in poor compliance with SPT following active periodontal therapy were 5.6 times more likely to lose teeth than were regularly compliant patients. However, Konig et al. [13] reported that there was no significant difference between a compliant group and a noncompliant group with respect to tooth loss during SPT. Miyamoto et al. [11] reported that complete compliers lost more teeth over time than erratic compliers.

The purpose of this retrospective study was to evaluate the effect of patient compliance with SPT on tooth loss in Korean adults.

MATERIALS AND METHODS

Subjects

The study was conducted as a retrospective study. A total of 1,004 patients completed active periodontal treatment and began SPT in the Department of Periodontics, Gangneung-Wonju National University Dental Hospital, from 1999 to 2001. We contacted all the 1,004 patients, and from them, 142 patients agreed to participate in this study. The patients who did not return for SPT at all after completing active periodontal treatment (noncompliers) were also included in this study. Eight patients were excluded because their clinical or radiographic data were insufficient. Therefore, the total number of subjects in the study was 134.

This study was approved by the Institutional Review Board at Gangneung-Wonju National University Dental Hospital (IRB No. 2011-1-2) as conforming to the Ethical Principles for Medical Research Involving Human Subjects according to the World Medical Association Declaration of Helsinki.

Periodontal treatment

All the patients completed a similar course of periodontal treatment, which included nonsurgical or surgical therapy, as appropriate. At the first visit, a medical and dental history was recorded, intraoral radiographs were taken, and the probing depths were assessed. After completing the active periodontal treatment, an SPT

plan was established, and the patients were followed up every 3 to 6 months according to the needs of each individual patient.

Re-examination

Re-examinations were performed from May 2011 to October 2011 at Gangneung-Wonju National University Dental Hospital. The compliance of the patient was classified, the prognosis for each tooth was determined retrospectively, and the tooth loss was examined at chairside.

Compliance with SPT was defined according to the classification by Park et al. [9]. The patients were categorized into three groups: complete compliance, erratic compliance, and noncompliance.

- Complete compliance (CC): patients who continued to attend their appointments in 2011 and had attended more than 80% of their recommended SPT appointments.
- Erratic compliance (EC): patients who continued to attend their appointments in 2011 and had attended less than 80% of their recommended SPT appointments or patients who had returned at least once for SPT but did not continue.
- Noncompliance (NC): patients who did not return for SPT.

The prognosis for each tooth was determined according to the classification by Checchi et al. [15].

- Hopeless: a tooth with bone loss greater than 75% or a tooth that had at least two characteristics from the "questionable" category.
- Questionable: a tooth with bone loss between 50% and 75% or the presence of an angular defect or furcation involvement.
- Good: a tooth with bone loss less than 50% or that did not fit into one of the two previous categories.

Statistical analysis

IBM SPSS ver. 19.0 (IBM Co., Armonk, NY, USA) was used for the statistical analysis, and the statistical significance level was set at a 95% confidence interval. The chi-square test was used to compare the tooth loss rate of each group. The Kruskal-Wallis method was used to compare the tooth loss/patient and tooth loss/patient/year, followed by individual post hoc comparisons using the Scheffé method.

RESULTS

Table 1 lists the characterization of the study population. The mean age of the patients was 47.3 years (range, 21–72 years), and the mean observation period was 11.0 years (range, 9.7–13.4 years).

Table 2 shows the number of teeth between baseline and re-examination. After completing the active periodontal treatment, the total number of teeth was 344 in the CC group, 2,515 in the EC group, and 365 in the NC group. The mean number of teeth/patient was 22.9 ± 6.4 in the CC group, 24.7 ± 4.2 in the EC group, and 21.5 ± 6.6 in the NC group.

At re-examination, the number of remaining teeth was 321 in

Table 1. Patient characteristics.

Characteristic	Complete compliance	Erratic compliance	Noncompliance	Total
Patients, n (%)	15 (11.2)	102 (76.1)	17 (12.7)	134 (100)
Age (year), mean (range)	46.2 (34–58)	46.9 (21–72)	51.1 (39–64)	47.3 (21–72)
Duration of SPT, mean (range)	11.2 (9.8–13.1)	11.0 (9.7–13.4)	10.6 (9.8–11.7)	11.0 (9.7–13.4)

SPT: supportive periodontal therapy.

Table 2. Number of tooth between baseline and re-examination.

	Complete compliance (n=15)	Erratic compliance (n=102)	Noncompliance (n=17)	Total (n=134)
Baseline	344	2,515	365	3,224
No. of teeth/patient	22.9±6.4	24.7±4.2	21.5±6.6	24.1±4.9
Re-examination	321	2,277	317	2,915
No. of teeth/patient	21.4±7.2	22.3±5.3	18.7±8.8	21.8±6.1

Values are presented as mean±standard deviation.

Table 3. Tooth loss during SPT.

	Complete compliance	Erratic compliance	Noncompliance	Total
Tooth loss[a]	23 (6.7)	238 (9.5)	48 (13.2)	309 (9.6)
Tooth loss /patient	1.5±1.9	2.3±2.1	2.8±2.8	2.3±2.2
Tooth loss /patient/year	0.14±0.18	0.21±0.20	0.26±0.26	0.21±0.20

Values are presented as number (%) or mean±standard deviation.
SPT: supportive periodontal therapy.
[a]Chi-square test was used, with the level of significance set at $P<0.05$. Three groups are statistically significant differences.
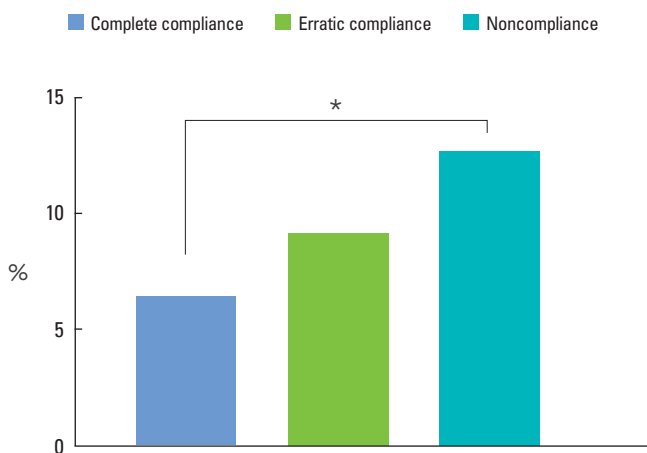

Figure 1. The tooth loss rate of the complete compliance group was significantly lower than that of the noncompliance group. *Significant difference ($P<0.05$).

the CC group, 2,277 in the EC group, and 317 in the NC group. The mean number of teeth/patient was 21.4±7.2 in the CC group, 22.3±5.3 in the EC group, and 18.7±8.8 in the NC group. During SPT, 309 teeth (9.6%) were lost or extracted. The tooth loss rate was 6.7% in the CC group, 9.5% in the EC group, and 13.2% in the NC group. The tooth loss rate of the CC group was significantly lower than that of the NC group (Table 3, Fig. 1). The tooth loss/patient and the tooth loss/patient/year tended to decrease as patient compliance increased, but there was no significant difference among the three groups.

The rates of tooth loss for the teeth given a good, questionable, and hopeless prognosis were 3.5%, 25.0%, and 68.2%, respectively. A statistical analysis revealed a significant correlation between the

Figure 2. The rates of tooth loss for the teeth given a good, questionable, and hopeless prognosis were 3.5%, 25.0% and 68.2%, respectively. Statist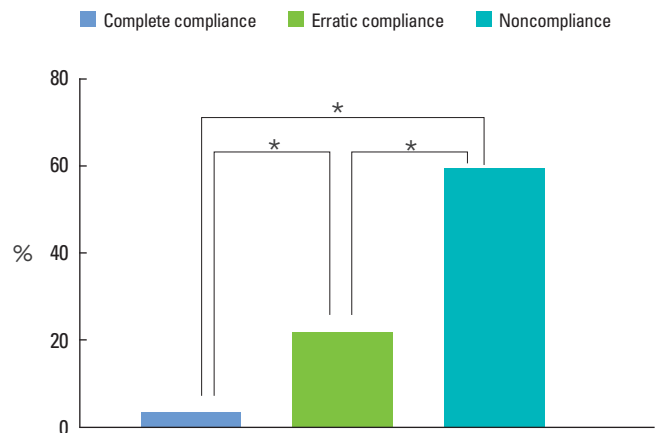ical analysis revealed a significant correlation between the tooth loss rate and the tooth prognosis. *Significant difference ($P<0.05$).

Table 4. Tooth loss by prognosis and compliance.

Prognosis	Group			P-value	Total[c]
	Complete compliance	Erratic compliance	Noncompliance		
Good[a]					
Baseline	238	2,135	295		2,668
Tooth loss, n (%)	1 (0.4)[a]	78 (3.7)[b]	15 (5.1)	0.011	94 (3.5)
Questionable[b]					
Baseline	74	267	39		380
Tooth loss, n (%)	3 (4.1)	82 (30.7)	10 (25.6)	0.000	95 (25.0)
Hopeless					
Baseline	32	113	31		176
Tooth loss, n (%)	19 (59.4)[a,b]	78 (69.0)[b]	23 (74.2)[b]	0.428	120 (68.2)

[a,b]Chi-square test was used, with the level of significance set at $P<0.05$. Three groups are statistically significant differences. [c]$P=0.000$
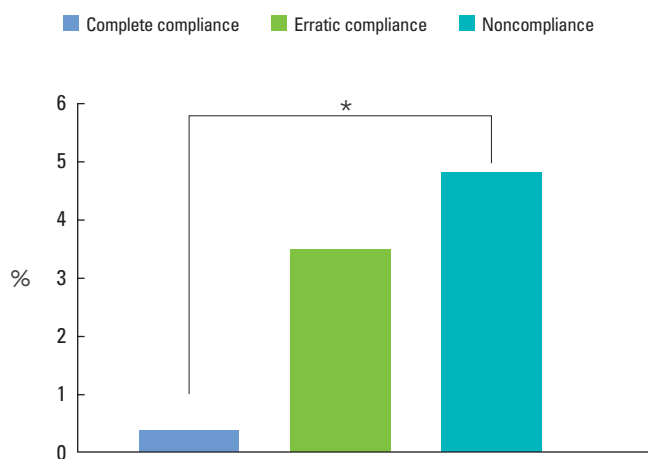
Figure 3. The teeth with a good prognosis in the complete compliance group showed a significantly lower rate of tooth loss (0.4%) than did the teeth with a good prognosis in the noncompliance group (5.1%). *Significant difference ($P < 0.05$).

Figure 4. The teeth with a questionable prognosis in the complete compliance group also showed a significantly lower rate of tooth loss (4.1%) than did the teeth with a questionable prognosis in the erratic compliance (30.7%) or the noncompliance (25.6%) groups. *Significant difference ($P < 0.05$).

tooth loss rate and the tooth prognosis (Fig. 2).

Among the teeth with a good prognosis in the CC group, only one tooth was lost during the maintenance period, and the cause of extraction was dental caries. The teeth with a good prognosis in the CC group showed a significantly lower rate of tooth loss (0.4%) than did the teeth with a good prognosis in the NC group (5.1%). The teeth with a questionable prognosis in the CC group also showed a significantly lower rate of tooth loss (4.1%) than did the teeth with a questionable prognosis in the EC (30.7%) or the NC (25.6%) group. As for the teeth with a hopeless prognosis, the difference in the tooth loss rates per compliance group was not significant (Table 4, Figs. 3 and 4).

DISCUSSION

After periodontal therapy, most patients can maintain their function and comfort for an extended period by effective, regular oral hygiene combined with periodic SPT [18]. Regular oral hygiene by the patient is absolutely necessary. Periodic SPT, however, can maintain a level of attachment despite less than perfect oral hygiene [12]. It has been reported that most patients with an advanced form of periodontal disease maintain their probing depth, clinical attachment level, and bone level for an extended period [19].

Many studies reported that periodic SPT can prevent tooth loss and maintain a beneficial outcome on a long-term basis [16, 17,20,21]. Hirschfeld and Wasserman [20] re-examined 600 patients for an average of 22 years after their active periodontal treatment and observed the patterns of tooth loss. During the maintenance period, 300 patients did not lose any teeth from periodontal disease, and 199 lost 1–3 teeth. Tsami et al. [21] reported that tooth loss was associated with the compliance of the patient with the suggested maintenance visits during the maintenance period.
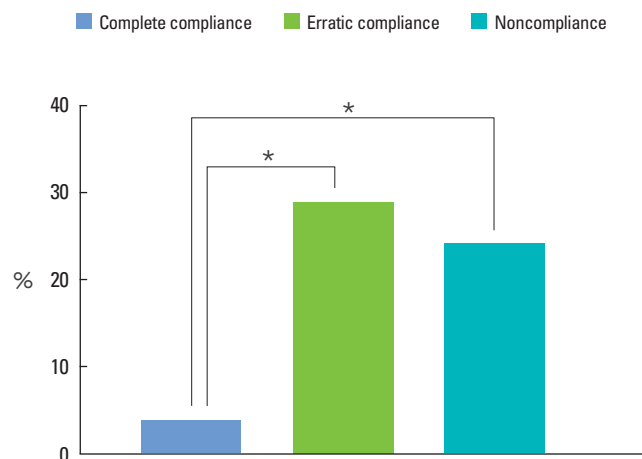
Among studies of tooth loss according to compliance with SPT, few studies have included patients who never returned for SPT, that is, the noncompliant patients. Ng et al. [22] reported that noncompliers lost more teeth than regular/irregular compliers for 7 years after active periodontal treatment. The evaluation of tooth loss according to compliance with SPT has been considered to represent a problem due to the difficulty in classifying and quantifying compliance [11]. Because the classification of CC and EC is dependent on the individual study criteria, making comparisons between CC/EC and NC may be superior to making comparisons between CC and EC. In this study, the NC group was included. We found that the EC group did not show a significantly higher tooth loss rate than the CC group, whereas the NC group did show a significantly higher tooth loss rate than the CC group. Our study indicated that the tooth loss/patient/year of the NC group was 0.26, which was similar to the rate observed in a previous study (Ng 2011; 0.26) [22]. The tooth loss/patient/year of the CC group was 0.14, which was similar to the results of several other studies (Hirschfeld and Wasserman [20] 1978, 0.08; McFall Jr [23] 1982, 0.14; Goldman et al. [24] 1986, 0.17; Ng et al. [22] 2011, 0.09) and lower than that of the NC group.

In this study, the tooth loss rate according to the prognosis was also assessed. If the prognosis for each tooth is accurate, a tooth with a poor prognosis would have a higher risk of tooth loss [25], and a tooth with a hopeless prognosis would be at a high risk for loss even with regular SPT. There are many criteria used to make a tooth prognosis [20,26,27]. In the present study, the prognosis of each tooth was determined according to the classification by Checchi et al. [15], in which an initial x-ray was used to make the prognosis retrospectively. The real prognosis can be overestimated or underestimated by using this classification system because only bone loss, furcation involvement, and the vertical bone defect shown in the x-ray are evaluated. Our study demonstrated that

the tooth loss rate was low (0.4%–5.1%) in teeth with a good prognosis and high (59.4%–74.2%) in teeth with a hopeless prognosis. The loss of teeth with a good prognosis decreased with better patient compliance, and the teeth with a good prognosis in the CC group had a significantly lower rate of tooth loss during SPT than the teeth with a good prognosis of the NC group. As for the teeth with a questionable prognosis, the teeth of the CC group had a significantly lower rate of tooth loss than the teeth of the other groups. For the teeth with a hopeless prognosis, those of the CC group showed the lowest rate of tooth loss, but there was no significant difference between the teeth of the three groups. Our results indicated that increased compliance with SPT led to a lower rate of tooth loss. However, the teeth with a hopeless prognosis were at a high risk irrespective of the patient compliance.

Although the difference was not significant, the teeth with a questionable prognosis of the EC group showed a higher tooth loss rate than did the teeth with a questionable prognosis of the NC group. This effect may have occurred because the clinicians had more chances to extract the teeth of erratic compliers because they visited the clinic more often than did noncompliers. Tooth loss is heavily affected by the decision of the clinician regarding whether to extract the tooth [28]. It is possible that there were fewer chances for clinicians to advise the noncompliant patients to have their teeth extracted because these patients did not visit for SPT.

Miyamoto et al. [29] raised the question of whether tooth loss should be taken as an evaluation indicator of the treatment effect because the dentist can have a great deal of influence on tooth loss. However, many researchers consider the rate of tooth loss to be an effective evaluation of periodontal treatment [30,31]. Further research should be performed using novel methods that exclude the influence of the dentist.

In the present study, we did not analyze the cause of tooth loss. The cause of tooth loss in the EC and NC groups was assessed using a questionnaire, but many of the patients were unable to remember why their teeth had been extracted, and there were also some cases of questionable patient answers. It is important to confirm the reason for the tooth loss when evaluating a tooth loss prevention effect as part of the periodontal treatment [32]. For example, if the cause of tooth loss is unclear, questions may arise as to whether tooth extraction for a prosthodontic treatment should be included in the tooth loss rate calculations.

Ong [33] reported that the most prominent cause of tooth loss was periodontal disease in periodontal patients, and most of the tooth loss was presumed to have been caused by periodontal disease in our study as well.

Only 134 patients out of 1,004 patients participated in our study. In particular, the participation rate of the fully edentulous patients was very low (only 1 of these patients participated in the study). Further, it is possible that the patients who did not participate in the study may have lost more teeth than did the patients who did participate [34]. Therefore, tooth loss may have been underestimated, particularly in the NC group. However, the fact that SPT is effective in tooth loss prevention despite these limitations can be assured.

Within the limits of this study, the patients who were poorly compliant with SPT were more likely to lose teeth than regularly compliant patients. However, the risk of tooth loss with a hopeless prognosis was high irrespective of the compliance level.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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