

A clinical comparison of the efficacy and efficiency of two professional prophylaxis procedures in orthodontic patients

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SUMMARY This study compared the efficacy and efficiency of two professional prophylaxis procedures in orthodontic patients performing different oral hygiene regimens: the air powder polishing system (APP), and the rubber cup and pumice (RCP) technique.

Sixty-two patients were divided into two groups: group I included 40 subjects who did not use any chlorhexidine mouthwash and group II comprised 22 subjects who regularly rinsed with a chlorhexidine mouthwash (at a 0.12 per cent concentration) and showed increased tooth staining.

Using a split-mouth experimental design, the buccal and lingual tooth surfaces were cleaned in half of the mouth by the APP and in the opposite half by the RCP technique. Tooth surfaces were scored before (PRE) and after (POST) the experimental procedures for the plaque index (PI), and for the presence of tooth staining. In addition, the treatment time required by each procedure was recorded.

In test group I, significant reductions in the PI after APP and RCP were observed. Likewise, in test group II, both procedures significantly reduced the baseline PI values. In both experimental groups, the percentage of stained sites significantly decreased after APP and RCP, but in test group II, APP seemed to be more effective than RCP. In addition, APP required significantly less time than RCP to remove dental plaque and staining. These data show that both professional prophylaxis procedures are effective in orthodontic patients, with APP being the most time-efficient technique and the most effective method for removal of tooth staining.

Introduction

Bacterial plaque control is a major concern during orthodontic treatment in order to prevent the occurrence of caries and periodontal inflammation (Löe *et al.*, 1965; Zachrisson and Zachrisson, 1972; Theilade and Theilade, 1976; Atack *et al.*, 1996).

Full-banded and bracketed orthodontic patients may show increased dental plaque accumulation requiring reinforced personal oral hygiene regimens and regular professional prophylaxis procedures (Lundström *et al.*, 1980; Huber *et al.*, 1987; Anderson *et al.*, 1997).

The conventional rubber cup prophylaxis (RCP) and the air powder polishing (APP) system are both effective professional techniques for plaque and stain removal, without detrimental effects on tooth structure and gingival tissues when correctly used (Willman *et al.*, 1980; Weeks *et al.*, 1984; Mishkin *et al.*, 1986; Orton, 1987; Barnes *et al.*, 1990; Jost-Brinkmann, 1996).

Barnes *et al.* (1990) showed that the use of the APP system in orthodontic patients neither affected the composite resin or zinc-phosphate cement used to secure brackets and bands,

nor caused any damage to arch wires or other appliances.

Furthermore, the APP system is more efficient since it requires less time than RCP to effectively remove dental plaque.

The purpose of this study was to investigate and compare, in orthodontic patients performing different oral hygiene regimens, and with different levels of plaque and tooth staining, the efficacy and efficiency of two professional prophylaxis procedures: the APP system and the RCP technique.

Materials and methods

Sixty-two orthodontic patients (30 males, 32 females) ranging in age from 12 to 24 years with a mean age of 17 years participated in the study.

The subjects had to fulfil the following criteria:

- (1) a minimum of 20 bracketed and/or banded teeth;
- (2) no supragingival calculus;
- (3) a mean plaque index score < 3;
- (4) presence of healthy gingiva or mild gingivitis;
- (5) absence of systemic disease.

The patients were divided into two groups: group I comprised 40 subjects who did not use a chlorhexidine mouthwash and group II included 22 subjects who regularly rinsed with a chlorhexidine mouthwash (at a 0.12 per cent concentration) and showed increased tooth staining.

A split-mouth experimental design was performed for each subject in both test groups. The buccal and lingual tooth surfaces were randomly cleaned in half of the mouth by the APP system (Air Flow SI, EMS-Electro Medical System, Nyon, Switzerland), while in the opposite half the RCP technique was used.

In each patient, the buccal and lingual tooth surfaces were scored by the same examiner before (PRE) and after (POST) the experimental procedures for the plaque index (PI) of Quigley-Hein modified by Turesky as reported by Fischman (1988), and for the presence/absence of tooth staining in a binomial fashion (dichotomous scoring) according to Ainamo and Bay (1975).

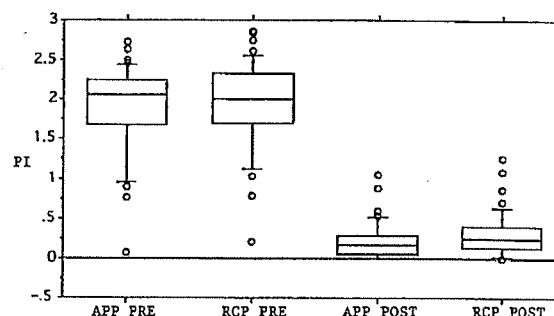


Figure 1 Box-plot graphs of plaque index (PI) in group I ($n = 40$); (o = outlier).

In addition, the treatment time required by each procedure for removal of stain and plaque was recorded.

Statistical analysis

The PI scores were averaged for each subject, since the within subject variation was much lower than the among subject variation.

The mean and the median of PI values, and of percentages of stain positive sites recorded before and after the experimental procedures for each patient in the two test groups were analysed. Data were compared using the Wilcoxon signed rank test.

Similarly, the mean and the median of the treatment time required by the two techniques in both test groups were computed and data compared with the Wilcoxon signed rank test.

Results

The distribution of PI values before (PRE) and after (POST) the APP system and the RCP technique, are shown by means of box-plot graphs in Figures 1 and 2 for each experimental group.

In group I, reductions of mean PI from 1.88 to 0.22 after APP and from 1.92 to 0.31 after RCP were observed. At the start there was no significant difference between APP and RCP PI values, while after this difference was statistically significant (Table 1). APP appeared to be more effective than RCP for dental plaque removal.

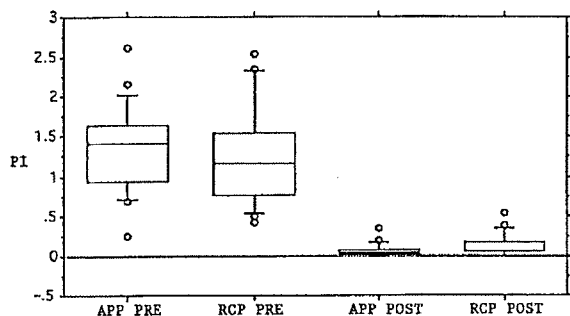


Figure 2 Box-plot graphs of plaque index (PI) in group II ($n = 22$); (o = outlier).

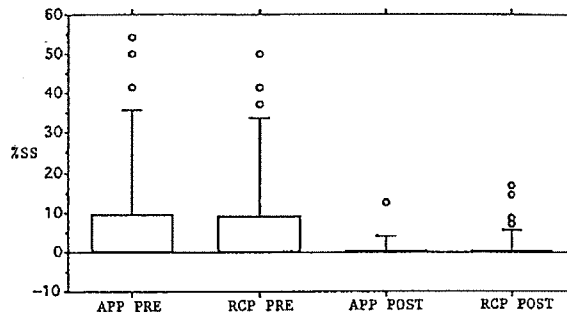


Figure 3 Box-plot graphs of percentage of stained sites (SS) in group I ($n = 40$); (o = outlier).

Table 1 Wilcoxon signed rank test of plaque index in group I.

	P value
PRE versus POST	
APP	0.0001
RCP	0.0001
APP versus RCP	
PRE	0.0801
POST	0.0004

P value refers to the significance at a level $\alpha = 0.05$.

Table 2 Wilcoxon signed rank test of plaque index in group II.

	P value
PRE versus POST	
APP	0.0001
RCP	0.0001
APP versus RCP	
PRE	0.5267*
POST	0.0151

P value refers to the significance at a level $\alpha = 0.05$.

*Not significant at a level $\alpha = 0.05$.

Likewise in group II, both APP and RCP reduced the baseline PI mean values from 1.34 to 0.05 and from 1.27 to 0.12, respectively. In addition, comparing the two techniques APP was significantly more effective than RCP (Table 2).

The box-plot graphs of percentages of stained sites are shown in Figure 3 for group I and in

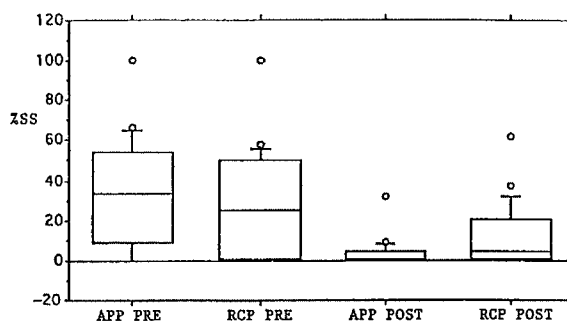


Figure 4 Box-plot graphs of percentage of stained sites (SS) in group II ($n = 22$); (o = outlier).

Figure 4 for group II. The mean percentage of stained sites was reduced after both prophylaxis procedures in group I, but at both PRE, as well as at POST the differences between APP and RCP were not statistically significant (Table 3). However, in group II, where at the start there was an increased percentage of stained sites, a reduction of mean percentage of stained sites from 34.76 to 3.13 after APP, and from 29.74 to 12.64 after RCP were observed. APP was significantly more effective than RCP at removal of tooth staining (Table 4).

Furthermore, no orthodontic appliance was disturbed by the APP technique, while RCP caused, in some cases, minor damage to brackets or arch wires.

In both experimental groups, APP required significantly less time than RCP to remove dental plaque and staining from tooth surfaces.

Table 3 Wilcoxon signed rank test of percentage of stained sites in group I.

	<i>P</i> value
PRE versus POST	
APP	0.0004
RCP	0.001
APP versus RCP	
PRE	0.1914*
POST	0.3433*

P value refers to the significance at a level $\alpha = 0.05$.

*Not significant at a level $\alpha = 0.05$.

Table 4 Wilcoxon signed rank test of percentage of stained sites in group II.

	<i>P</i> value
PRE versus POST	
APP	0.0003
RCP	0.0008
APP versus RCP	
PRE	0.0294
POST	0.0022

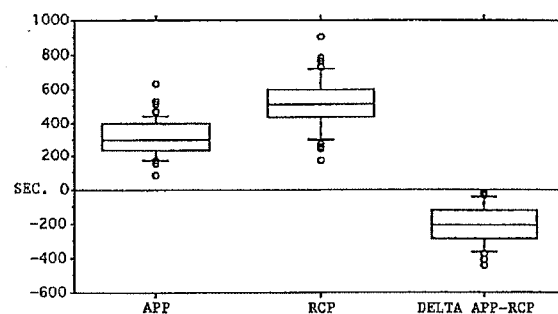
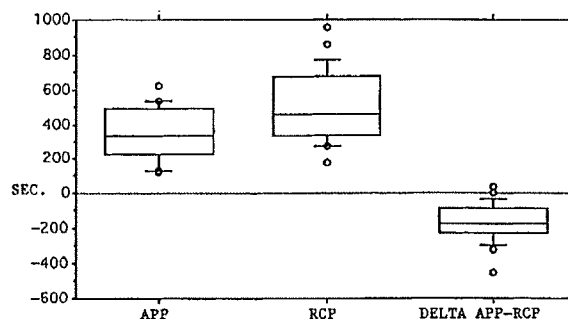
P value refers to the significance at a level $\alpha = 0.05$.

The delta box-plot graphs show that APP required less time in all subjects in group I (Figure 5), and in all but two patients in group II (Figure 6).

Discussion

The efficacy and efficiency of the APP system and of the RCP technique, have been evaluated and compared in two groups of orthodontic patients with different levels of plaque accumulation and tooth staining.

The experimental design was set in order to select a patient group with abundant tooth staining due to the chlorhexidine mouthwash, frequently prescribed during orthodontic treatment (Anderson *et al.*, 1997), with minimum effects on the other experimental conditions. The selection of a different patient group with an abundance of stained tooth surfaces, such

**Figure 5** Box-plot graphs of treatment time (seconds) in group I ($n = 40$); (o = outlier).**Figure 6** Box-plot graphs of treatment time (seconds) in group II ($n = 22$); (o = outlier).

as smokers, would certainly have affected the clinical conditions because of the detrimental effects of smoking on plaque accumulation and periodontal tissues (Genco, 1996).

At baseline, the chlorhexidine group (group II) showed increased tooth staining and a lower PI value compared with group I, but these differences did not have any effect on the prophylaxis procedures tested. APP and RCP were effective in both test groups for dental plaque removal with a statistically significant reduction of PI values after treatment. The Wilcoxon signed test revealed a significant difference between the two techniques, with APP being the most effective for plaque removal. However, even though statistically significant, this seems to be clinically irrelevant.

These results are in agreement with Barnes *et al.* (1990) who reported a major reduction of

plaque scores after APP compared with RCP in 50 patients with orthodontically bracketed and banded teeth.

With regard to tooth staining, APP as well as RCP showed a significant percentage reduction of stained sites in both test groups. Although in group I, the difference between the two techniques was not statistically significant, in group II the Wilcoxon signed test indicated a significant difference between the two procedures, with APP being the most effective for stain removal.

These data show that, in the presence of abundant tooth staining, APP seems to be more effective than RCP. These results are contrary to the study of Barnes *et al.* (1990), where no statistically significant difference between the two procedures was registered. Such discordance may be due to the different methods of tooth staining evaluation, but is more likely due to the insufficient number of subjects with tooth staining considered in that study.

Further evidence from the present investigation shows that APP seems to be more efficient than RCP. In both groups, APP required a significantly shorter treatment time than RCP to remove dental plaque and staining. These results are in agreement with the study of Barnes *et al.* (1990), even though in group I, APP required less time in every single case, while in test group II in all but two experimental cases.

Finally, no orthodontic appliance was damaged by the APP technique. This differed from RCP in that APP seems to be the safest procedure for orthodontic patients without detrimental effects when correctly used.

Conclusions

Both APP and RCP prophylaxis procedures are effective for dental plaque and stain removal on orthodontically bracketed or banded teeth, with APP being the most time-efficient technique and the most effective method for removal of abundant tooth staining.

It is suggested that APP is a prophylaxis procedure particularly indicated in orthodontic patients who rinse with a chlorhexidine mouthwash on a regular basis.

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