The comparison of two professional prophylaxis systems in plaque removal and debonding of orthodontic brackets

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Abstract:
Introduction: During orthodontic treatment, patients are expected to undergo consistent periodic prophylaxis as a result of complexities in oral hygiene. The aim of this study was to investigate, analyze, and compare the effectiveness of two professional prophylaxis systems of rubber cup polishing (RCP) and air-powder polishing (APP) in patients undergoing orthodontic treatment based on different levels of plaque and pigment on teeth and the extent of attachment of brackets after prophylaxis. Materials and Methods: A total of 50 patients were selected for this clinical trial study. A couple of months after the orthodontic treatment, the patients were placed on professional prophylaxis in terms of the plaque index. Randomized cross-arch prophylaxis (right maxilla with left mandible), RCP (left maxilla with right mandible), and APP were carried out on the patients. The main indexes in the study (number of plaque removal and debonding), the work time duration per second, and convenience of patients using visual analog scale in each of the methods were evaluated as minor factors. Data were recorded in a special checklist. Results: The mean of the plaque index and the time spent on RCP were observed to be higher than APP. The average satisfaction rate of patients with RCP was higher than APP. The debonding of the bracket and the tooth was not observed in any of the methods. Conclusion: APP is more efficient than RCP for performing professional prophylaxis of orthodontic patients.

Key words:
Dental polishing, orthodontic bracket, professional, prophylaxis

INTRODUCTION

The occurrence of dental lesions in people undergoing orthodontic treatment is very risky due to changes in oral ecology. More so, it has been shown that microbial plaque control is very important in preventing decay and periodontal diseases in these patients.[10] Orthodontic fixed devices increase teeth plaques, demineralization of the enamel, creation of white spots and eventually tooth decay due to microbial plaque retention, as well as prolonged exposure to the tooth surface.[11-13]

To effectively control and reduce these problems faced by patients undergoing orthodontic treatment, in addition to proper training on strengthening and maintaining a healthy oral hygiene, professional prophylaxis is recommended periodically for these patients.[9] The main purpose of oral prophylaxis is to remove the stains on the tooth surfaces while its secondary advantage is to remove the biofilm and reduce the adhesion of plaques, but the purpose of selective polishing is to avoid unnecessary removal of even small amounts of surface enamel.[14] Air-powder polishing (APP) and rubber cup polishing (RCP) are both effective on removing plaques and pigments, which, if applied appropriately, would have no adverse effects on the structure of the teeth and gums.[6,8]

For more than half a century, RCP has been used for plaque and pigment removal. In this method, the paste containing particles of pumice, glycerin, and colorants is used in addition to sodium bicarbonate or calcium carbonate are used under effects on the structure of the teeth and gums.

In APP technique, the particles of sodium bicarbonate or calcium carbonate are used under a combination of pressurized air and water with
the aim of removing plaques and changing the colors of tooth surfaces. Some studies have found that the effect of this method is approximately equivalent to manual or rotary tools in removing discoloration and plaques from the tooth surface.\[10\]

One of the problems encountered during the orthodontic treatment process is debonding of the bracket. The failure rate is reported to be 3.5%–25%.\[11,12\] The use of professional systems for plaques and pigments' removal could be a risk for debonding of the bracket from the tooth surface.

Therefore, the goal of this study was to compare and study the effectiveness of two professional prophylaxis systems of RCP and APP on patients undergoing orthodontic treatment with different levels of plaques and pigments on teeth and the debonding rate of the brackets after prophylaxis.

**MATERIALS AND METHODS**

This clinical trial study was approved by the Research Ethics Committee of Hamadan University of Medical Sciences and then performed on 50 patients whose mean age and standard deviation (SD) were recorded at 19.88 and 23.8 years, respectively, and who underwent orthodontic treatment and were also referred to the medical office, after being recorded in the clinical trial center of Iran with No. IRCT201506029014N65. The most important inclusion criteria included at least 16 and at most 22 orthodontic brackets of 22 MBT type with bond system (Orthodontic bonding system, 3M, Swiss) on the teeth, and the plaque index was ≥30. Furthermore, cardiovascular disease and blood pressure, respiratory problems, hemodialysis, sodium contraindication, gingival decay with cement exposure, and plaques were among the most important exclusion criteria.

Before the commencement of the study and after obtaining informed consent, the methods of oral hygiene were described to all participants including the correct method of brushing, the use of an orthodontic toothbrush, an interdental toothbrush, and a dental floss in the form of face-to-face evaluation by an informed person and using educational pamphlets.

Intraoral prophylaxis (right maxilla with left mandible) with the RCP method and (left maxilla with right mandible) the APP method were performed in a randomized and cross-arch form by a skilled expert. The RCP method was performed using Angle (low speed, Japan, NSK) from one-third gingiva to the incisal surface, Prophy Paste (Smart Practice, USA), and rubber cup (USA, Takpro) polishing [Figure 1].

The APP method was performed using a Prophy-Jet device (Dentsply, Long Island City, NY, USA) with sodium bicarbonate powder (USA, LM-Dental) from a distance of 2–3 mm from the dental surfaces and a 60°–70° angle with the polishing tooth. The plaque index of all teeth was measured by a person who was not aware of the study conditions [Figure 1]. This measurement was based on the O'Leary index\[10\] before and after treatment using a disclosing tablet (Oral-B, USA). After the plaque index was prepared, and before the prophylaxis began, the patient had to wash her mouth thoroughly to remove tablet remnants from the teeth. However, the presence of tablet’s color is not an obstacle or bias in the study because the clinician was trying to do the best for both methods. The goal of professional prophylaxis is to bring the plaque index to zero, which is even facilitated by colored teeth. It should be noted that these conditions exist for both methods and there was no interference with the study.

In the following, after recording the plaque index in the special chart, the RCP method and then the APP method were performed, and the plaque index was registered again [Figures 2 and 3]. Then, the same person reports the size of the debonding of the brackets in the form of a quantitative number, which is an observation reported as a proportion of the teeth with brackets in the quadrant under study.

The main indexes in the study (number of plaque removal and debonding), the work time duration per second, and convenience of patients using visual analog scale (VAS) in each of the methods were evaluated as minor factors. VAS was categorized from 0 to 100, which, according to the patient’s statement, was marked on the target area. In this category, the number 0 indicates absolute discomfort, 1–25 is a poor comfort, 26–50 shows average comfort, 51–75 shows good comfort, 76–99 is a great convenience, and 100 shows absolute comfort.\[14\]

Statistical analyses were performed using SPSS version 16 (SPSS Inc, IBM SPSS Statistics), paired t-test, and Wilcoxon test with significant level of P < 0.001.

**RESULTS**

According to Table 1, the participants’ mean age was 19.88 years, SD was 23.8 years with a minimum age of 14 years and the maximum age of 29 years, and the mean age was 21 years. Most of the participants in the study were female (34, 62.72%) and had degrees above bachelor (28, 57.1%).

According to Table 2, the mean plaque index in the APP method before intervention was significantly higher than the mean plaque index after intervention, and this difference was statistically significant. The mean of this index in the RCP method after intervention was less than before intervention (but not as APP method), which was statistically significant (P < 0.001).

According to Table 3, the mean number of brackets in the APP method was the same before and after the intervention, and there was no statistically significant difference. The mean of this index in the RCP method was the same before and after the intervention.

The mean and SD of time needed to perform RCP and APP methods were 265.7, 53.61 and 107.8, 25.63, respectively,

**Table 1: Underlying specification of patients**

| Patients          | Results          |
|-------------------|------------------|
| Mean (SD) age (year) | 19.88 (23.8)     |
| Men               | 16 (62.8)        |
| Women             | 34 (60.77)       |
| Educations        |                  |
| Diploma to bachelor | 22 (44.8)   |
| Above bachelor    | 28 (57.1)        |

SD – Standard deviation
which was statistically significant ($t = 22.26$ and $P < 0.001$). Furthermore, the mean (SD) comfort in RCP and AAP methods was 93.04% (14.99) and 59.53% (19.97), respectively. Based on the Wilcoxon nonparametric test, there was a statistically significant difference in the convenience of the two methods ($P < 0.001$ and $z = -5.785$), such that individuals tended to report more comfort in the RCP method.

**DISCUSSION**

The objective of this study was to seek an effective method for the professional removal of plaque with a low cost and without damaging the bonding of brackets and teeth and to provide patients with oral and dental health during orthodontic treatment, in addition to health education and provision of medical aids.

Based on our results, the average plaque index and the time consumed to perform RCP were more than in the APP technique. Furthermore, the average satisfaction rate of patients with RCP was more than APP. Considering these points, it is also important to note that debonding of the bracket was not observed in any of the methods.

One of the important characteristics of this study is the maximum control of confounding factors by designing a clinical trial, performing work by an expert, using a relatively large sample size, and using a relatively new prophylactic method. Both treatments were performed simultaneously in each patient. Each method was done by a dentist on both sides of the mouth in the form of a cross-arch, in order not be affected by the right or left hand of the patient and the angle of vision of the dentist and the prestudy data became homogeneous. The use of the disclosing tablet before the polishing allowed all plaques to be seen and accelerated; this improved the polishing.

The results of our study are consistent with the results of Kaur et al.,[9] which found that the use of powder and air removes more plaques and pigments compared to the rubber cup method. They also found that APP using aluminum trihydroxide powder without permanent damage to the gum was effective on removing plaque.
However, in our study, sodium bicarbonate powder was used. Findings from Barnes et al.\textsuperscript{13} also showed that APP was very effective on plaque removal, and its advantage over the RCP method was to spend less time and make the patient more comfortable. They also showed that the use of the APP system had no negative effect on resin composites and bonding of brackets and did not lead to the damage of the wire and other appliances. However, in our study, the patients were more comfortable with the RCP method. According to most of the patients, the cause of this discomfort is associated with the bitter taste of the applied powder. Although flavored sodium bicarbonate powder was used in this study, patients were reluctant to feel bitter taste in their mouths. Of course, if other powders such as glycine were used, patients would be more comfortable. Furthermore, the use of sodium bicarbonate particles under atmospheric pressure could be another reason for the decrease in the patient’s satisfaction with the APP method. In this regard, some studies have reported symptoms of respiratory problems during or immediately after gum polishing or damage to the surface of the mucus of the lower lip, following the use of pressurized air.\textsuperscript{16}

In another study by Simon et al.\textsuperscript{17} on patients with chronic periodontitis, it was found that glycine and ultrasonic polishing would result in the removal of plaque and gum index. Of course, it should be noted that in the present study, patients were without plaque, periodontitis, periodontal envelope, and gingival decay. However, this study also demonstrated the effectiveness of the APP method on plaque removal.

In the present study, the resin bond strength between the teeth and brackets was not investigated in terms of micromechanical tests, but there was no objective evidence of any fracture and disconnection in the bracket bond, teeth, and their debonding in the patients. The results from Ramaglia et al.\textsuperscript{18} showed that the APP system did not cause harm to dental appliances compared with RCP.

According to the results of this study, it is important that in addition to the periodic health education, patients undergoing orthodontic treatment, especially children and adolescents, should undergo professional prophylaxis depending on the number of plaque, pigment, and periodontium condition due to the increased risk of developing dental caries and gum disease during orthodontic treatment which result from the lack of proper control of plaque. To evaluate this goal, the APP method can be proposed as an efficient way requiring less time.

**CONCLUSION**

In this study, APP was more efficient and less time-consuming than RCP for professional prophylaxis in patients undergoing orthodontic treatment.

**Acknowledgements**

This article was prepared from a dissertation for a specialty degree in restorative dentistry. The authors would like to extend their gratitude to the Deputy of Research at Hamadan University of Medical Sciences and the Dental Research Center.

**Financial support and sponsorship**

Vice-chancellery of research affairs of Hamadan University of Medical Sciences supported this study by a grant.

**Conflicts of interest**

There are no conflicts of interest.

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**RECORDING CHART**

**Demographic characteristics:**
- Age: ______ year: ______
- Sex: Male ☐ Female ☐
- Occupation:
- Education: Illiterate ☐ <Diploma ☐ Diploma-B.S ☐ B.S< ☐

**Criteria evaluation:**
- Plaque index in each quadrant before/after treatment:
  - RCP PI
  - APP PI
  - APP PI
  - RCP PI

- Number of braces in each quadrant before/after treatment:
  - RCP Braces
  - APP Braces
  - APP Braces
  - RCP Braces

- Time of treatment in each quadrant:
  - RCP time
  - APP time
  - APP time
  - RCP time

- Patient comfort during treatment
  - 0 25 50 75 100
  - Not Confortable
  - Totally comfortable

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418 Journal of Indian Society of Periodontology - Volume 22, Issue 5, September-October 2018