

Efficacy evaluation of rubber cup and air polishing techniques using glycine in plaque and stain removal - A clinical trial

Avineet Kaur¹, Arvind Bhardwaj¹, Shanam Kansil², Rasveen Kaur¹,
Supreet Kaur¹, Ramandeep S. Gambhir³

¹Department of Periodontology and Oral Implantology, MM College of Dental Sciences and Research, MM (Deemed to be University), Mullana, Haryana, ²Dental Implant Clinic, Landmark Hospital, Chandigarh,

³Department of Public Health Dentistry, Rayat-Bahra Dental College and Hospital, Mohali, Punjab, India

ABSTRACT

Background: Researchers have proved Glycine to be safe, less abrasive, sweet and comfortable for patients. It is beneficial in removing plaque as well as stains. The present study aims to compare the plaque and extrinsic stain removal efficacy of the air-polishing device and rubber cup prophylaxis technique along with a comparative evaluation of the gingival trauma caused by both the techniques. **Method:** This split-mouth randomized clinical trial was conducted on a total of 60 subjects in half of whom, left side was assigned to Glycine powder air polishing and the right side to rubber cup prophylaxis with (Glycine powder) and vice versa in the other half. All the subjects had their calculus removed one month prior to the intervention. Plaque index, Stain index and Trauma index were recorded and statistical analysis was done. **Results:** Both the techniques (RCP and AP) demonstrated a significant reduction in plaque and stains within their respective groups, but revealed non-significant differences between the study groups. Gingival trauma was found to be significantly higher in case of AP group. Rubber cup technique was preferred over air polishing by the subjects. **Conclusion** The data indicates that both the techniques were equally beneficial for plaque and stain removal, but rubber cup polishing technique has an advantage over the air polishing technique.

Keywords: Air polishing, glycine, plaque, rubber cup, stain

Introduction

Periodontal diseases are multi-factorial in nature and are caused by various micro-organisms which tend to accumulate and colonize along the tooth surface at or below the gingival margin.^[1] Its treatment necessitates thorough supra and sub-gingival calculus and biofilm removal which are also the central part of the

periodontal maintenance therapy. Hand instruments, sonic or ultrasonic scalers may be used for debridement purposes.^[2] Even if instrumentation is performed by well trained and proficient clinicians, the use of these instruments periodically may render surfaces of the teeth rough apart from leaving stains on them. Tooth polishing, a procedure which is carried out as a part of oral prophylaxis in most dental practices, is an act of smoothening the tooth surfaces to make it glossy and lustrous. The most effective professional techniques for plaque and stain removal are conventional rubber cup prophylaxis and air powder polishing system.^[3] For over half a century, the use of rubber cup and paste has been the most common method of prophylaxis.^[4]

Address for correspondence: Dr. Ramandeep S. Gambhir, Professor, Department of Public Health Dentistry, Rayat-Bahra Dental College and Hospital, Mohali, Punjab - 140 104, India. E-mail: raman2g@yahoo.com

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As prophylaxis paste should be chosen carefully as it can cause incidental damage while removing the dental stains. Though sodium bicarbonate has been commonly used since the 1980s because of its water solubility and lack of toxicity, its deleterious effects on denuded root surfaces or dentin are also well documented.^[5-8] An air polishing powder consisting of an amino-acid glycine was introduced because of inherent limitations and drawbacks of sodium bicarbonate.^[5]

Glycine, a nonessential amino acid is a substrate for the endogenous synthesis of physiologically important substances such as tetrahydrofolic acid, purine etc., It is odourless and colorless in nature and is highly water soluble. The low-abrasive glycine powder is produced by milling glycine crystals in an agate disc grinder with a mean particle size of less than 45 μm to 60 μm is obtained.^[9] Glycine has approximately one-fifth of the abrasiveness when compared to sodium bicarbonate but is capable of removing biofilm from a root surface within 5 seconds. Findings of another study reveal that glycine powder resulted in improved access to pits and fissures and demonstrated rapid removal of biofilm and debris.^[9] Therefore the present study was conducted to compare the plaque and extrinsic stain removal efficacy of an air polishing device and conventional rubber cup prophylaxis technique using glycine powder, to do a comparative evaluation of the gingival trauma caused by both the techniques and to evaluate the patient acceptance with respect to both the modalities.

Materials and Method

Ethical clearance and informed consent

Ethical clearance was obtained prior to the start of the study (Institutional Ethics Committee of Gian Sagar Dental College and Hospital, Rajpura, January 2015). Informed consent was obtained from the subjects for their willingness to participate in the study. Participation in the study was voluntary and any type of information revealing the identity of the subjects was not obtained.

Participants

The present study (clinical trial) was conducted on 60 subjects. Sample size was calculated on the basis of a pilot study which was done on 14 subjects with significant level $\alpha = 0.05$ and $\beta = 0.2$, and using PASS version 11 (NCSS, USA) software, the sample size was calculated to be 54. The final sample size was taken as 60 considering the rate of possible loss to follow-up as 15%. Patients who visited the Department of Periodontology of the institution for their routine treatment comprised the study population.

Inclusion criteria

- Patients of age between 19 to 60 years
- Patients presenting with plaque, calculus and extrinsic stains
- Patients with full complement of teeth
- Patients having good general health

Exclusion criteria

- Patients presenting with contagious diseases.
- Pregnancy and lactation.
- Systemic diseases such as neutropenia, agranulocytosis, diabetes or bleeding disorders
- If radiotherapy or chemotherapy were performed before or needed to be performed during the study period
- Patients with valvular heart disease or with any risk factor for endocarditis.
- Crowded/carious teeth or those with restorations.
- Patients wearing orthodontic appliances.

Randomization and intervention

The study was conducted as a split mouth, randomized clinical trial. Subjects were divided into two equal groups comprising of 30 subjects in each group which were selected randomly. In the first group, left side of the oral cavity was assigned to air polishing (with glycine powder) and the right side to conventional rubber cup prophylaxis with the same agent. In the second group, right side of the oral cavity was assigned to air polishing (with glycine powder) and the right side to conventional rubber cup prophylaxis. All the subjects had their supra and subgingival calculus removed three days prior to the intervention.

As part of intervention, the powder chamber of air polishing device was filled with low abrasive glycine powder (according to manufacturer's instructions). For use the tip of the jet was positioned at an angle of 60°-90° to the long axis of the tooth at a distance of 4-5 mm from the tooth surface with the central beam of the jet spray to be produced projected on the middle third of the tooth. Once activated, a constant circular motion was used to cover the entire clinical crown for a total time period of 5 seconds per surface (facial and lingual) of each tooth on the allotted side of the subject. The time measurement was done by using a stopwatch. The instrument's powder chamber was refilled to maximum level after every 20s of instrumentation period to ensure reproducibility.

On the contralateral side for rubber cup prophylaxis the paste was prepared in the glass dappen dish by mixing glycine powder in distilled water. The rubber cup was then mounted on a contra-angle rotary handpiece with sufficient torque to ensure a steady speed (2500 rpm to 3000 rpm) that could be easily maintained and the abrasive slurry (approximately 0.5 g) was placed in the cup. The cup was activated and placed onto the tooth surface and a constant circular motion was given to cover the entire clinical crown for a time period not exceeding 5 seconds as measured by the stopwatch. The rubber cup was filled afresh with the abrasive slurry for each tooth in order to ensure reproducibility of the abrasive particle application to the tooth. Before and after intervention the following parameters were recorded for each patient on both the left and right sides:

- Quigley-Hein plaque index modified by Turesky, Gilmore and Glickman (PI).^[10]
- Lobene Stain Index, 1968 (SI).^[11]
- Trauma Index (TI).^[12]

Statistical analysis

Statistical analysis was performed using SPSS 20.0 version for Windows (IBM, Chicago, USA). Shapiro-Wilk test was used for Intra-group and intergroup differences for normal distribution. In cases of skewed distribution, Wilcoxon test was used for statistical significance. Mann Whitney U-test (Mann Whitney test) to compare mean values of Plaque Index and Gingival Index. Patient acceptance was compared using Chi-square test. A significance level of $P < 0.05$ was set in all the calculations.

Results

Intergroup comparison of Pre Plaque Index (PI), Post PI, Pre Stain Index (SI), Post SI, and Trauma Index (TI) between the two groups using Mann Whitney Test is depicted in Table 1 and Figure 1. Pre PI shows mean values of 1.213 ± 0.429 and 1.195 ± 0.331 for the rubber cup polishing (RCP) and air polishing (AP) groups respectively with a mean difference of 0.0185 ± 0.070 , which was found to be statistically non significant based on P value 0.964. Similarly, the mean values of PI immediately post operatively were computed to be 0.0297 ± 0.367 and 0.316 ± 0.394 for the RCP and AP groups respectively with a statistically non significant (P -value 0.896) difference of 0.019 ± 0.069 .

While the mean value of Pre SI for the RCP group was found to be 2.320 ± 1.519 the same for AP group came out to be 2.270 ± 1.533 . Their difference i.e., 0.050 ± 0.278 was also statistically non significant ($P > 0.725$) The Post SI mean values for RCP and AP groups were found to be 1.827 ± 1.291 and 1.857 ± 1.276 respectively, which too were not statistically significantly different ($0.030 \pm 0.234 P > 0.962$) from each other.

The Trauma Index which was recorded only post-operatively showed mean values of 0.270 ± 0.465 for the RCP group and 0.362 ± 0.413 for the AP group. Their mean difference (0.091 ± 0.080) was statistically significant ($P < 0.043$)

thereby implying that rubber cup polishing technique was significantly less traumatic to the gingiva.

Intra-group comparison of pre and post PI within the study groups using Wilcoxon test is depicted in Table 2 and Figure 2.

The mean difference between pre PI and post PI for RCP and AP groups were found to be 0.916 ± 0.412 and 0.879 ± 0.289 respectively and both were statistically highly significant with P value < 0.001 . This means that individually both these techniques are significantly effective in removal of plaque.

Intra-group comparison of pre and post SI within the Study groups using Wilcoxon test is depicted in Table 3 and Figure 3. The mean difference between pre SI and post SI for RCP and AP groups were found to be $0.493 + 0.725$ and $0.412 + 0.803$ respectively and both were statistically highly significant with P value < 0.001 .

Table 1: Intergroup comparison of Pre PI, Post PI, Pre SI, Post SI and TI between study groups (using Mann whitney test)

| | Rubber Cups (mean±S.D) | Air Polisher (mean±S.D) | Mean difference | Z | P |
|-------------------|------------------------|-------------------------|-----------------|--------|-------|
| Plaque Index pre | 1.213±0.429 | 1.195±0.331 | 0.0185±0.070 | -0.045 | 0.964 |
| Plaque Index post | 0.297±0.367 | 0.316±0.394 | -0.019±0.069 | -0.130 | 0.896 |
| Stain Index Pre | 2.320±1.519 | 2.270±1.533 | 0.050±0.278 | -0.352 | 0.725 |
| Stain Index Post | 1.827±1.291 | 1.857±1.276 | -0.030±0.234 | -0.47 | 0.962 |
| Trauma Index | 0.270±0.465 | 0.362±0.413 | -0.091±0.080 | -2.025 | 0.043 |

Table 2: Intra-group comparison of pre and post plaque index within study groups (using wilcoxon test)

| | Plaque Index Pre (Mean±S.D.) | Plaque Index Post (Mean±S.D.) | Mean difference | Z | P |
|--------------|------------------------------|-------------------------------|-----------------|--------|--------|
| Rubber Cups | 1.213±0.429 | 0.297±0.367 | 0.916±0.412 | -6.707 | <0.001 |
| Air Polisher | 1.195±0.331 | 0.316±0.394 | 0.879±0.289 | -5.195 | <0.001 |

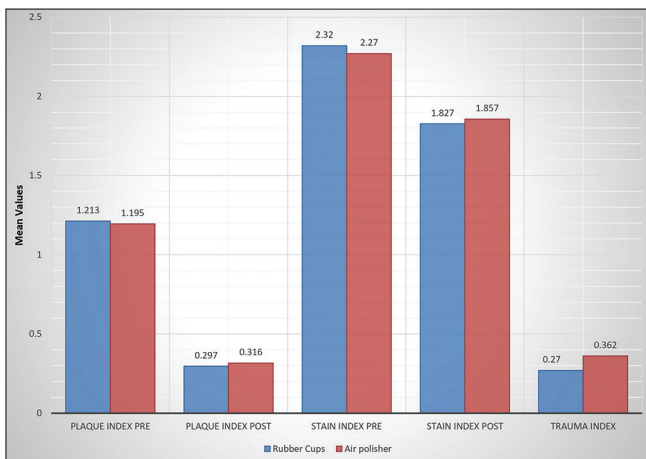


Figure 1: Intergroup comparison of Pre PI, Post PI, Pre SI, Post SI and TI between study groups

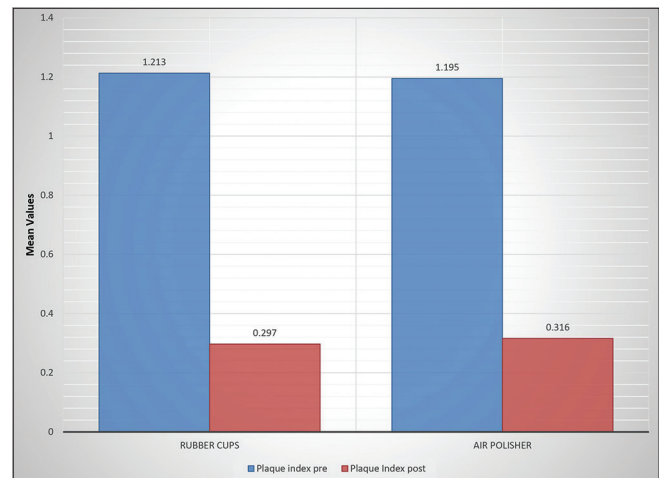


Figure 2: Intragroup comparison on pre and post plaque index within study groups

Table 4 and Figure 4 depict intergroup comparison of plaque reduction stain reduction and trauma between the study groups using Mann Whitney test. The mean values of plaque reduction for RCP and AP groups were found to be 0.916 ± 0.411 and 0.879 ± 0.289 respectively. Their mean difference was 0.377 ± 0.0648 and found to be statistically non-significant ($P > 0.624$).

Similarly mean values of stain reduction for RCP and AP groups were found to be 0.493 ± 0.726 and 0.412 ± 0.803 respectively with a mean difference of 0.081 ± 0.140 which is non-significant ($P > 0.548$). The trauma index values for RCP and AP groups were found to be -0.270 ± 0.465 and -0.362 ± 0.413 respectively with a mean difference of 0.091 ± 0.080 which was found statistically significant ($P < 0.043$).

Table 5 depicts inter-group comparison of patient acceptance between the study groups. Patient acceptance was 75% (45/60) in case of RCP group and 25% (15/60) in case of AP group. These figures unambiguously point towards an unequivocal preference among patients in favour of rubber cup polishing technique.

Discussion

Non-surgical treatment is unequivocally accepted by contemporary periodontal fraternity, as an indispensable cornerstone of initial periodontal disease management as well as post-operative maintenance. However, literature is replete with myriads of reports emphasizing that the use of hand instruments is not only technically demanding but also entails considerable cumulative tooth substance loss/damage and gingival recession.^[12-14] Therefore it is logically desired to use treatment modalities which are not only effective in removal of plaque and stains but are also kind to the hard and soft tissues. There seems to be no dearth of reports incriminating sodium bicarbonate polishing powder for severe root damage within short applications.^[15-17] It has also been contraindicated in cases with sodium restricted diet hypertension and renal insufficiency etc.

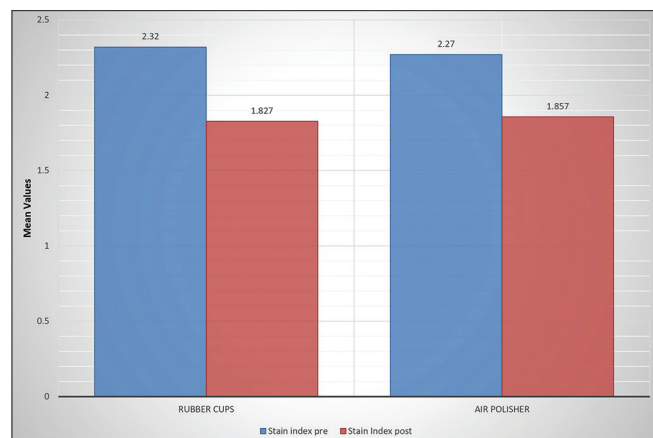


Figure 3: Intragroup comparison on pre and post stain index within study groups

Therefore to mitigate the above stated undesirable aspects and to overcome the limitations of sodium bicarbonate, glycine air polishing powder with a mean particle size of less than $45\mu\text{m}$ to $60\mu\text{m}$ was developed. As with rubber cup prophylaxis, least abrasive paste should be used for plaque and stain removal.

Corroborating the observations made during the course of the study, the statistical analysis presented in Table 2 and Figure 2 showing pre PI to post PI difference within the groups clearly depicts that both the techniques caused a statistically highly significant reduction in plaque scores (P value < 0.001 for both the groups). These findings are concurrent with the findings of some other studies who also reported that both the rubber

Table 3: Intra-group comparison of pre and post stain index within study groups (using Wilcoxon test)

| | Stain index pre (Mean±S.D.) | Stain index post (Mean±S.D.) | Mean difference | Z | P |
|--------------|-----------------------------|------------------------------|-----------------|--------|--------|
| Rubber Cups | 2.320±1.519 | 1.827±1.291 | 0.493±0.725 | -6.767 | <0.001 |
| Air Polisher | 2.270±1.533 | 1.857±1.276 | 0.412±0.803 | -4.197 | <0.001 |

Table 4: Intergroup comparison of plaque reduction, stain reduction and trauma index between study groups (using Mann Whitney test)

| | Rubber Cups (Mean±S.D.) | Air Polisher (Mean±S.D.) | Mean difference | Z | P |
|----------------|-------------------------|--------------------------|-----------------|--------|-------|
| Pre PI-Post PI | 0.916±0.411 | 0.879±0.289 | 0.377±0.0648 | -0.491 | 0.624 |
| Pre SI-Post SI | 0.493±0.726 | 0.412±0.803 | 0.081±0.140 | -0.601 | 0.548 |
| Pre TI-Post TI | -0.270±0.465 | -0.362±0.413 | 0.091±0.080 | -2.025 | 0.043 |

Table 5: Intra-group comparison of patient acceptance within study groups

| Patient Acceptance | Rubber Cups n (%) | Air Polisher n (%) |
|--------------------|-------------------|--------------------|
| No | 15 (25) | 45 (75) |
| Yes | 45 (75) | 15 (25) |

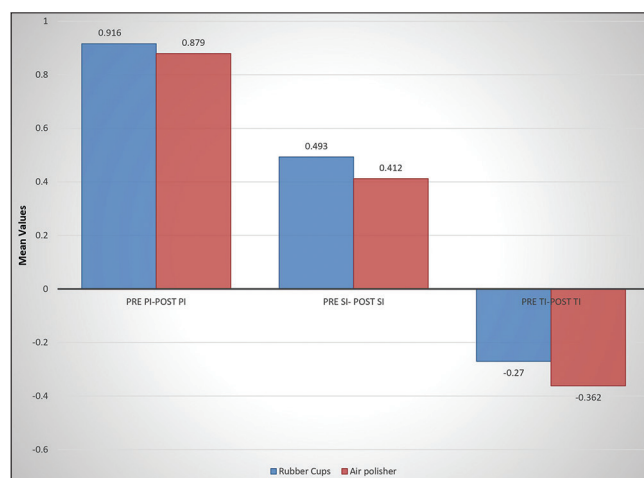


Figure 4: Intergroup comparison of plaque reduction, stain reduction and trauma index between study groups

cup prophylaxis and air polishing techniques to be significantly effective in plaque reduction.^[12,18,19] However, it is also pertinent to mention that an extensive research of literature could not find a study using glycine air polishing powder as an abrasive paste with rubber cup thereby pointing to the novelty of the present study.

As regards the observations made with respect to tooth stain reduction, the statistical analysis presented in depicts that both the techniques caused a statistically highly significant reduction in stain scores (P value < 0.001 for both the groups). These findings are also in concordance with the findings of some other studies.^[12,19]

It is also observed from the findings of the current study that the difference between plaque reduction (0.377 ± 0.0648) caused by both the techniques is statistically non-significant ($P = 0.624$) as is the difference between tooth stain reduction (0.081 ± 0.140) caused by both the techniques ($P = 0.548$). While these findings are harmonious with the findings of some other study who found both the techniques to be equally efficacious regarding removal of supragingival plaque and in reducing gingival inflammation.^[20] However, the findings are in they are in contrast to other studies conducted elsewhere who found air powder polishing system to be better on both the accounts i.e., plaque as well as stain reduction.^[3]

Some authors found the rubber cup technique to be a very gentle prophylactic method on removal of dentine.^[21] As far as trauma to the soft tissue is concerned in the present study, air polishing method proved to be significantly more traumatic than rubber cup prophylaxis immediately post operatively an outcome that concurs with some previous studies as well.^[12,13,22]

Since in the present study both the techniques have proved to be effective with only a 5-second application per tooth, the entire dentition comprising of 28 teeth would take a nominal time of approximately 9.3 minutes which is a positive factor for patient compliance. With respect to patience acceptance parameter, an overwhelming number of 45 out of the total 60 patients in the present study found rubber cup prophylaxis to be more comfortable than the air polishing technique. A diligent interrogation undertaken with the patients in this regard revealed that a majority of them felt uncomfortable because of the aerosol production concomitant with air polishing.

Conclusion

To conclude it can be averred that both the rubber cup prophylaxis and air polishing techniques with glycine powder have proved to be satisfactory with respect to plaque and stain removal. However rubber cup polishing technique with glycine powder has been shown to be significantly less traumatic and also enjoys better patient acceptance hence warranting its routine use in periodontal maintenance.

Relevance of the paper to the practice of primary care physicians

Dental health professionals have also a significant role to play towards imparting primary care to their patients. A thorough case history taken before starting dental treatment can highlight patient's general health and well being (diagnosis and assessment of risk factors) which is of great significance in the final treatment outcome. Oral hygiene prophylaxis using rubber cup and glycine powder can significantly remove plaque and stains from the teeth thereby enhancing oral health and general health of the patient (secondary prevention). For those patients who do not generally utilize health care services and are likely to only be seen in a dental office for emergency situations, health care screenings may be performed during routine dental visits. Most importantly, dental health professionals and primary care physicians can work together on a common platform to strengthen the overburdened health infrastructure of our country during this time of pandemic (COVID-19) emergency.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Lindhe J, Lang NK, Karring TK. Clinical Periodontology and Implant Dentistry. Vol. 1. UK: Wiley; 2008.
2. Bühler J, Amato M, Weiger R, Walter C. A systematic review on the effects of air polishing devices on oral tissues. *Int J Dent Hyg* 2016;14:15-28.
3. Poormoradi B, Tamasoki S, Shahbazi A, Hooshyarfard A, Vahdatinia F, Behgozin F, *et al.* The comparison of two professional prophylaxis systems in plaque removal and debonding of orthodontic brackets. *J Indian Soc Periodontol* 2018;22:414-8.
4. Sawai MA, Bhardwaj A, Jafri Z, Sultan N, Daing A. Tooth polishing: The current status. *J Indian Soc Periodontol* 2015;19:375-80.
5. Petersilka GJ. Subgingival air-polishing in the treatment of periodontal biofilm infections. *Periodontol* 2000 2011;55:124-42.
6. Moëne R, Décaillet F, Andersen E, Mombelli A. Subgingival plaque removal using a new air-polishing device. *J Periodontol* 2010;81:79-88.
7. Cobb CM, Daubert DM, Davis K, Deming J, Flemmig TF, Pattison A, *et al.* Consensus conference findings on

- supragingival and subgingival air polishing. *Compend Contin Educ Dent* 2017;38:e1-4.
8. Graumann SJ, Sensat ML, Stoltenberg JL. Air polishing: A review of current literature. *J Dent Hyg* 2013;87:173-80.
 9. Pence S. The Evolution of air polishing. *Dimens Dent Hyg* 2015;13:58-61.
 10. Carranza FA. The Epidemiology of Gingival and Periodontal Disease in "Glickman's Clinical Periodontology". 7th ed. Philadelphia: WB Saunders Company; 1990. p. 302-29.
 11. Lobene RR. Effect of dentifrices on tooth stains with controlled brushing. *JADA* 1968;77:849-55.
 12. Lu H, He L, Zhao Y, Meng H. The effect of supragingival glycine air polishing on periodontitis during maintenance therapy: A randomized controlled trial. *Peer J* 2018;6:e4371.
 13. Jahn CA. The dental water jet: A historical review of the literature. *J Dent Hyg* 2010;84:114-20.
 14. Shah N, Mathur VP, Jain V, Logani A. Association between traditional oral hygiene methods with tooth wear, gingival bleeding, and recession: A descriptive cross-sectional study. *Indian J Dent Res* 2018;29:150-4.
 15. Janiszewska-Olszowska J, Drozdziak A, Tandecka K, Grocholewicz K. Effect of air-polishing on surface roughness of composite dental restorative material-comparison of three different air-polishing powders. *BMC Oral Health* 2020;20:30.
 16. Simon CJ, Munivenkatappa Lakshmaiah Venkatesh P, Chickanna R. Efficacy of glycine powder air polishing in comparison with sodium bicarbonate air polishing and ultrasonic scaling-a double-blind clinico-histopathologic study. *Int J Dent Hyg* 2015;13:177-83.
 17. Fratolin MM, Bianco VC, Santos MJ, Rizkalla AS, Santos GC Jr. The effect of prophylactic powders on the surface roughness of enamel. *Compend Contin Educ Dent* 2014;35:e31-5.
 18. Camboni S, Donnet M. Tooth surface comparison after air polishing and rubber cup: A scanning electron microscopy study. *J Clin Dent* 2016;27:13-8.
 19. Miller DL, Hodges KO. Polishing the surface. A comparison of rubber cup polishing and air polishing. *Probe* 1991;25:103,105-9.
 20. Patil SS, Rakhewar PS, Limaye PS, Chaudhari NP. A comparative evaluation of plaque-removing efficacy of air polishing and rubber-cup, bristle brush with paste polishing on oral hygiene status: A clinical study. *J Int Soc Prev Community Dent* 2015;5:457-62.
 21. Chowdhary Z, Mohan R. Efficiency of three different polishing methods on enamel and cementum: A scanning electron microscope study. *J Indian Soc Periodontol* 2018;22:18-24.
 22. Kaur G, Grover V, Malhotra R, Kapoor A. Comparative evaluation of gingival trauma by Prophy-Jet and rubber-cup polishing techniques using aluminium trihydroxide. *Indian J Dent* 2015;6:130-4.