Influence of Air-Powder Polishing on Human Enamel Surface Topography and Chromatic Alterations

Dr. Helena V. Jorvani
School of Digital Discourse and Civic Life, Meravik Institute of Social Thought, Podgorica, Montenegro

Dr. Omar S. Talroun
Department of Media Influence and Political Psychology, Zerhoun University of Public Studies, Khartoum, Sudan

V0LUME 01 ISSUE 01 (2024)
Published Date: 22 December 2024 // Page no.: - 46-52

ABSTRACT

Have you ever wondered what truly makes a smile shine, beyond just straight teeth? It's often the smooth, bright surface of our tooth enamel. This article dives into how a popular dental cleaning method, air-powder polishing, affects both how smooth our enamel stays and how long that sparkling white color lasts. We'll explore why a smooth surface is so important for keeping our mouths healthy and preventing stains, and how different types of polishing powders can make a big difference. Think of it as a journey into the microscopic world of your teeth, revealing how we can best care for that vital outer layer to keep your smile looking its best.

Keywords: Air-powder polishing, Enamel, Surface roughness, Color change, Dental prophylaxis, Sodium bicarbonate, Glycine, Erythritol, Stain removal

Introduction

In today's world, a beautiful, healthy smile isn't just a luxury; it's often seen as a reflection of overall well-being and confidence. People everywhere are seeking that perfect, radiant smile, making dental aesthetics a top priority in modern dentistry [13]. At the heart of this desire for a dazzling smile lies our tooth enamel – that incredibly tough, glistening outer layer of our teeth. It's not just there to look good; enamel is your tooth's first line of defense, shielding the softer, more sensitive inner layers from everything you eat, drink, and even the daily wear and tear of chewing. But beyond its protective role, the way your enamel's surface feels and its natural color are huge factors in how attractive and healthy your smile appears.

Imagine a perfectly smooth, polished surface. It's easy to clean, right? The same goes for your teeth. A smooth enamel surface is absolutely essential for good oral hygiene. Why? Because if your enamel has tiny bumps or rough spots, it creates perfect little hideouts for bacteria to cling to. These bacterial hideouts can quickly turn into plaque, which is the main culprit behind cavities and gum disease [3]. On the flip side, a beautifully smooth surface makes it much harder for plaque to stick around, and it also helps prevent those annoying external stains from setting in.

Speaking of stains, tooth discoloration is a common complaint that sends many people to the dentist. These stains can come from inside your tooth (intrinsic) or, more commonly, from outside (extrinsic). Intrinsic stains are usually due to things like genetics, certain medications, or conditions that affect tooth development. But those everyday stains – the ones from your morning coffee, that afternoon tea, a glass of red wine, or even from smoking – those are extrinsic stains [7]. The deeper and more stubborn these external pigments are, the more effort it takes to get rid of them [14].

For a long time, dentists relied on traditional mechanical methods to clean teeth and remove stains. This usually involved using rotating brushes or rubber cups with abrasive pastes to scrub the tooth surface [12, 17]. While these methods certainly got the job done, they sometimes had a downside: they could leave the enamel a little rougher than before [1, 12]. This led dental professionals to search for gentler, yet still highly effective, ways to clean teeth.

Enter air-powder polishing systems – the modern marvel of dental cleaning. These clever devices work by spraying a fine mist of compressed air, water, and tiny abrasive particles onto the tooth surface [26]. It's like a gentle, high-pressure sandblasting for your teeth, but much, much milder! This powerful yet controlled stream effectively blasts away plaque, sticky biofilms, and those stubborn extrinsic stains, even reaching tricky spots between teeth, around braces, or near dental fillings [15, 26]. The big perks of air-powder polishing? It's often quicker, more comfortable for patients (less vibrating and heat!), and can get into areas that traditional tools might miss [15]. Manufacturers often suggest that if you follow their guidelines, these systems can even leave your tooth surface smoother than older methods [16].

But here's where the scientific curiosity comes in. Despite how popular and beneficial air-powder polishing seems, we need to really understand its precise impact on that delicate enamel surface. There's been ongoing discussion and research about whether it might cause tiny, microscopic changes in surface roughness or affect how long your teeth stay bright and stain-free, especially when different types of abrasive powders are used [23, 24]. Even a slight increase in enamel roughness, invisible to the naked eye, could potentially create more nooks and crannies for bacteria to hide, possibly undoing some of the good work of the cleaning and making your teeth more vulnerable to future problems [3]. And any noticeable change in tooth color – whether it's a direct alteration or just making your teeth more likely to pick up new stains – could really impact that beautiful smile you're aiming for [4, 14].

Scientists have already done a lot of work looking at how different polishing methods affect tooth roughness [1, 12, 17, 27] and how well dental materials keep their color [4, 29]. They've also investigated how tooth whitening products influence enamel's hardness and surface [8, 19, 20]. While some studies have directly compared various air-polishing powders on enamel and fillings [16, 23, 24, 28, 30], we still need a deeper, more comprehensive understanding. We want to know the intricate dance between specific air-polishing settings, the resulting enamel surface, and how it affects color over the long haul, especially when it comes to how easily teeth get stained again. This is a fascinating area that still needs more detailed scientific exploration.

This article aims to provide a thorough, yet easy-to-understand, overview of what we currently know about how air-powder polishing affects the feel and color of human enamel. We'll also lay out a detailed plan for a hypothetical laboratory study to really dig into these effects. By looking at different common abrasive powders, we hope to shed light on how these findings can be applied in real dental clinics. Our ultimate goal is to help dental professionals fine-tune their air-polishing techniques, ensuring they effectively remove stains while carefully protecting the integrity of your enamel, so you can enjoy a healthy, beautiful smile for years to come.

Methods

To systematically evaluate the impact of air-powder polishing on human enamel surface roughness and color, a hypothetical *in vitro* study would be designed as follows:

Sample Preparation

One hundred and twenty sound human molar teeth, extracted for orthodontic or periodontal reasons and free from caries, cracks, or restorations, would be collected and stored in distilled water at 4∘C until use. Each tooth would be sectioned to obtain standardized enamel blocks (4×4×2 mm) from the buccal or lingual surfaces. The blocks would be embedded in self-curing acrylic resin, ensuring the enamel surface is exposed and parallel to the base. The exposed enamel surfaces would then be ground and polished with silicon carbide papers of progressively finer grits (e.g., 600, 800, 1200, 2500 grit) under water cooling to create a uniformly smooth baseline surface. This standardized initial surface is critical for accurate comparative measurements of roughness and color change [1].

Baseline Measurements

Before any treatment, baseline measurements would be recorded for each enamel block.

1. **Surface Roughness:** Surface roughness (Ra value, representing the arithmetic mean deviation of the roughness profile from the mean line) would be measured using a profilometer (e.g., Mitutoyo SJ-210) at three different, randomly selected points on each enamel surface. The average of these three readings would be taken as the baseline Ra value for that sample [1, 8].
2. **Color Measurement:** Color coordinates (L∗a∗b∗ values) would be measured using a spectrophotometer (e.g., VITA Easyshade V) against a white background. L∗ represents lightness (0 = black, 100 = white), a∗ represents the red-green axis (+a∗ = red, −a∗ = green), and b∗ represents the yellow-blue axis (+b∗ = yellow, −b∗ = blue) [2, 4]. Three readings would be taken for each sample, and the average would be recorded as the baseline color.

Group Allocation and Treatment

The 120 enamel blocks would be randomly divided into four main groups (n=30 per group), based on the type of air-polishing powder used. This systematic division ensures a fair comparison of the effects of each polishing agent.

Table 1: Experimental Group Allocation and Treatment Protocols

Group	Treatment Protocol	Abrasive Powder Type	Key Characteristics of Powder	Number of Samples (n)
A	Control	N/A (Water Spray Only)	Baseline comparison for natural enamel changes	30
B	Air-powder polishing	Sodium Bicarbonate	Standard, harder, larger, cubic particles; effective stain removal [9, 10, 25]	30
C	Air-powder polishing	Glycine	Finer, spherical, less abrasive; suitable for subgingival use [16, 26]	30
D	Air-powder polishing	Erythritol	Very fine, low-abrasive; effective for biofilm removal [28]	30

Air-powder polishing would be performed using a standardized air-polishing device (e.g., EMS Air-Flow Handy 3.0). To ensure consistency and reproducibility, the nozzle would be held at a consistent distance (e.g., 3-5 mm) and angle (e.g., 60∘) to the enamel surface. A standardized application time (e.g., 10 seconds per sample) and pressure would be maintained, carefully simulating a typical clinical prophylaxis procedure [23, 30]. To minimize any potential variability introduced by different operators, all procedures would be meticulously carried out by a single, experienced operator.

Post-Treatment Measurements

Immediately after the air-powder polishing procedures, and after thorough rinsing and drying, the surface roughness and color measurements would be repeated for all samples using the same methods as the baseline measurements. This immediate post-treatment assessment is crucial for capturing the direct effects of the polishing procedure.

Stain Challenge (Optional, for long-term color stability)

To assess the susceptibility to re-staining, a subset of samples from each group (n=10) could be subjected to an artificial staining protocol. This step is vital for understanding the long-term aesthetic implications of the different polishing methods. Samples would be immersed in a standardized staining solution (e.g., concentrated coffee, strong black tea, or red wine) for a defined period (e.g., 7 days), with daily solution changes to ensure consistent staining conditions [5, 6]. After the staining period, the samples would be thoroughly rinsed, and final color measurements would be taken. The total color change (ΔE) would be calculated using the widely accepted CIELab* formula:

$\Delta E=(L2*-L1*)2+(a2*-a1*)2+(b2*-b1*)2$

where L1∗a1∗b1∗ represent the baseline color values (before any treatment or staining) and L2∗a2∗b2∗ represent the color values after the treatment or post-staining challenge [2, 4]. It's important to note that a ΔE value greater than 3.3 is generally considered to be a clinically perceptible color difference, meaning it would be noticeable to the human eye in a real-world setting [4].

Statistical Analysis

Statistical analysis would be performed using appropriate software (e.g., IBM SPSS Statistics, version 27). Before proceeding with comparative tests, data would be rigorously checked for normality using the Shapiro-Wilk test. Depending on whether the data distribution is normal or non-normal, one-way Analysis of Variance (ANOVA) or Kruskal-Wallis tests would be employed to compare differences in surface roughness and color change among the various groups. For instances where significant differences are identified, appropriate post-hoc tests (e.g., Tukey's Honestly Significant Difference (HSD) for parametric data or Dunn's test for non-parametric data) would be applied for multiple comparisons between specific groups. To assess the changes within each group from baseline to post-treatment, paired t-tests (for normal data) or Wilcoxon signed-rank tests (for non-normal data) would be utilized. The level of statistical significance for all analyses would be set at $p<0.05$, meaning a result with a p-value less than 0.05 would be considered statistically significant.

Results

The hypothetical study would yield quantifiable data on changes in enamel surface roughness and color following air-powder polishing with different abrasive agents. These results would provide clear insights into the effectiveness and potential side effects of each polishing method.

Surface Roughness

Baseline Ra values for all groups would be statistically similar, confirming the effectiveness of the standardized polishing protocol in creating a uniform initial surface across all samples. This ensures that any observed differences after treatment are indeed due to the polishing methods and not pre-existing variations.

Following air-powder polishing, significant increases in surface roughness would be observed across all active treatment groups (Groups B, C, D) when compared to their respective baseline values and to the control group (Group A). This indicates that even gentle air-polishing can alter the enamel's microscopic texture.

Table 2: Hypothetical Mean Surface Roughness (Ra**) Values (**μm**)**

Group	Treatment Powder	Baseline Ra (T1)	Post-Polishing Ra (T2)	Change in Ra (ΔRa)	Statistical Significance (T1 vs T2)
A	Control	0.10±0.01	0.10±0.01	0.00±0.00	Not Significant
B	Sodium Bicarbonate	0.10±0.01	0.55±0.05	0.45±0.04	p<0.001
C	Glycine	0.10±0.01	0.25±0.03	0.15±0.02	p<0.001
D	Erythritol	0.10±0.01	0.22±0.02	0.12±0.01	p<0.001

Note: Values are presented as Mean ± Standard Deviation.

Specifically, Group B (sodium bicarbonate) would likely exhibit the most significant increase in Ra values, as clearly shown in Table 2. This finding aligns with previous research indicating that sodium bicarbonate particles, being harder and larger, can cause more pronounced changes to enamel topography [23, 24]. The mean Ra value for this group might increase from an initial 0.1μm to approximately 0.55μm, potentially exceeding the threshold for bacterial plaque retention, which is often cited around 0.2μm [3].

In contrast, Group C (glycine) and Group D (erythritol) would show comparatively smaller, though still statistically significant, increases in surface roughness (Table 2). The Ra values for these groups might increase to 0.25μm and 0.22μm respectively. This observation supports the notion that finer and softer particles, such as glycine and erythritol, are less abrasive to the enamel surface, leading to a smoother finish [16, 28]. Some studies suggest that these newer powders can achieve effective cleaning with minimal surface alteration [26].

Statistical analysis would confirm significant differences in post-treatment Ra values among the groups ($p<0.001$), with sodium bicarbonate causing significantly higher roughness than both glycine and erythritol powders. There might be no significant statistical difference between glycine and erythritol in terms of roughness, or erythritol might show slightly less roughness due to its even finer particle size and spherical morphology.

Regarding color, baseline L∗a∗b∗ values would be consistent across all groups, indicating a uniform starting point for color assessment. After air-powder polishing, all active treatment groups would show a reduction in extrinsic staining, leading to an increase in L∗ (lightness) and a shift towards less yellow (b∗) and less red (a∗) values. This would result in a positive ΔE value, indicating effective stain removal, which is a primary goal of air-polishing [5].

Color Change

Table 3: Hypothetical Mean Color Change (ΔE) Values

Group	Treatment Powder	ΔE (Baseline to Post-Polishing)	ΔE (Post-Polishing to Post-Stain Challenge)
A	Control	0.00±0.00	4.80±0.50
B	Sodium Bicarbonate	7.20±0.80	6.50±0.70
C	Glycine	6.10±0.60	3.10±0.40
D	Erythritol	6.00±0.55	2.80±0.35

Note: Values are presented as Mean ± Standard Deviation. A ΔE>3.3 *is clinically perceptible.*

The magnitude of color change (ΔE) from baseline to immediately post-polishing would likely be highest in Group B (sodium bicarbonate), as shown in Table 3. This is not necessarily due to intrinsic tooth whitening, but rather its superior efficacy in vigorously removing extrinsic stains [9]. However, this greater immediate stain removal might be accompanied by the aforementioned increase in roughness. Groups C and D would also demonstrate significant color improvements, albeit potentially with slightly lower ΔE values compared to sodium bicarbonate, reflecting their effective yet gentler stain removal capabilities.

When considering the optional stain challenge phase (Table 3), the results would be particularly insightful for long-term aesthetic stability. Samples from Group B (sodium bicarbonate), due to their higher post-polishing roughness, would likely exhibit a greater susceptibility to re-staining after immersion in the staining solution. This would result in a larger ΔE value after the staining challenge (e.g., 6.50±0.70) compared to Groups C and D. This increased re-staining potential is consistent with the principle that rougher surfaces provide more areas for chromogens to adhere [6, 14]. Conversely, Groups C and D, having smoother post-treatment surfaces, would demonstrate better color stability and less re-staining (e.g., ΔE values of 3.10±0.40 and 2.80±0.35 respectively), indicating a more durable aesthetic outcome [4]. Notably, the re-staining ΔE for glycine and erythritol groups would likely fall below the clinically perceptible threshold of 3.3, unlike sodium bicarbonate.

The control group (Group A) would show minimal changes in roughness and color initially. Any color changes in this group during the staining challenge would represent the natural staining process of untreated enamel, serving as a crucial comparison point (Table 3).

Overall, the results would highlight a clear trade-off between the immediate, aggressive stain removal efficacy of coarser powders and the long-term aesthetic stability influenced by surface roughness. While sodium bicarbonate might offer robust immediate stain removal, the finer powders like glycine and erythritol would provide a more favorable surface topography, potentially leading to better long-term color maintenance by reducing re-staining.

Discussion

The hypothetical findings from this study underscore the multifaceted impact of air-powder polishing on human enamel, specifically concerning surface roughness and color stability. The observed increases in surface roughness across all air-polishing groups, particularly with sodium bicarbonate, are consistent with previous literature [23, 24, 30]. Sodium bicarbonate particles are typically larger and more angular than newer generation powders like glycine and erythritol, contributing to greater mechanical abrasion of the enamel surface [16]. This higher abrasiveness, while effective in removing stubborn extrinsic stains [9], can lead to a surface topography that is less favorable for long-term oral health.

The clinical implication of increased surface roughness is significant. As established by Bollen et al. [3], a surface roughness (Ra) exceeding 0.2μm can promote bacterial plaque retention, increasing the risk of caries and periodontal inflammation. Our hypothetical results suggest that sodium bicarbonate polishing might push enamel surface roughness beyond this critical threshold, potentially compromising the very goal of prophylaxis, which is to reduce bacterial load. This aligns with studies that have shown traditional polishing methods and even some air-polishing agents can increase surface roughness [1, 12, 27].

In contrast, glycine and erythritol powders demonstrated a gentler effect on enamel surface roughness. This is attributed to their smaller, spherical particle shapes and lower hardness, which allow for effective biofilm disruption and stain removal with minimal abrasive impact [16, 28]. The ability of these newer powders to maintain a smoother enamel surface is a crucial advantage, as it minimizes the risk of increased plaque accumulation and supports long-term oral health [26]. This aligns with findings by Németh et al. [27] and Janaphan et al. [28] who highlighted the less abrasive nature of these powders.

Regarding color change, the study would confirm that air-powder polishing is highly effective in removing extrinsic stains, leading to an immediate lightening of the enamel surface. This is a well-documented benefit of air-polishing [5, 29]. The greater immediate color improvement observed with sodium bicarbonate could be attributed to its more aggressive stain removal action. However, the subsequent re-staining challenge would reveal a critical aspect: the long-term color stability. The hypothetical finding that rougher surfaces (e.g., after sodium bicarbonate polishing) are more prone to re-staining is a significant concern. Rough surfaces provide more microscopic irregularities where chromogenic substances can adhere and accumulate, leading to faster discoloration [6, 14]. This phenomenon has also been observed with composite resins, where surface characteristics influence water absorption and discoloration [14].

This highlights a potential trade-off in clinical practice: while a more abrasive powder might yield immediate, dramatic stain removal, a finer, less abrasive powder might offer better long-term aesthetic stability by preserving a smoother enamel surface. This is particularly relevant in the context of tooth whitening procedures, where maintaining a smooth surface post-bleaching can influence stain absorption [6, 7, 21]. Although the study focuses on air-polishing, the principles of surface integrity influencing color stability are broadly applicable across various dental interventions, including those involving bleaching agents [2, 8, 19, 20, 22].

It is important to note that the study design is *in vitro*, which inherently has limitations. The oral environment is complex, involving salivary pellicle formation, masticatory forces, and dietary habits, all of which can influence enamel surface characteristics and color over time. An *in vivo* study would provide a more realistic assessment of these effects, though controlling variables would be more challenging. Additionally, the study did not evaluate the effect of air-polishing on microhardness, which is another important property of enamel that can be influenced by dental treatments [8, 19]. Future research could incorporate microhardness testing and evaluate the long-term effects of air-polishing in a clinical setting.

Furthermore, the study focused solely on enamel. Air-polishing can also affect restorative materials, and their interaction with different powders needs careful consideration in clinical practice [23, 24]. The choice of air-polishing powder should therefore be guided not only by its efficacy on enamel but also by its compatibility with existing restorations in the patient's mouth.

Conclusion

This hypothetical study provides valuable insights into the impact of different air-polishing powders on human enamel surface roughness and color. While all tested air-polishing agents effectively remove extrinsic stains and improve immediate tooth brightness, the type of abrasive powder significantly influences the resulting enamel surface topography. Sodium bicarbonate, while highly effective for stain removal, tends to create a rougher surface, potentially increasing the risk of bacterial plaque retention and accelerating re-staining. In contrast, finer powders like glycine and erythritol offer a more favorable outcome, achieving effective stain removal with minimal increase in surface roughness, thereby promoting better long-term aesthetic stability and oral health. These findings emphasize the importance of selecting appropriate air-polishing powders based on a balance between immediate stain removal efficacy and the preservation of enamel integrity for optimal long-term patient outcomes.

References

1. Karacaoglu F, Tuzcel NY, Akkaya M. A comperative evaluation of 3 different polishing methods on tooth surface roughness. J Biomed Sci 2016;6:1-6.
2. Mondelli RF, Azevedo JF, Francisconi AC, Almeida CM, Ishikiriama SK. Comparative clinical study of the effectiveness of different dental bleaching methods –

Two year follow-up. J Appl Oral Sci 2012;20:435-43.
3. Bollen CM, Lambrechts P, Quirynen M. Comparison of surface roughness of oral hard materials to the threshold surface roughness for bacterial plaque retention: A review of the literature. Dent Mater 1997;13:258-69.
4. Ardu S, Duc O, Di Bella E, Krejci I, Daher R. Color stability of different composite resins after polishing. Odontology 2018;106:328-33.
5. Wang C, Lucas R, Smith AJ, Cooper PR. An in vitro screening assay for dental stain cleaning. BMC Oral Health 2017;17:37.
6. Moosavi H, Darvishzadeh F. The influence of post bleaching treatments in stain absorption and microhardness. Open Dent J 2016;10:69-78.
7. Alqahtani MQ. Tooth-bleaching procedures and their controversial effects: A literature review. Saudi Dent J 2014;26:33-46.
8. Goyal K, Saha SG, Bhardwaj A, Saha MK, Bhapkar K, Paradkar S. A comparative evaluation of the effect of three different concentrations of in-office bleaching agents on microhardness and surface roughness of enamel – An in vitro study. Dent Res J (Isfahan) 2021;18:49.
9. Li Y. Stain removal and whitening by baking soda dentifrice: A review of literature. J Am Dent Assoc 2017;148:S20-6.
10. Thong S, Hooper W, Xu Y, Ghassemi A, Winston A. Enhancement of plaque removal by baking soda toothpastes from less accessible areas in the dentition. J Clin Dent 2011;22:171-8.
11. Camboni S, Donnet M. Tooth surface comparison after air polishing and rubber cup: Ascanning electron microscopy study. J Clin Dent 2016;27:13-8.
12. Yurdaguven H, Aykor A, Ozel E, Sabuncu H, Soyman M. Influence of a prophylaxis paste on surface roughness of different composites, porcelain, enamel and dentin surfaces. Eur J Dent 2012;6:1-8.
13. Wen C, Jiang R, Zhang Z, Lei B, Zhong Y, Zhou H. Esthetic evaluation and acceptability of different hole designs on implant crowns from the perspective of patients and dentists in China. Patient Prefer Adherence 2022;16:427-37.
14. Comba A, Manzon E, Giuliano C, Farina E, Pasqualini D, Michelotto Tempesta R, et al. Influence of surface coating sealer on resin composite water absorption and discoloration: An in vitro study. Am J Dent 2018;31:24-8.
15. Ng E, Byun R, Spahr A, Divnic-Resnik T. The efficacy of air polishing devices in supportive periodontal therapy: Asystematic review and meta-analysis. Quintessence Int 2018;49:453-67.
16. Petersilka GJ, Bell M, Häberlein I, Mehl A, Hickel R, Flemmig TF. In vitro evaluation of novel low abrasive air polishing powders. J Clin Periodontol 2003;30:9-13.
17. Angerame D, Sossi D, De Biasi M, Cattaruzza M, Castaldo A. Surface roughness of a microhybrid composite polished with abrasive pastes. J Dent Res 2013;92:414.
18. Mopper KW. Contouring, finishing, and polishing anterior composites. Inside Dent 2011;7:62-70.
19. SasakiRT, ArcanjoAJ, Flório FM, BastingRT. Micromorphology and microhardness of enamel after treatment with home-use bleaching agents containing 10% carbamide peroxide and 7.5% hydrogen peroxide. J Appl Oral Sci 2009;17:611-6.
20. Thakur R, Shigli AL, Sharma DS, Thakur G. Effect of catalase and sodium fluoride on human enamel bleached with 35% carbamide peroxide. Int J Clin Pediatr Dent 2015;8:12-7.
21. Carey CM. Tooth whitening: What we now know. J Evid Based Dent Pract 2014;14:70-6.
22. Ito Y, Momoi Y. Bleaching using 30% hydrogen peroxide and sodium hydrogen carbonate. Dent Mater J 2011;30:193-8.
23. Barnes CM, Covey D, Watanabe H, Simetich B, Schulte JR, Chen H. An in vitro comparison of the effects of various air polishing powders on enamel and selected esthetic restorative materials. J Clin Dent 2014;25:76-87.
24. Pelka MA, Altmaier K, Petschelt A, Lohbauer U. The effect of air-polishing abrasives on wear of direct restoration materials and sealants. J Am Dent Assoc 2010;141:63-70.
25. Madeswaran S, Jayachandran S. Sodium bicarbonate: A review and its uses in dentistry. Indian J Dent Res 2018;29:672-7.
26. Graumann SJ, Sensat ML, Stoltenberg JL. Air polishing: A review of current literature. J Dent Hyg 2013;87:173-80.
27. Németh KD, Haluszka D, Seress L, Lovász BV, Szalma J, Lempel E. Effect of air-polishing and different post-polishing methods on surface roughness of nanofill and microhybrid resin composites. Polymers (Basel) 2022;14:1643.
28. Janaphan K, Hill R, Gillam D. In vitro evaluation of the abrasiveness of novel bioactive glass powders (Biominf®) on ivory dentine in air polishing procedures compared to selected reference powders. J Dent Maxillofac Res 2021;4:1-6.
29. Kuzu TE, Karatas O. The effect of prophylaxis paste and air-powder polishing on color stability and surface roughness of different composite resins. J Oral Res Rev 2023;15:34-9.
30. Valian A, Ansari ZJ, Rezaie MM, Askian R. Composite surface roughness and color change following airflow usage. BMC Oral Health 2021;21:398.