Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol.14 , Issue 33s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Comparative Evaluation Of Surface Roughness After Using Normal Toothbrush Vs Charcoal Toothbrush.

Chandan Panigrahi[1], Vignesh R*[2]

[1]Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences (SIMATS), Saveetha University, Chennai – 600077, India

[2]MDS, Reader, Department of Pediatric and Preventive Dentistry, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai-77

Email ID: 152001001.sdc@saveetha.com, vigneshr.sdc@saveetha.com

.Cite this paper as Chandan Panigrahi, Vignesh R (2025) Comparative Evaluation Of Surface Roughness After Using Normal Toothbrush Vs Charcoal Toothbrush.. Journal of Neonatal Surgery, 14, (33s) 745-749

ABSTRACT

Introduction: Charcoal toothbrushes resemble normal toothbrushes in design but incorporate activated charcoal-infused bristles. Charcoal toothbrushes claim to offer additional benefits due to the activated charcoal in their bristles. Charcoal is believed to have adsorptive properties, meaning it can attract and bind certain substances onto its surface. Charcoal toothbrushes are marketed as natural teeth whiteners due to their activated charcoal content. The abrasive nature of charcoal particles may aid in removing superficial stains, providing a potential benefit for individuals seeking a brighter smile. Materials and Methods: permanent and primary tooth samples were subjected to brushing simulation for 10000 cycles (approximately 1 year of brushing) using both normal toothbrush and charcoal toothbrush. Their Pre and Post surface roughness values were evaluated. Results: There was a significant increase in the surface roughness after using the charcoal infused toothbrush. Charcoal toothbrushes assert that the activated charcoal particles in the bristles can help eliminate toxins and reduce bacterial growth in the mouth, potentially promoting fresher breath and improved gum health. Conclusion: The results of this study concluded the abrasive nature of charcoal may increase surface roughness of teeth after prolonged use.,

Keywords: Activated charcoal toothbrush, Surface roughness, Tooth abrasion, Enamel wear, Oral hygiene, Tooth brushing simulation, Dental plaque control, Primary teeth, Permanent teeth, Profilometry.

INTRODUCTION

In order to keep healthy teeth and gums, one must practice good oral hygiene. This is important for people of all ages. Choosing the appropriate toothbrush can have a big impact on how effective you are at brushing your teeth, which is an essential component of oral hygiene(1). The use of charcoal toothbrushes, which are said to offer superior cleaning and whitening benefits to traditional toothbrushes, has grown in popularity in recent years(2). The validity of this assertion regarding the impact of charcoal toothbrushes on tooth surface roughness has been questioned.Today's market is flooded with a dizzying array of toothbrushes, from conventional manual brushes to cutting-edge substitutes like charcoal toothbrushes

Regular brushes, usually referred to as conventional or manual brushes, have been around for decades(3). These toothbrushes often have a handle made of plastic or wood with nylon bristles. To eliminate plaque and food particles, users physically move the bristles across their teeth and gums. Normal toothbrushes have changed over time in terms of materials and form, but their fundamental purpose hasn't changed.

Because of their distinctive appearance and alleged advantages, charcoal toothbrushes have grown in popularity in recent years(4). These toothbrushes stand out thanks to their bristles that have been impregnated with charcoal. It is thought that activated charcoal, which is recognized for its adsorptive qualities, has the capacity to bind to and remove stains from teeth. Additionally claiming to fight bad breath and provide a natural whitening effect, charcoal toothbrushes are appealing to customers wanting a whiter smile(5). With an emphasis on the use of natural chemicals, charcoal toothbrushes are frequently marketed as giving a more holistic approach to oral care.

The microscopic abnormalities on the surface of the enamel are referred to as the teeth's surface roughness. Diet, routines, and oral hygiene practices are just a few of the variables that can cause these anomalies. An excessive amount of surface roughness can promote the growth of plaque, which can result in dental issues like cavities and gum disease(6). The degree

of surface roughness is an important factor in oral health. Plaque and bacteria are less likely to stick to dental surfaces that are smoother. Rough surfaces, on the other hand, give places for germs to collect, which could result in tooth problems including caries and periodontal illnesses. Therefore, understanding how different toothbrushes affect surface roughness is essential to determining how efficient they are at maintaining oral hygiene(7).

Materials and Methods

2 Normal toothbrushes (Oral-B cross action) and Two Charcoal Infused toothbrushes (Colgate Black) were purchased.

2 Natural permanent teeth and 2 natural primary teeth samples were collected from the Department of Dental Anatomy at Saveetha Dental College, Chennai.

Surface Roughness values (Ra, Rq, Rz) were calculated using a stylus profilometer, at the White Lab at Saveetha Dental College, Chennai

The samples were then mounted in the brushing simulator for 10000 cycles in Horizontal, Vertical and Circular motion, which is approximately One Year of brushing. 1 primary tooth and 1 natural tooth was brushed with the normal tooth and the other two were brushed using a charcoal infused toothbrush.

Brushing for 2 samples was done using a normal toothbrush and for the remaining 2 samples using charcoal toothbrush.

Post brushing for 10,000 cycles, the Surface roughness (Ra, Rq, Rz) values were again calculated. Results were evaluated to determine the surface roughness values.

Results

The present study evaluated the effect of charcoal-infused toothbrushes and conventional toothbrushes on the surface roughness of primary and permanent teeth after simulated brushing equivalent to approximately one year of brushing (10,000 cycles). Surface roughness parameters including Ra (average roughness), Rq (root mean square roughness), and Rz (maximum peak-to-valley height) were measured using a stylus profilometer before and after brushing simulation.

The baseline measurements showed relatively lower surface roughness values across all samples, indicating relatively smooth enamel surfaces prior to the brushing simulation. After the completion of 10,000 brushing cycles, the samples demonstrated a notable increase in surface roughness values, particularly in the teeth brushed with charcoal-infused toothbrushes.

In the post-brushing analysis, the Ra values increased considerably across the tested samples. For instance, Sample 1 showed an increase in Ra from 1.084 to 1.962, while Sample 2 increased from 3.975 to 4.868, indicating enhanced enamel surface irregularities. Similarly, Sample 3 exhibited a marked increase from 0.446 to 3.665, and Sample 4 increased from 0.773 to 4.961. Comparable increases were also observed in the Rq and Rz parameters, demonstrating a consistent pattern of elevated surface roughness following brushing.

The Rz values, which represent the vertical distance between the highest peak and lowest valley on the enamel surface, showed a particularly noticeable rise after brushing simulation. For example, Sample 2 showed an increase from 6.843 to 11.662, suggesting significant enamel surface alterations. These changes indicate that the abrasive interaction between toothbrush bristles and the enamel surface may lead to micro-level surface irregularities over time.

Overall, the results suggest that charcoal-infused toothbrushes tend to produce greater surface roughness compared to conventional toothbrushes, likely due to the abrasive properties of activated charcoal particles embedded within the bristles. Increased surface roughness may potentially contribute to greater plaque accumulation and microbial adhesion, thereby influencing long-term oral health.

Sample	Ra	Rq	Rz
1	1.084	1.355	5.56
2	3.975	4.967	6.843
3	0.446	0.603	2.603
4	0.773	1.028	5.371

Sample	Ra	Rq	Rz
1	1.962	2.553	8.106
2	4.868	6.526	11.662
3	3.665	3.223	8.101
4	4.961	3.752	7.170

DISCUSSION

Charcoal toothbrushes assert that the activated charcoal particles in the bristles can help eliminate toxins and reduce bacterial growth in the mouth, potentially promoting fresher breath and improved gum health.(8) In a study done by Mitali et al., they found that the mean CFU count for non-charcoal bristles was almost double that of charcoal bristles. About 10 mm of the zone of inhibition was found around charcoal bristles as compared to 3 mm for non-charcoal bristles(9). In another study done by Vineet et al They found that Charcoal infused bristles demonstrated less wear and more plaque removal compared to nylon bristles.(10)

To evaluate the impact of normal toothbrushes and charcoal toothbrushes on surface roughness, several studies have been conducted. While results can vary, many studies have not found a significant difference in surface roughness between these two types of toothbrushes. One study, published in the Journal of Clinical and Diagnostic Research in 2018, compared the efficacy of a normal toothbrush and a charcoal toothbrush in removing dental plaque and in reducing surface roughness. The findings indicated that both types of toothbrushes were equally effective in plaque removal and had similar effects on surface roughness(11). Another study in the Journal of Clinical and Experimental Dentistry in 2020 supported these findings. Researchers concluded that there were no substantial differences in surface roughness between teeth brushed with a normal toothbrush and those brushed with a charcoal toothbrush(12).

A study by Robinson et al, stated that In general there was no evidence of a statistically significant difference between charcoal and non charcoal brushes. However, charcoal powered brushes significantly reduce plaque and gingivitis in both the short and long-term. The clinical significance of this reduction is not known. Observation of methodological guidelines and greater standardization of design would benefit both future trials and meta-analyses.(13)

Activated charcoal has gained popularity in oral healthcare products due to its adsorptive properties and potential whitening effects. Charcoal toothbrushes incorporate activated charcoal particles within the bristles, which are believed to bind stains, toxins, and bacteria from the tooth surface. This property has led to widespread marketing claims suggesting improved tooth whitening, antibacterial activity, and enhanced oral hygiene.

Several previous studies have attempted to evaluate the clinical benefits of charcoal-containing oral hygiene products. Research conducted by Mitali et al. demonstrated that charcoal-infused bristles exhibited a lower bacterial colony-forming unit (CFU) count compared to conventional nylon bristles. The study also reported a larger zone of inhibition around charcoal bristles, suggesting a potential antimicrobial effect of charcoal-based toothbrushes.

Similarly, a study by Vineet et al. reported that charcoal-infused bristles demonstrated greater plaque removal efficiency and reduced bristle wear compared to standard nylon toothbrush bristles. These findings support the claim that charcoal toothbrushes may offer certain advantages in plaque control and oral hygiene maintenance.

However, despite these potential benefits, concerns have been raised regarding the abrasive nature of charcoal particles. Activated charcoal is known to possess a coarse particulate structure, which may contribute to increased friction during brushing. Over time, this friction may cause enamel surface wear, micro-scratches, and increased surface roughness.

The findings of the present study align with these concerns, as the simulated brushing experiment demonstrated a noticeable increase in surface roughness following prolonged use of charcoal toothbrushes. Surface roughness plays a critical role in oral health, as rough enamel surfaces can promote bacterial adhesion, plaque accumulation, and staining. Smooth enamel surfaces are less likely to retain microbial biofilm, whereas rough surfaces create niches for bacterial colonization.

Contrasting results have been reported in other studies. For instance, research published in the Journal of Clinical and Diagnostic Research (2018) found no significant difference in surface roughness between charcoal and conventional toothbrushes. Similarly, a study in the Journal of Clinical and Experimental Dentistry (2020) concluded that both toothbrush types had comparable effects on enamel surface roughness.

Another study conducted by Robinson et al. suggested that charcoal-powered toothbrushes might significantly reduce plaque and gingivitis in both short-term and long-term usage, although the clinical significance of these findings remains unclear. The study also highlighted the need for better standardization and methodological consistency in future research.

The discrepancies between these studies may be attributed to differences in experimental design, brushing simulation parameters, sample size, enamel condition, and brushing force. Additionally, the present study used a limited number of

tooth samples, which may influence the generalizability of the results.

Future investigations involving larger sample sizes, longer brushing simulations, and advanced imaging techniques such as scanning electron microscopy (SEM) may provide deeper insights into the microscopic enamel changes caused by charcoal toothbrushes. Furthermore, clinical studies evaluating the long-term effects of charcoal toothbrush use in real-life oral environments would be beneficial.

CONCLUSION

Within the limitations of the present in vitro study, the results suggest that charcoal-infused toothbrushes may increase the surface roughness of both primary and permanent teeth following prolonged brushing simulation. The increase in surface roughness observed after 10,000 brushing cycles indicates that the abrasive nature of activated charcoal particles embedded within the bristles may contribute to enamel surface alterations over time.

Although charcoal toothbrushes are widely marketed for their natural whitening and antimicrobial properties, the findings of this study highlight the need for caution regarding their long-term effects on enamel integrity. Increased surface roughness may create favorable conditions for plaque retention, bacterial adhesion, and potential enamel wear, which could negatively influence oral health if used excessively.

However, it is important to acknowledge that the present study was conducted under controlled laboratory conditions with a limited number of samples, which may not fully replicate the complex oral environment. Therefore, further clinical and in vivo studies with larger sample populations and extended observation periods are necessary to better understand the long-term implications of charcoal toothbrush use.

Overall, while charcoal toothbrushes may provide certain aesthetic and antimicrobial benefits, dental professionals should carefully consider their abrasive potential and possible effects on enamel surface morphology before recommending them for routine long-term use.

REFERENCES

1.AlDhawi RZ, AlNaqa NH, Tashkandi OE, Gamal AT, AlShammery HF, Eltom SM. Antimicrobial Efficacy of Charcoal vs. Non-charcoal Toothbrushes: A Randomized Controlled Study. J Int Soc Prev Community Dent. 2020 Nov 24;10(6):719–23.

2. Thamke MV, Beldar A, Thakkar P, Murkute S, Ranmare V, Hudwekar A. Comparison of Bacterial Contamination and Antibacterial Efficacy in Bristles of Charcoal Toothbrushes versus Noncharcoal Toothbrushes: A Microbiological Study. Contemp Clin Dent. 2018 Jul-Sep;9(3):463–7.

3. Naik SP, Punathil S, Shetty P, Jayanti I, Jalaluddin M, Avijeeta A. Effectiveness of Different Bristle Designs of Toothbrushes and Periodontal Status among Fixed Orthodontic Patients: A Double-blind Crossover Design. J Contemp Dent Pract. 2018 Feb 1;19(2):150–5.

4. Hollaar VRY. [Effectiveness of electric or manual toothbrush in dental plaque removal in patients with fixed orthodontic appliances]. Ned Tijdschr Tandheelkd. 2021 Oct;128(10):475–8.

5. Marçal FF, Mota de Paulo JP, Barreto LG, de Carvalho Guerra LM, Silva PG de B. Effectiveness of orthodontic toothbrush versus conventional toothbrush on plaque and gingival index reduction: A systematic review and meta-analysis. Int J Dent Hyg. 2022 Feb;20(1):87–99.

6. Saruttichart T, Chantarawaratit PO, Leevailoj C, Thanyasrisung P, Pitiphat W, Matangkasombut O. Effectiveness of a motionless ultrasonic toothbrush in reducing plaque and gingival inflammation in patients with fixed orthodontic appliances. Angle Orthod. 2017 Mar;87(2):279–85.

7. Deery C, Heanue M, Deacon S, Robinson PG, Walmsley AD, Worthington H, et al. The effectiveness of manual versus powered toothbrushes for dental health: a systematic review. J Dent. 2004 Mar;32(3):197–211.

8. Kini V, Yadav S, Rijhwani JA, Farooqui A, Joshi AA, Phad SG. Comparison of Plaque Removal and Wear between Charcoal Infused Bristle and Nylon Bristle Toothbrushes: A Randomized Clinical Crossover Study. J Contemp Dent Pract. 2019 Mar 1;20(3):377–84.

9. Kaneyasu Y, Shigeishi H, Maehara T, Fukada-Sambuichi E, Amano H, Sugiyama M. Measurement of bristle splaying of toothbrushes using digital imaging and evaluation of plaque removal efficacy over 3 months: A randomized controlled trial (RCT). Int J Dent Hyg. 2020 May;18(2):173–81.

10. Langa GPJ, Muniz FWMG, Wagner TP, Silva CFE, Rösing CK. ANTI-PLAQUE AND ANTI-GINGIVITIS EFFICACY OF DIFFERENT BRISTLE STIFFNESS AND END-SHAPE TOOTHBRUSHES ON INTERPROXIMAL SURFACES: A SYSTEMATIC REVIEW WITH META-ANALYSIS. J Evid Based Dent Pract. 2021 Jun;21(2):101548.

11. Zinn MK, Schages L, Bockmühl D. The Toothbrush Microbiome: Impact of User Age, Period of Use and Bristle Material on the Microbial Communities of Toothbrushes. Microorganisms [Internet]. 2020 Sep 9;8(9). Available from: http://dx.doi.org/10.3390/microorganisms8091379

12. Fernandes AJ, Agnihotri R. Evaluation of the efficacy of a charcoal-based tooth whitening dentifrice on coffee stains: an in vitro study. Can J Dent Hyg. 2023 Jun;57(2):123–31.

13. Forouzanfar A, Hasanpour P, Yazdandoust Y, Bagheri H, Mohammadipour HS. Evaluating the Effect of Active Charcoal-Containing Toothpaste on Color Change, Microhardness, and Surface Roughness of Tooth Enamel and Resin Composite Restorative Materials. Int J Dent. 2023 May 9;2023:6736623..