Content available at: https://www.ipinnovative.com/open-access-journals

Journal of Dental Specialities

Journal homepage: https://www.jdsits.in/

Review Article

Does the activated charcoal tooth paste utilization yield effects in dental whitening in adult population: A systematic review

Preethi Varadan[1]*, Priyanka Balasubramanian[1], Anisha Divakar[1], Mathan Rajan Rajendran[1]

[1]Dept. of Conservative Dentistry and Endodontics, Sri Ramachandra Dental College, SRIHER (DU), Porur, Chennai, Tamil Nadu, India

Abstract

Aim: The aim of this study was to systematically review the effectiveness of activated charcoal-based dentifrices on tooth whitening using randomized clinical trials.

Materials and Methods: This study reviewed published articles on the impact of dentifrices based on activated charcoal on teeth whitening, including both original research and a review of the literature from databases like PubMed, Cochrane, Ebscohost, etc. Articles were included from 2008 to 2024. Data extraction and quality evaluation of the chosen studies were carried out separately by two reviewers.

Results: Three studies in total were included for qualitative analysis. The results revealed that activated charcoal tooth paste produced tooth whitening with its abrasive behaviour which in-turn attributed to post-operative sensitivity and tooth surface texture alteration.

Conclusion: Activated charcoal did not show significant effect on teeth whitening in comparison with peroxide-based agents.

Keywords: Activated charcoal, Tooth whitening, Tooth whitening agents, Whitening tooth paste, Tooth bleaching agents, Whitening toothpaste.

Received: 06-11-2024; **Accepted:** 28-02-2025; **Available Online**: 23-04-2025

1. Introduction

In the modern period, radiant smile has sparked a craze among the people to undergo aesthetic dental procedures. A beautiful smile improves your overall appearance and boosts confidence, providing a dynamic impact on the quality of life. Tooth discoloration and staining are common cosmetic concerns affecting a substantial portion of the adult population.[1,2,3,4] Among the various methods of removal of dental discoloration, tooth whitening is a more conservative and less expensive approach when compared to invasive procedures.[5] Dental whitening can be performed both in dental office and at home for which various whitening agents are available in the market categorized under synthetic and natural whitening agents.[6,7,8,9] Among the synthetic dental whitening agents, Hydrogen peroxide and Carbamide peroxide are the most preferred commercially available synthetic whiteners whose effects have been well reported in the literature.[10,11,12]

Currently natural whitening agents have gained public spotlight in a new natural compound, the activated charcoal.[9,10,11,12,13] Marketed as a cost-effective and minimally invasive alternative, activated charcoal is often touted for its purported ability to remove surface stains and improve dental aesthetics.[14] The principle behind activated charcoal's whitening effect lies in its absorption capabilities.[15,16] The porous nature of activated charcoal is believed to allow it to attract and bind to particles and stains on the tooth surface, potentially removing them and improving the appearance of tooth whiteness. This has made activated charcoal an appealing option for individuals seeking a natural, less invasive approach to tooth whitening. The activated charcoal produced is obtained in a powder form via burning or oxidation process of carbon containing compounds. Currently, at home dental whitening procedure is more preferred among young population due to their acceptable outcomes at a short span of time.[17,18,19]

Nonetheless, there is ongoing discussion in the dental world over the safety and efficacy of activated charcoal in

Corresponding author: Preethi Varadan
Email: preethiv@sriramachandra.edu.in

http://doi.org/10.18231/j.jds.2025.003

teeth whitening. There isn't much clinical proof to support activated charcoal's capacity to whiten teeth and successfully eliminate surface stains, despite some research and anecdotal accounts suggesting otherwise. This study's objective was to provide a succinct, comprehensive overview of the effects of dentifrices based on activated charcoal on teeth, with a particular emphasis on the products' ability to whiten teeth through randomized clinical trials.

2. Materials and Methods

2.2. Protocol registration

The proposal was registered prior proceeding in Prospero with a Prospero ID-CRD42024562044**.**

2.3. Creation of research question

A review question was created using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards, "Will the utilization of Activated charcoal-based dentifrices yield effects on dental whitening in adult population using randomized clinical trials"?

2.4. The review question in PICOS format

1. Population (P) – Patients undergoing tooth whitening procedure
2. Intervention (I) – Activated charcoal
3. Comparison (C) – Other synthetic tooth whitening agents
4. Outcome (O) – Tooth whitening efficacy
5. Study Designs(S) – Randomized clinical trials

2.5. Inclusion criteria

1. Studies assessing the whitening efficacy of activated charcoal-based dentifrices
2. Randomized clinical trials
3. Adult population

2.6. Exclusion criteria

1. Case reports
2. Case series
3. In vitro studies
4. Studies performed in primary teeth
5. Research performed using carious teeth
6. Restorative defects and restored teeth

2.7. Search methods for recognition of relevant studies

2.7.1. Search performed using electronic databases

A thorough review of the literature was conducted utilizing databases like EBSCOhost, Cochrane, and PubMed. A manual search was also conducted using Google. The exploration terms included "activated charcoal" OR "charcoal-based dentifrices" OR "activated charcoal tooth paste" AND "Tooth whitening", "Natural whitening agents" OR "Activated charcoal based dentifrices" OR "Whitening tooth paste" Filters: Randomized clinical trial.

2.8. Study selection and data extraction

Figure 1 shows a graphic of the study selection process using PRISMA standards. The collected data features of the included studies were grouped according to the author's name, the year of study published, participant age group, experimental groups, whether or not pre- and post-shade assessments were carried out, assessment techniques, findings, and research conclusion.

The acquired data characteristics of included studies were categorized under name of the author, the year of research published, age group of participants, experimental groups, whether pre and post shade assessment were performed, methods of assessment, results, and research conclusion (**Table 1**).

2.9. Quality analysis

Cochrane ROB2 was used to assess the quality of the included studies. The risk of bias was evaluated using the following domains:

1. Bias resulting from the randomization method;
2. Bias resulting from deviating from the intended intervention;
3. Bias resulting from missing outcome data;
4. Bias in measuring the outcome; and
5. Bias in choosing to disclose outcomes.

3. Results

After removing duplicates, 51 records were located, and about 46 articles underwent title and abstract screening. 43 of those were excluded because they did not meet the inclusion criteria. The remaining three papers in the whole publication were assessed for appropriateness. In the end, a qualitative analysis was conducted on all three studies.

Riberio et al[20] revealed that, there was a negative impact on the effectiveness of activated charcoal-based dentifrices when compared to carbamide peroxide as patients did not observe any noticeable color change after whitening treatment. With respect to aesthetic concern domain, traditional toothpaste and activated charcoal-based toothpaste groups showed a very slight increase from 4.4 to 4.8 and 2.2 to 2.5 in scores aspect respect tively, while activated charcoal powder showed no noticeable change.

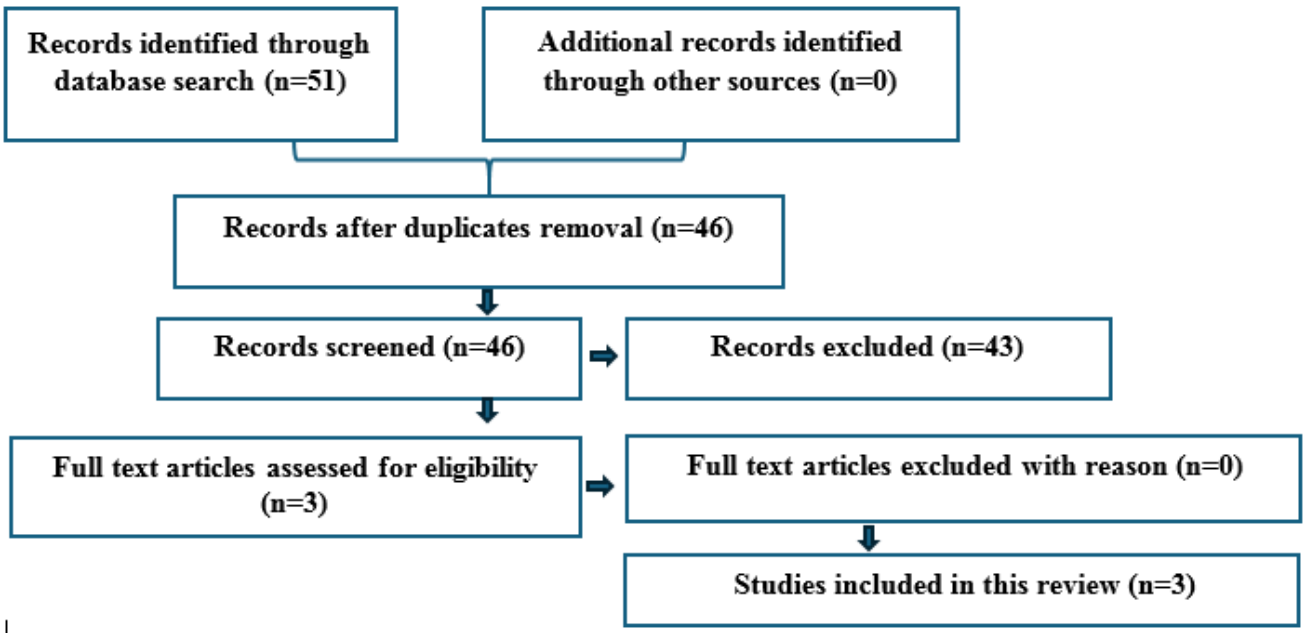

Figure 1: PRISMA flow chart

S NO	DOMAIN	ARTICLES		
		Ribeiro et al.2023	Ribeiro et al.2024	Muntean et al. 2024
1	Risk of bias arising from randomization process			
2	Risk of bias due to deviation from the intended intervention			
3	Risk of bias due to missing outcome data			
4	Risk of bias in measurement of the outcome			
5	Risk of bias in selection of reported results			

- Low risk of bias - High risk of bias -Some concerns

Figure 2: Quality assesment of included articles – Cochrane rob2 tool

Table 1: Study characteristics table

Year and author of study	Age of participants	Total no. of participants	Groups	Pre assessment of shade prior to the procedure	Methods of preoperative assessment	Post-operative assessment done by	Methods of post-operative assessment	Duration of dentrifices used	Conclusion
E.P. Ribeiro et al. (2023)[20]	Aged between 18 and 30 years	N=64	G1 (n=16)- Activated charcoal powder G2 (n=16)- Activated charcoal dentrifice G3 (n=16)- Conventional fluoride toothpaste G4 (n=16)- 10% Carbamide peroxide	Evaluation done	The color assessment was carried out by the subjective method with the aid of visual color scale in environment with controlled light	Patient and operator based	Questionnaires based	14 days	Activated charcoal products **showed** no significant effect on colour and whiteness.
E.P. Ribeiro et al. (2024)[21]	Aged between 18 to 30 years	N=64	G1 (n=16)- Activated charcoal powder G2 (n=16)- Activated charcoal toothpaste G3 (n=16)- Regular fluoridated toothpaste G4 (n=16)- 10% Carbamide peroxide	Evaluation done	The color assessment of anterior teeth was performed in an environment with standardized lighting conditions with the aid of clinical mirror and color scale.	Patient based	visual shade guide	14 days	The use of activated charcoal-based products produced lower impact regarding quality of life and aesthetics perception.
Muntean et al. (2024)[22]	Age between 18 and 30.	N=81	NA	Evaluation done	Patient assessment (n=81) was carried out by 2 calibrated operators. Colour evaluation was realized using the VITA Classical Shade Guide	Operator based	VITA classical Shade Guide	4 weeks	Charcoal toothpaste had positive effect on enamel appearance in the maxillary arch and some teeth in the mandibular arch and improvement in tooth shade was observed especially for females.

Riberio et al[21] in his study mentioned that Carbamide peroxide showed highest whitening efficacy ($p<0.05$) while Activated Charcoal powder and Activated Charcoal Toothpaste exhibited similar effects in terms of whitening, subjective and objective color change ($p>0.05$). Muntean at al[22] in contrary revealed that activated charcoal toothpaste improved tooth whitening significantly except in mandibular incisors ($p=0.126$).

With respect to the risk of bias assessment of the three included studies, Muntean et al.[22] revealed a high risk of bias due to compromised randomization and ambiguous data on the outcome, but the other two studies revealed a low risk of bias (**Figure 2**).

4. Discussion

One of the dental procedures that people want the most often these days is tooth whitening. Whitening teeth can be done at home or in a dentist's office. Under a dentist's supervision, items with extremely concentrated bleaching chemicals are administered in the latter scenario. Products for at-home teeth whitening include gels and toothpaste. The public prefers natural whitening agents since they are more optimized and do not change the tooth's microstructure. Many natural teeth-whitening products are on the market, including sea salt lemon and activated charcoal.[18] Activated charcoal toothpaste is one of these products that is said to have the capacity to whiten teeth through its absorption process. Activated charcoal's porous surface has the ability to absorb and remove pigments or stains that are adhered to teeth.[19] Thus, the aim of our systematic review was to compare the efficacy of synthetic bleaching agents that are commercially available and standardized with activated charcoal.

With the available research evidence, it can be observed that 10% carbamide peroxide was more preferred among the included population due to their improved whitening effect in comparison to natural activated charcoal-based dentifrices.

E.P. Ribeiro et al.[20] in his study revealed that population who received 10% carbamide peroxide (CP) showed positive psychological effects in addition to actual whitening effect. In spite of activated charcoal producing a relative whitening effect, they were unable to offset the positive psychological effects of proven-effective teeth whiteners among allocated population. The above study results align with and reinforces the conclusion of the results of the study by E.P. Riberio et al.[21] who stated that whitening effect of charcoal-based products was inferior to peroxide-based bleaching products, as they had a minimal and ineffective whitening impact, while carbamide peroxide resulted in optimal tooth whitening and the highest level of satisfaction among volunteers. On contrary Muntean et al.[22] reported that, activated charcoal toothpaste significantly altered the appearance of dental enamel on all assessed teeth, with the exception of the central mandibular incisors.

A previous systematic review evaluated the efficacy of activated charcoal based products on dental whitening using invitro studies and concluded that the potential of activated charcoal-rich toothpastes in providing tooth whitening comes from extrinsic stains removal, and not actually by altering the intrinsic color of enamel or dentin. Hence it's clear that activated charcoal produces bleaching only through its abrasive effect.[13]

In methods of assessment of whitening effect, included studies showed variations. Both E. P. Ribeiro et al.[20] and E. P. Ribeiro et al.[21] used a visual color scale for assessment while Muntean et al[22] study used a VITA classical shade guide. In addition, variability was also observed across all the three included articles regarding individuals responsible for assessing whitening. Ribeiro et al.[20] in his study reported results based on both operators and patients' opinion, whereas in the study by Muntean et al.[22] results were only operator based and in the study by Riberio et al.[21] results were only patients based.

On quality assessment, except Muntean et al,[22] both Ribeiro et al.[20] and Ribeiro et al.[21] exhibited a low risk of bias. Due to heterogeneity among the included studies, meta-analysis was not performed to get a quantitative assessment.

5. Conclusion

In conclusion, activated charcoal did not achieve an acceptable whitening effect compared to peroxide-based agents, which showed optimal whitening. Activated Charcoal whitens teeth primarily through its abrasive action, removing extrinsic stains rather than addressing intrinsic discoloration.

6. Sources of Funding

None.

7. Conflict of Interest

None.

References

1. Joiner A, Hopkinson I, Deng Y, Westland S. A review of tooth colour and whiteness. *J Dent*. 2008;36(1):S2–7.
2. Wang Y, Gao J, Jiang T, Liang S, Zhou Y, Matis BA. Evaluation of the efficacy of potassium nitrate and sodium fluoride as desensitizing agents during tooth bleaching treatment—A systematic review and meta-analysis. *J Dent*. 2015;43(8):913–23.
3. Carey CM. Tooth whitening: what we now know. *J Evid Based Dent Pract*. 2014;14:70–6.
4. Martins D, Rangel C, Fontanetti G, Soto J, Pierote JJA, Paulillo LAMS. Dental Whitening at-home, in-office and Combined Techniques: Case Report and Literature Review. *Adv Dent Oral Health*. 2019;11(5):153–7.
5. Brooks JK, Bashirelahi N, Reynolds MA. Charcoal and charcoal-based dentifrices: A literature review. *J Am Dent Assoc*. 2017;148(9):661–70.
6. Epple M, Meyer F, Enax J. A Critical Review of Modern Concepts for Teeth Whitening. *Dent J (Basel)*. 2019;7(3):79.

7. Pintado-Palomino K, Peitl Filho O, Zanotto ED, Tirapelli C. A clinical, randomized, controlled study on the use of desensitizing agents during tooth bleaching. *J Dent*. 2015;43(9):1099–105.
8. Bruzell EM, Pallesen U, Thoresen NR, Wallman C, Dahl JE. Side effects of external tooth bleaching: a multi-centre practice-based prospective study. *Br Dent J*. 2013;215(9):E17.
9. Mourad LME-KM, Elzainy MA, Hussein SI. Comparing the Effect of Activated Charcoal Whitening Agents against Regular Whitening Toothpastes on the Enamel Surface of Premolar Teeth: In vitro Study. *Open Access Maced J Med Sci*. 2022;10(D):493–8.
10. Dionysopoulos D, Papageorgiou S, Malletzidou L, Gerasimidou O, Tolidis K. Effect of novel charcoal-containing whitening toothpaste and mouthwash on color change and surface morphology of enamel. *J Conserv Dent*. 2020;23(6):624–31.
11. Ghajari MF, Shamsaei M, Basandeh K, Galouyak MS. Abrasiveness and whitening effect of charcoal-containing whitening toothpastes in permanent teeth. Dent Res J (Isfahan). 2021;18:51.
12. Silva JVBS, Melo VA. De, Dias M. F, Lins-Filho P. C.; Souza F. B. De, Guimaraes R. P. Clinical evaluation of domestic dental whitening strategies. *Res Soc Dev*. 2021;10:e35610514948.
13. Tomas DBM, Pecci-Lloret MP, Guerrero-Gironés J. Effectiveness and abrasiveness of activated charcoal as a whitening agent: A systematic review of in vitro studies. *Ann Anat*. 2023;245:151998.
14. Greenwall LH, Greenwall-Cohen J, Wilson NHF. Charcoal-containing dentifrices. *Br Dent J*. 2019;226(9):697–700
15. Vaz VTP, Jubilato DP, Oliveira MRM, Bortolatto JF, Floros MC, Dantas AAR, Oliveira Junior OB. Whitening toothpaste containing activated charcoal, blue covarine, hydrogen peroxide or microbeads: which one is the most effective?. *J Appl Oral Sci*. 2019;27:e20180051.
16. Maciel CRO, Amorim AA, Oliveira RFL, Vivanco RG, Pires-de-Souza FCP. Whitening efficacy of popular natural products on dental enamel. *Braz Dent J*. 2022;33(3):55–66.
17. Casado BGS, Moraes SLD, Souza GFM, Guerra CMF, Souto-Maior JR, Lemos CAA, Vasconcelos BCE, Pellizzer EP. Efficacy of Dental Bleaching with Whitening Dentifrices: A Systematic Review. *Int J Dent*. 2018;2018:7868531
18. ElAziz RHA, Gadallah LK, Saleh RS. Evaluation of Charcoal and Sea Salt-Lemon-based Whitening Toothpastes on Color Change and Surface Roughness of Stained Teeth. *J Contemp Dent Pract*. 2022;23(2):169–75.
19. Aziz A, Ayesha A, Sevianti E, Makalalag GV, Noordiansyah MA, Wicaksono MP, et al. Effectiveness of Toothpaste from Activated Charcoal as Teeth Whitening: A Systematic Literature Review. *Eureka Herba Indonesia*. 2023;4(3): 263–7.
20. Ribeiro EP, Emídio AG, Zanin GT, Melo E Silva VFF, Lopes MB et al. Dental aesthetic perception of patients submitted to activated charcoal-based bleaching agents: A randomized clinical trial. *J Dent*. 2023;139:104744.
21. Ribeiro EP, Zanin GT, Gonçalves AE, Kury M, Cavalli V, Guiraldo RD et al. Whitening efficacy of activated charcoal-based products: A single-blind randomized controlled clinical trial. *J Dent*. 2024;143:104877.
22. Muntean A, Candrea S, Delean AG, Condurache AI, Munceanu A, Neagoe S, et al. In Vivo Assessment Of Charcoal Toothpaste Effect On Enamel Appearance-a Natural Alternative For Dental Aesthetics. *Rom J Oral Rehabil*. 2024;16(1):168–176.

Cite this article: Varadan P, Balasubramanian P, Divakar A, Rajendran MR. Does the activated charcoal tooth paste utilization yield effects in dental whitening in adult population: A systematic review. *J Dent Spec* 2025;13(1):10-15.