

Effect Of Egg-Shell On Dental Erosion - A Systematic Review

Naseema S¹, Dinesh Dhamodhar², Rajmohan M³, Bharathwaj V V⁴, Sindhu R⁴, Prabu D^{5*}, Elakiya S⁶

¹Undergraduate student, SRM dental college, Ramapuram, Chennai, India

²Reader, Department of Public Health Dentistry, SRM dental college, Ramapuram, Chennai, India

³Reader, Department of Public Health Dentistry, SRM dental college, Ramapuram, Chennai, India

⁴Senior Lecturer, Department of Public Health Dentistry, SRM dental college, Ramapuram, Chennai, India

⁵Professor and Head of the Department, Department of Public Health Dentistry, SRM dental college, Ramapuram, Chennai, India

⁶Postgraduate student, Department of Public Health Dentistry, SRM dental college, Ramapuram, Chennai, India

*Corresponding Author: Prabu.D

*Master of Dental Surgery, Professor and Head of the Department, Department of Public Health Dentistry SRM Dental college, Ramapuram, Chennai-600089, Tamilnadu, India, Email- researchphdsrm@gmail.com, Mobile no: 8072019608

Doi: 10.47750/pnr.2022.13. 505.167

Abstract

Aim: To evaluate the micro-hardness and remineralizing effect of chicken egg shell (CESP) on dental erosion.

Materials and Methods: Database search was done in PubMed, Google Scholar, Elsevier Science Direct, Prospero, Cochrane Library, Grey Literature, Wiley Online Library, Web of Science, OSF, Ovid Medline, Embase. Four in-vitro studies of extracted human teeth were included evaluating the effect of egg-shell on dental erosion. This review was reported under PRISMA guidelines. Cochrane risk assessment was used for bias analysis.

Results: Four studies were reviewed, and all of them showed an increase in micro-hardness and remineralizing effect of egg-shell (CSEP-Chicken Egg-Shell Powder) on erosive enamel surfaces.

Conclusion: The study concludes that the effect of egg-shell on dental erosion has increased the remineralization of tooth enamel and reduction in surface roughness.

Keywords: Dental erosion, Egg-shell (CESP solution), microhardness, remineralization, surface roughness.

INTRODUCTION:

Tooth wear (wasting diseases of teeth) is an irreversible loss of tooth structure, not caused by dental caries. ^[1] Tooth wear has been a major problem in both adults and children, and quality of life is affected by a lack of health education. Due to lifestyle changes, erosive tooth wear has increasingly become a challenge for dental professionals in this modern world because modern diets containing acids can demineralize enamel. ^[2] The definition of dental erosion is irreversible chemical loss of mineralized tooth substance caused by exposure to acids and not by bacteria. ^[3]

Dental erosion is caused by extrinsic factors like dietary acids- carbonated drinks, candy, sodas, starchy foods, citrus fruits, sports drinks, fruit juices, wine, sugary foods, swimming pools, acidic drinking water and oral hygiene products- toothpastes, mouthwashes with acidic pH and inappropriate use of oral medications and salivary substitutes can also cause tooth erosion. The intrinsic factors are gastric acid produced during excessive vomiting and regurgitation, poor oral hygiene, pregnancy, alcoholism, decreased saliva, gastroesophageal reflux disease, genetic and metabolic disorders, psychosomatic disorders-Bulimia Nervosa and other systemic disorders. ^[2] It occurs on all surfaces of the teeth and is common in palatal surfaces of anterior teeth and occlusal surfaces of lower first molars (cupping-concavity on enamel cusp tips). ^[4]

Enamel appears softened and gives a blank or matte finish due to demineralization, and surfaces are round or flat and have a melted appearance. Increased sensitivity, cracks and chipping of the tooth, smooth or rough surfaces, worn dentition, shiny spots, translucent teeth, discolouration, pain, exposed roots. ^[5] Demineralization occurs when factors causing it are not controlled. This process can gradually progress to the point of degrading enamel completely, thereby exposing the dentin and pulp later. ^[6] Preventive measures like oral health education, reducing carbonated beverages, acidic and sugary foods, drinking plenty of water, maintaining good oral hygiene, balanced diet, treating the underlying systemic cause, chewing xylitol, low abrasive toothpaste and correct usage of toothbrush techniques are followed. ^[7] Even though various methods are used to prevent and manage dental erosion, it has not been succeeded completely. Egg-shell is rich in minerals like calcium carbonate, magnesium, phosphorous and traces of other microelements like iron,

manganese, zinc, cobalt, chromium, lead etc. Egg-shell membrane has protein, fat, collagen, silica, amino acids, glycoprotein, proteoglycan, moisture.^[8] Egg-shell is believed to be a substitute for enamel because there is a change in pH and enamel erosion due to many acidic beverages. Various experiments have also been done to clearly understand the relation between egg-shell and dental enamel to establish the remineralization capacity on teeth.^[9]

The calcification process is used for making egg-shell powder for better mechanical and physical properties.^[10] A large number of egg-shell waste is generated globally, so it can be used to treat dental erosion to enhance remineralization of the tooth and reduce the cost of treatment.^[11] This study is done to evaluate the micro-hardness and remineralizing effect of chicken egg shell powder solution (CESP) on dental erosion enamel surfaces

MATERIALS AND METHODS:

Study Design:

This study is a systematic literature review of the effect of egg-shell on dental erosion. The duration of study was conducted over the period of February 2022 to May 2022.

SEARCH STRATEGY:

Electronic databases used to find the effect of egg-shell on dental erosion are PubMed, Google Scholar, Elsevier Science Direct, Prospero, Cochrane Library, Grey Literature, Wiley Online Library, Web of Science, OSF, Ovid Medline, Embase was taken into study for this systematic review. A literature search to collect relevant data were performed using the terms dental erosion and egg-shell. A total of 128 articles appeared from the sources, and 84 duplicates were removed. Forty-four full-text articles were screened, and 14 articles were related to the research topic. Out of these, four articles were retrieved for review. This systematic review were performed using PRISMA guidelines.

ELIGIBILITY CRITERIA FOR THE STUDY

Inclusion Criteria-

- Articles on the effect of egg-shell on dental erosion
- Full-text original articles
- In-vitro studies
- Randomized control trials
- Articles that are in the English language

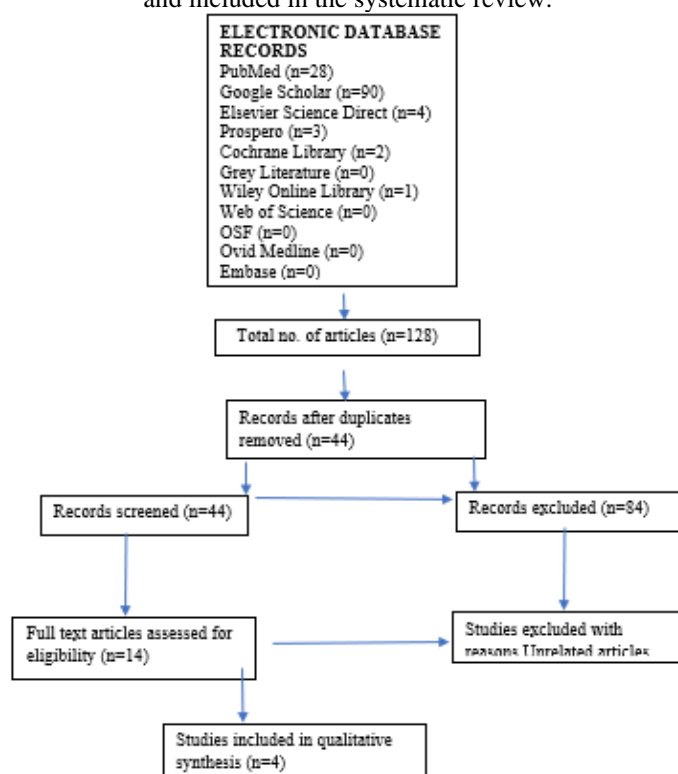
Exclusion Criteria-

- Only abstracts available
- Review articles
- Unrelated articles
- Animal studies

SEARCHED DATABASES

- PubMed
- Google Scholar
- Elsevier Science Direct
- Prospero
- Cochrane Library
- Grey Literature
- Wiley Online Library
- Web of Science
- OSF
- Ovid Medline
- Embase

Flow chart 1: Flow chart diagram showing the number of studies identified, screened, assessed for eligibility, excluded and included in the systematic review.



RESULTS:

Table 1: Characteristics Of The Studies Selected And Included In Systematic Review

S.NO	AUTHOR & YEAR	NO. OF SAMPLES	NO. OF CHICKEN EGGS	PREPARATION USED (CESP SOLUTION FORM)	INTERVENTIONS
1	Sandleen Feroz, Moeen F, Haq SN (2017) ^[12]	30 extracted human incisors	12	1g CESP dissolved in 20ml 4% acetic acid pH-11.2	Group 1: Controlled group-untreated Group 2: Carbonated drink Group 3: CESP solution
2	Shatha A Abbas (2020) ^[13]	20 extracted maxillary 1 st premolars	20	1g CESP in 20ml de-ionized water containing 4% acetic acid pH-11.8	Group A: Untreated Group B: Demineralisation & CESP Group C: Demineralisation & CESP Group D: Demineralisation & 0.05% NaF
3	Gehan A Elolimy (2020) ^[14]	20 extracted deciduous anterior	30	1g chicken egg-shell powder mixed with 2ml artificial saliva	Group I (Control group)- Claritin syrup- untreated Group II (Study group)- Claritin syrup & CESP slurry
4	Abdelrahman E. Elshik, Etman WM, Genaid TM (2020) ^[15]	36 extracted 1 st premolars	15	(3% concentration) 1g calcined powder dissolved in 33.3ml sterile de-ionized water	Group I- CESP solution & artificial saliva Group II- CESP solution

Table 1: shows the characteristics of the intervention in the included studies. In all above the effect of Egg-shell was reviewed.

Table 2: Outcome Of The Studies Included In Systematic Review

S.NO	AUTHOR & YEAR	TYPE OF DRINK	OUTCOME	P-VALUE
1	Sandleen Feroz, Moeen F, Haq SN (2017) ^[12]	6ml carbonated drink (coca-cola)- 2.4pH at 20°C	Increase in surface roughness after exposure to carbonated drink. Decrease in enamel surface roughness after application of CESP.	p-value 0.00
2	Shatha A Abbas (2020) ^[13]	6ml Carbonated beverage (Pepsi cola)-2.1pH at 20°C for 2 minutes	Group B has the highest enamel microhardness (54.13%), followed by Group C (44.52%) after treatment with CESP. Lesser time of immersion also showed increased remineralization.	p-value 0.001
3	Gehan A Elolimy (2020) ^[14]	Claritin syrup- anti-histaminic syrup has citric acid, loratadine 1mg/ml, sodium benzoate, glycerine, water, inactive components etc. pH-3.4	Group I -increase in roughness after erosion with Claritin syrup. Group II-increase in microhardness after CESP slurry usage.	p-value 0.01
4	Abdelrahman E. Elshik, Etman WM, Genaid TM (2020) ^[15]	10ml demineralizing solution at 37°C	Increased remineralization of enamel surface after utilizing CESP twice daily due to increase in Ca, P than using CESP once daily. CESP solution treated enamel surface resisted further acidic challenges.	Group I p-value 0.001 Group II p-value 0.000

Table 2: shows an outcome and result of the effect of Egg- shell in above-mentioned studies.

Table 3: Bias Analysis Of The Studies

S. NO	AUTHOR	RANDOM SEQUENCE GENERATION	ALLOCATION CONCEALMENT	SELECTIVE REPORTING	INCOMPLETE OUTCOME DATA	BLINDING OF OUTCOME ASSESSMENT	BLINDING PARTICIPANTS AND PERSONALS
1	Sandleen Feroz, Moeen F, Haq SN (2017) ^[12]	+	-	-	+	-	+
2	Shatha A Abbas (2020) ^[13]	+	?	-	+	-	+
3	Gehan A Elolimy (2020) ^[14]	+	-	-	+	-	+
4	Abdelrahman E. Elshik, Etman WM, Genaid TM (2020) ^[15]	+	-	-	+	-	+

Table 3: shows the bias analysis of all the included studies. It is categorized as high-risk bias “-“, low risk bias “+” and unclear “?”.

DISCUSSION:

Dentin is one of the most highly mineralized tissues in the tooth after enamel. In the oral cavity, demineralization and remineralization are the normal processes which occur due to the loss or gain of calcium, fluoride and phosphorous ions that are meant to be balanced. However, inappropriate dietary habits, lifestyle and poor oral hygiene cause mineral loss and trigger the demineralization process to dominate remineralization. This results in initial enamel lesions that progress

with time into the dentin. Various remineralizing agents were used to restore these ions to revert the remineralization process and thereby reduce the formation of dental erosion.

Many research was done on natural products to obtain this mechanism; one such item is the egg shell which was widely used as a natural treatment and alternative therapy for various types of diseases and various studies have suggested the healing, cosmetic and nutritional benefits of eggshell. ^[10,11,12,13] Although some systematic review studies were conducted on eggshells, none of the systematic reviews was done previously based on the effectiveness of eggshell on dental erosion. With a growing interest in using eggshell for treating dental erosion, this systematic review was performed to assess the evidence of egg shell in stimulating dentin remineralization.

In this study, high standards for inclusion criteria and exclusion criteria were formatted in order to avoid bias in the results. Out of fourteen full-text articles based on the effect of eggshell on dental erosion, only four in-vitro studies fulfilled the criteria of the study and were used for the analysis of the systematic review. The bias assessment was done to assess the methodological quality of the studies. Lack of random sequence generation, incomplete assessment of data, and lack of double blinding are the common drawbacks observed in all of the four studies. All the invitro studies reported a low risk of bias and were found to be a very beneficial therapeutic option for dental erosion.

A study conducted by Feroz et al in the year 2017 ^[12] reported that the chicken eggshell powder (CESP) reduces the surface roughness of all treated teeth samples and enhances the remineralization of enamel due to the bioavailability of calcium and phosphate ions in eggshell depresses the process of dental erosion on tooth surfaces. The tooth samples treated with eggshell were found to be statistically significant, which indicates the remineralizing effect of chicken eggshell on enamel and dentin surfaces. The bias was found to be very low and the lack of double blinding was the major limitation observed in this study. Another study conducted by Abbas et al in the year 2020 ^[13] revealed the effect of eggshell on enamel microhardness among four randomly distributed groups and concluded that the tooth samples treated with eggshell combined with sodium fluoride were found to be more beneficial in treating dental erosion by enhancing the remineralization process of the tooth surfaces. The bias such as selection bias, performance bias, and double blinding bias was more prevalent in this study compared to other studies.

Another study done by El-olimy in the year 2020 ^[14] suggested the remineralizing effect of chicken eggshell powder slurry on deciduous teeth with dental erosion. The effect of enamel remineralization was obtained in this study by continuous application of eggshell twice daily for 3 mins for a period of 10 days. The bias assessment reveals that there was a lack of randomization in this study which might affect the appropriate outcome. The study conducted by Elshik et al in the year 2020 ^[15] evaluated the demineralization resistance effect of eggshell in preventing dental erosion by dividing the samples into two groups. The concentration of eggshell powder to treat dental erosion was 3% which was the highest compared to the other studies and it was concluded that the treated specimens of both groups were exposed to a pH cycling regimen that consisted of alternating demineralization and remineralization cycle. The period of the demineralization phase was adjusted to be for three hours, to simulate the duration of demineralization (low cariogenic challenge) that occurs in the oral cavity. The selection bias, randomization bias, outcome bias, and blinding are the various types of bias observed in this study.

An overall analysis of this systematic review suggested that the egg shell was found to be very effective in preventing dental erosion by enhancing the remineralization process; this might be due to the fact that the chicken eggshell contains not only calcium but also other essential elements such as strontium and fluoride (F) which tends to have a more positive effect on bone and dental metabolism. Moreover, the eggshell has a high degree of bioavailability due to its high calcium carbonate content, and the high amount of pH of the chicken eggshell solution has the great potential to favour the remineralization process.

LIMITATION OF THE STUDY:

The limitations of the study are only a minimum number of invitro studies were available since many studies were excluded to the unavailability of full-text articles. The studies chosen for the systemic review had a more prevalent bias. Further, no in vivo studies were conducted; more in vivo studies are required to be performed in the future to get proper evidence about the effectiveness of chicken eggshell on enamel remineralization.

CONCLUSION:

All the studies show strong conclusive evidence that egg-shell (CESP solution) has reduced the surface roughness due to erosion and increased the remineralization of dental enamel. It also resisted further acidic challenges. Egg-shell is commonly available, so egg-shell preparations can be used for enamel formation on the tooth, which is affected by dental erosion due to various factors.

REFERENCES:

1. Warreth A, Abuhijleh E, Almaghribi MA, Mahwal G, Ashawish A. Tooth surface loss: A review of literature. The Saudi dental journal. 2020; Feb 1,32(2):53-60.
2. Pandey A, Kalra A, Jaggi N, Malik SN, Alam MK. Wasting Disease: Erosion! A Diagnosis, Prevention and Management. International Medical Journal. 2014; Oct, 21(5):490-2.
3. Paryag A, Rafeek R. Dental erosion and medical conditions an overview of aetiology, diagnosis and management. The West Indian Medical Journal. 2014; Sep, 63(5):499.
4. Johansson AK, Omar R, Carlsson GE, Johansson A. Dental erosion and its growing importance in clinical practice: from past to present. International journal of dentistry. 2012; Jan 1.
5. Lussi A, Hellwig E, Ganss C, Jäggi T. Dental erosion. Operative dentistry. 2009; May, 34(3):251-62.

6. Yaberi M, Haghgoo R. A comparative study of the effect of nanohydroxyapatite and eggshell on erosive lesions of the enamel of permanent teeth following soft drink exposure: A randomized clinical trial. *Journal of International Oral Health*. 2018; Jul 1, 10(4):176.
7. Rios D, Magalhaes AC, Machado MA, da Silva SM, Lizarelli RD, Bagnato VS, et al. In vitro evaluation of enamel erosion after Nd: YAG laser irradiation and fluoride application. *Photomedicine and Laser Surgery*. 2009; Oct 1, 27(5):743-7.
8. King'Ori AM. A review of the uses of poultry eggshells and shell membranes. *International Journal of Poultry Science*. 2011; Jan, 10(11):908-12.
9. Onwubu SC, Mdluli PS, Singh S. Evaluating the buffering and acid-resistant properties of eggshell–titanium dioxide composite against erosive acids. *Journal of Applied Biomaterials & Functional Materials*. 2019; Feb, 17(1):2
10. Abdulrahman I, Tijani HI, Mohammed BA, Saidu H, Yusuf H, Jibrin MN, et al. From garbage to biomaterials: an overview on egg shell based hydroxyapatite. *J. Mater*. 2014; Aug, 25:802467.
11. Waheed M, Butt MS, Shehzad A, Adzahan NM, Shabbir MA, Suleria HA, et al. Eggshell calcium: A cheap alternative to expensive supplements. *Trends in Food Science & Technology*. 2019; Sep 1, 91:219-30.
12. Feroz S, Moeen F, Haq SN. Protective effect of chicken egg shell powder solution (CESP) on artificially induced dental erosion: an in vitro atomic force microscope study. *Int J Dent Sci Res*. 2017; Aug, 5(3):49-55.
13. Abbas SA. The Effect of Chicken Eggshell Extract on Artificially Induced Dental Erosion in Permanent Teeth (In Vitro Study) (Doctoral dissertation, Ministry of High Education & Scientific Research University of Baghdad College of Dentistry The Effect of Chicken Eggshell Extract on Artificially Induced Dental Erosion in Permanent Teeth (In Vitro Study) A Thesis Submitted to the College of Dentistry, University of Baghdad).
14. El-olimy GA. In-vitro evaluation of remineralization efficiency of chicken eggshell slurry on eroded deciduous enamel. *Egyptian Dental Journal*. 2020; Oct 1, 66:2519-2528.
15. Elshik AE, Etman WM, Genaid TM. Resistance of chicken egg shell powder treated demineralized enamel to further acidic challenges. *Tanta Dental Journal*. 2020; Apr 1, 17(2):38.