OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

Message from the School of Dentistry Anthology Team

Christina Truong, D.M.D., Samyia Chaudhry, D.M.D.

Welcome to the first issue in 2025 (fourth issue since 2023) of the OHSU School of Dentistry Anthology, or SODA. This edition showcases a diverse collection of research from dental students, residents and faculty members from the School of Dentistry.

Dental students learn evidence-based dentistry as early as the fall term in their first year. Clinical Scientific Inquiry, or CDEN 701, is a course taught by faculty member Lyndie Foster Page, Ph.D., B.D.S., DIPClinDent, MComDent, that provides the framework and supporting literature for understanding the background, principles and value of evidence-based dentistry. During the course, students produce a Critically Appraised Topic, or caseCAT.

The topics are concise summaries of the best available evidence related to a specific clinical question written in a format known as problem, intervention, comparison and outcome, or PICO. Students learn to search for, critically review and apply scientific literature to answer clinical questions.

Ultimately, the process helps dental professionals make evidence-based decisions in practice for patient care. At the end of the course, OHSU students present their caseCATs to their peers. Seven caseCATs from the class of 2028 are highlighted in this School of Dentistry Anthology edition.

In addition to caseCATs, this issue of SODA highlights four thesis abstracts and four research abstracts from our recent and current residents from the OHSU School of Dentistry Advanced Education programs in orthodontics, periodontics and endodontics. Also included is a manuscript on managing non-vital primary teeth in pediatric patients written by a second-year dental student and a faculty member.

The abstracts cover broad topics such as the anatomic-psychologic score to predict changes in the temporomandibular joint, or TMJ; contact mechanics of TMJ alloplastic implants; cleft volume as a predictor of the alveolar bone graft score and a new Oregon Health Plan for orthodontic coverage. They also include the difference between amnion chorion membranes and platelet-rich fibrin membranes in the open membrane technique of ridge preservation; differential coating of bacteria by peptidoglycan recognition protein 3, or PGRP3, in subgingival dental plaque; evaluating the noise levels of endodontic equipment during microscopic-assisted procedures; and assessing the validity of chatbot responses in endodontic diagnosis and treatment with clinical vignettes.

Thank you to our SODA editorial team: senior editor Ron Sakaguchi, D.D.S., M.S., Ph.D., M.B.A., senior communicator Rhonda Morin, M.L.S., APR, and Pam Pierce, M.L.S., M.S., OHSU Library, for their tremendous contributions and support in publishing the anthology.

The next edition in the spring will showcase outstanding research and scholarly presentations by OHSU School of Dentistry students, residents, staff and faculty from our Research Day in March. We deeply appreciate your continuous support of and participation in the School of Dentistry Anthology.

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

Contents

caseCATs

VOLUME 3 | ISSUE 1 | WINTER 2025

Resident Abstracts

Orthodontic Theses Abstracts

Periodontic Research Abstracts

Endodontic Research Abstracts

VOLUME 3 | ISSUE 1 | WINTER 2025

Research

Call for consideration

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

In adults, is the use of traditional cigarettes more harmful than the use of e-cigarettes in terms of gum recession and root exposure of the tooth?

Eric Alekseyev '28, Lynn Choi '28, Gabrielle Hanna-Choquette '28, Annie Nguyen '28, Maryam Shuaib '28, Caiyi Zhou '28

Background/case scenario

Increasing use of nicotine has become a more prevalent health issue that plagues society. The introduction of e-cigarettes was meant to be a healthier alternative for people looking to quit smoking traditional cigarettes. However, it brought with it a new set of problems as people became addicted to those products. The intent of this PICO was to explore the potential dangers of both types of smoking and see if one method had more harmful effects on the oral cavity, particularly gum recession and periodontitis.

Clinical question

For adult smokers, how do traditional cigarettes compare to e-cigarettes affect periodontal disease, gum recession and root exposure?

CAT 1

Article. Electronic cigarette use promotes a unique periodontal microbiome[1]
Authors. Thomas, S.C., et al.
Published. February, 2022
PubMed ID. 35189698

Methods. A longitudinal study compared conventional cigarette smokers (CS; n = 27), e-cigarette-only users (ES; n = 28), and nonsmokers (NS; n = 29) to assess subgingival microbiome differences.

Results/conclusion. E-cigarette users exhibit higher levels of bacteria associated with caries, gingivitis and periodontitis (e.g. L. wadei) compared to conventional cigarette smokers. Users exhibited a rapid inflammatory response after using their devices, even in those with healthy periodontal conditions.

POPULATION
Adult smokers

INTERVENTION
Traditional cigarettes

COMPARISON
E-cigarettes (vapes)

OUTCOME
Periodontal disease, gum recession, and root exposure

Conclusion/reflection. E-cigarettes increase the likelihood of real health disease in adults. While traditional cigarettes are more harmful when compared to e-cigarettes regarding biomarkers linked to periodontitis, there is still a significant risk of both types compared to nonsmokers. The literature is significant as it provides evidence-based insights showing the increased risk of periodontitis from both traditional and e-cigarette use, helping answer our PICO questions and support our conclusion.

Keywords. Periodontitis, e-cigarettes, vapes, smoking, gum recession, root exposure

Validity/applicability. The article provides a solid foundation with primary findings from their longitudinal clinical study. These findings can further be used as a basis for future meta-analytical studies. The study is also unique in that it compares traditional cigarette smokers, e-cigarette users and nonsmokers in terms of varying microbiome levels in response to participant conditions.

Level of evidence. Level 4–Longitudinal clinical study

CAT 2

Article. Comparison of periodontal parameters and self-perceived oral symptoms among cigarette smokers, individuals vaping electronic cigarettes and never-smokers[2]
Authors. Javed, F., et al.
Published. June, 2017
PubMed ID. 2864410

Methods. Comparative study that examined the use of traditional cigarettes and e-cigarettes on gum disease, measured by comparing plaque index, bleeding on probing and self-reported symptoms. There were 94 male participants, divided into three groups: traditional cigarette smokers, e-cigarette users and nonsmokers.

Results/conclusion. Cigarette smokers had the highest bleeding on probing, or BOP, measurements. Plaque index is significantly higher among cigarette smokers and vape users. Gingival pain was more often reported among cigarette smokers than vape users.

Validity/applicability. This comparative study was significant in that it compared the use of traditional cigarettes to e-cigarettes in terms of oral health indicators, which had not been previously studied. The use of a control group (nonsmokers) was beneficial in comparing results.

Level of evidence. Level 3–Comparative study

Evidence search strategy

MeSH Terms:

- Vapes
- Cigarettes
- Electronic cigarettes
- Periodontal disease
- Adults

VOLUME 3 | ISSUE 1 | WINTER 2025

CAT 3

Article. The impact of electronic and conventional cigarettes on periodontal health, a systematic review and meta-analysis[3]
Authors. Thiem, D. G. E., et al.
Published. August, 2017
PubMed ID. 26856705

Methods. A systematic electronic search using terms adjusted according to the pattern developed for Medline (OVID): "oral health and (electronic cigarette or electronic nicotine delivery system or vaporizer)." The meta-analysis was performed with the principles of PRISMA.

Results/conclusion. Highest bleeding on probing, or BOP, found among cigarette smokers; e-cigarette users showed a 0.33-fold lower chance for BOP compared to smokers ($p=0.03$). Plaque Index, or PI, showed cigarette users having higher tendency to grow adherent biofilm in comparison to the e-cigarette users and non-smokers. Probing depth, or PD, was significantly higher in cigarette smokers compared to e-cigarette users and non-smokers ($p<0.05$ and $p<0.01$).

Validity/applicability. This meta-analysis adopts good exclusion principles in the literature process. More standardization among the studies would help researchers obtain a clearer conclusion upon which clinical relevance can be derived.

Level of evidence. Level 1–Systematic review and meta-analysis

References

1. Thomas SC, Xu F, Pushalkar S, et al. Electronic Cigarette Use Promotes a Unique Periodontal Microbiome. mBio. 2022;13(1):e0007522. doi:10.1128/mbio.00075-22.

2. Javed F, Abduljabbar T, Vohra F, Malmstrom H, Rahman I, Romanos GE. Comparison of Periodontal Parameters and Self-Perceived Oral Symptoms Among Cigarette Smokers, Individuals Vaping Electronic Cigarettes and Never-Smokers. J Periodontol. 2017;88(10):1059-1065. doi:10.1902/jop.2017.170197.

3. Thiem DGE, Donkiewicz P, Rejaey R, et al. The Impact of Electronic and Conventional Cigarettes on Periodontal Health: A Systematic Review and Meta-Analysis. Clin Oral Investig. 2023;27(9):4911-4928. doi:10.1007/s00784-023-05162-4.

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

The role of orthodontic pacifiers in mitigating the development of malocclusions in children

Mir Ali '28, Jamie Colson '28, Ashlyn Hegar '28,
Bela (Isabela) Nicacio '28, April Sierra Martinez '28

Background/case scenario

Pacifiers are widely used to comfort and soothe infants. However, prolonged use of traditional pacifiers has been linked to dental malocclusions such as crossbite and insufficient or excessive overjet and overbite. A concerned mother visits the pediatric dental clinic with her 2-year-old child, worried about the child's dental development. The child has been using a traditional pacifier since infancy, and upon examination, the dentist notices early signs of malocclusion. The mother asks if switching to an orthodontic pacifier might help or if pacifier use should be discontinued altogether.

The dentist explains that orthodontic pacifiers are designed to minimize pressure on the jaw and teeth compared to traditional pacifiers, potentially reducing the risk of malocclusion. However, clinical evidence supporting their effectiveness is limited.

Clinical question

Is it better to use orthodontic pacifiers compared to traditional pacifiers during teeth eruption?

CAT 1

Article. The effect of pacifier sucking on orofacial structures: a systematic literature review[1]
Authors. Schmid, KM., et al.
Published. March, 2018
PubMed ID. 29532184

Methods. A search on multiple databases was conducted to find pertinent articles based on the PRIMSA guidelines. Ultimately 17 studies met the criteria guidelines. This created a total sample size of 8,832 children ranging in ages from 16 months to 120 months (5 years old). Articles included seven prospective cohort studies, nine cross-sectional studies, and one randomized clinical trial.

POPULATION
Children with malocclusion due to traditional pacifier use

INTERVENTION
Orthodontic pacifier

COMPARISON
Traditional pacifier or no pacifier

OUTCOME
No clinical observation of overjet, crossbite, or overbite

Conclusion/reflection. The type of pacifier may not be as significant in preventing malocclusion. Factors such as duration, frequency, and intensity of pacifier use have a greater impact in the development of malocclusions. The most important recommendation to reduce the risk is to limit pacifier use and aim for cessation by the age of two.

Keywords. Orthodontic pacifier, traditional pacifier, malocclusion in children, pediatric oral health, facial development

Results/conclusion. All studies were found to have a serious to moderate risk of bias with a strong correlation between pacifier sucking and the incidence of malocclusion. Orthodontic pacifiers led to significantly fewer open bites than conventional pacifiers, but there is not enough evidence concerning other types of malocclusions. A recent randomized controlled trial showed that thin neck nipples reduce anterior open bite and increase overjet.

Validity/applicability. All articles included were directly related to the topic and all had a medium to high risk of bias. It was concluded that the findings should be interpreted cautiously.

Level of evidence. Level 2–Systematic literature review

Evidence search strategy

MeSH Terms:

- Orthodontic pacifier
- Malocclusion

CAT 2

Article. Malocclusion prevention through the usage of an orthodontic pacifier compared to a conventional pacifier: a systematic review[2]
Authors. Medeiros, R., et al.
Published. October, 2018
PubMed ID. 30054865

Methods. Researchers initially identified 607 articles but narrowed them down to three studies after applying strict inclusion criteria. They extracted data on patient groups, pacifier types, and malocclusion outcomes, assessing the studies' quality using the Joanna Briggs Institute Tool.

Results/conclusion. After analyzing three studies with a moderate risk of bias, the findings showed no substantial evidence supporting orthodontic pacifiers' superiority. One study linked conventional pacifiers to higher occurrences of anterior open bite and overjet, others found no significant differences. Prolonged and frequent pacifier use, regardless of type, was strongly associated with malocclusion. The review concluded that orthodontic pacifiers offer minimal advantage, emphasizing the importance of limiting pacifier use duration and frequency. Further research is needed to develop clear guidelines for preventing malocclusions.

Validity/applicability. This article is a systematic literature review which represents the highest level of evidence. The articles were found to have moderate level of bias using the Joanna Briggs Institute tool and due to its small sample size after the inclusion criteria.

Level of evidence. Level 2–Systematic review of cohort study

VOLUME 3 | ISSUE 1 | WINTER 2025

CAT 3

Article. Effects of conventional and orthodontic pacifiers on the dental occlusion of children aged 24-36 months old[3]
Authors. Lima, A., et al.
Published. March, 2017
PubMed ID. 26856705

Methods. A cross-sectional study to evaluate the effects of conventional and orthodontic pacifiers on the dental occlusion of children aged 24-36 months. The study included 120 children who were divided into two groups based on the type of pacifier used (conventional or orthodontic). Dental examinations were performed to assess occlusion characteristics such as open bite, crossbite and overjet. The results were compared between the two groups using statistical analysis to determine the impact of pacifier type on dental development.

Results/conclusion. Overall, the risk of malocclusion was higher for the children that used pacifiers in comparison to those who did not use pacifiers ($p<0.05$). The researchers concluded that when comparing the effects of conventional pacifiers to orthodontic pacifiers, there was no difference in the prevalence of malocclusion except when considering anterior open bite ($p=0.027$). Only conventional pacifier showed higher odds of posterior crossbite compared to the control group ($p=0.040$).

Validity/applicability. The study employed a longitudinal design, collecting data at three time points. Participants were divided into three groups: control (no non-nutritive sucking habits), orthodontic pacifier users and conventional pacifier users. The study may have recall bias from caregiver reporting of pacifier use. Selection bias is possible due to the specific population studied.

Level of evidence. Level 3–Observational study

References

1. Schmid KM, Kugler R, Nalabothu P, Bosch C, Verna C. The Effect of Pacifier Sucking on Orofacial Structures: A Systematic Literature Review. Prog Orthod. 2018;19(1):8. Published 2018 Mar 13. doi:10.1186/s40510-018-0206-4.

2. Medeiros R, Ximenes M, Massignan C, et al. Malocclusion Prevention Through the Usage of an Orthodontic Pacifier Compared to a Conventional Pacifier: A Systematic Review. Eur Arch Paediatr Dent. 2018;19(5):287-295. doi:10.1007/s40368-018-0359-3.

3. Lima AA, Alves CM, Ribeiro CC, et al. Effects of Conventional and Orthodontic Pacifiers on the Dental Occlusion of Children Aged 24-36 Months Old. Int J Paediatr Dent. 2017;27(2):108-119. doi:10.1111/ipd.12227.

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

Are botulinum toxin injections (BTX) effective in the reduction of orofacial pain in bruxism patients?

Madeline Cottrell '28, Colton Noyes '28, Janus Houchen-Haun '28, Chaz Au '28, Lauren Simmons-Rolins '28

Background/case scenario

Bruxism, a common condition due to involuntary clenching or grinding of teeth, often during sleep (sleep bruxism, or SB) or while awake (awake bruxism, or AB). Bruxism can cause a range of complications such as tooth wear, fractures, jaw pain, headaches and temporomandibular, or TMJ, disorders. Night splints are commonly used for SB to prevent excess wear and pressure on the jaw, other methods include stress management, physical therapy, or medications. BTX is gaining attention as an adjunct treatment for bruxism as it temporarily weakens the masseter and other muscles involved in clenching, potentially reducing the frequency and intensity of episodes.

Clinical question

For adults with bruxism, are botulinum toxin, or Botox, injections in the masseter muscles an effective treatment when compared with placebo injections or other methods in reducing orofacial pain?

CAT 1

Article Title. The effectiveness of botulinum toxin for temporomandibular disorders: A systematic review and meta-analysis[1]
Authors. Saini, R. S., et al
Published. March, 2024
PubMed ID. 38483856

Methods. This review included randomized controlled trials, published through November 1, 2023, with adult participants (≥18 years), focusing on the effectiveness of botulinum toxin for temporomandibular disorders. Quality was assessed using the Cochrane Risk of Bias 2 tool, and data on study design, interventions, and outcomes were extracted for analysis. A meta-analysis was conducted using Review Manager 5.4 to calculate the mean difference, or MD, for pain reduction and risk ratios, or RR, for adverse events, with heterogeneity assessed using the I^2 statistic. Studies lacking relevant efficacy data or not meeting inclusion criteria were excluded.

POPULATION
Adults with bruxism

INTERVENTION
Botulinum toxin injections in the masseter muscle

COMPARISON
Other existing bruxism treatments

OUTCOME
Orofacial pain tooth

Conclusion/reflection. Our research indicates that Botox injections are generally safe and effective for managing bruxism-related pain. However, further studies are needed to compare Botox's efficacy against other treatments like occlusal splints, behavior therapy, and medication, as current data remains inconclusive. One study found Botox statistically insignificant in reducing pain, while another deemed it more effective than alternative options. Additional research is essential to clarify Botox's role and its comparative effectiveness.

Keywords. Botox, pain, bruxism, orofacial pain, placebo

VOLUME 3 | ISSUE 1 | WINTER 2025

Results/conclusion. Several studies reported positive outcomes for Botox compared to placebo, but a meta-analysis found no significant advantage of Botox over placebo in pain reduction or adverse events. Botox did not significantly improve mouth opening, maximum occlusal force, or reduce bruxism events compared to placebo other treatments. Overall, the review concludes that BTX injections provide no superior benefits for TMD management compared to placebo or other treatment options.

Validity/applicability. The literature search identified 272 articles: 61 from PubMed, 53 from Scopus, 58 from Dimensions Publication, and 100 from Google Scholar. After removing 12 duplicates, 238 articles were excluded during the title and abstract screening due to irrelevance. Full-text screening was conducted on the remaining 22 articles, leaving 14 articles included in this review.

Level of evidence. Level 1–Systematic review and meta-analysis

CAT 2

Article. Is there enough evidence to use botulinum toxin injections for bruxism management? A systematic literature review[2]
Authors. De la Torre Canales, G., et al.
Published. March, 2017
PubMed ID. 28255752

Methods. A systematic electronic search of the PubMed, Scopus, Web of Science, Embase, Cochrane, Scielo and Lilacs databases (1980-March 2016) analyzed the specific terms by three independent researchers. Randomized controlled studies, or RCTs, prospective and before-after studies that applied Botox at the masseter and/or temporalis muscles were included.

Results/conclusion. This review included three RCTs and two uncontrolled before-after studies, all focused on sleep bruxism with small sample sizes. None addressed awake bruxism. Two RCTs were double blinded with saline controls. Diagnosis methods varied, with two studies using polysomnography/electromyography and others relying on clinical history. Subjective evaluations showed Botox injections improved pain and jaw stiffness, while objective measures found no reduction in bruxism episodes, only decreased muscle contraction intensity. There was little inconsistent evidence of the effects of Botox on EMG/PSG, with significant reduction in self-reported pain in three of four studies.

Evidence search strategy

MeSH Terms:

- Botox
- Bruxism
- Sleep splint

Validity/applicability. This systematic review highlights the potential of botulinum toxin, or BTX, as a management option for sleep bruxism, particularly in reducing symptoms like pain and jaw stiffness and decreasing muscle contraction intensity. However, the included studies are limited by small sample sizes, lack of focus on awake bruxism, and variability in diagnostic methods. While subjective outcomes are positive, objective measures show limited effectiveness in reducing bruxism episodes. These limitations underscore the need for larger, high-quality studies to establish clear treatment guidelines and indications for BTX in bruxism management.

Level of evidence. Level 1–Systematic literature review

CAT 3

Article. Efficacy of botulinum toxin in the treatment of bruxism: Systematic review[3]
Authors. Fernandez-Nunez, T., et al.
Published. July, 2019
PubMed ID. 31246937

Methods. A systematic electronic search of PubMed, Cochrane Library, and Scopus (March–October 2017) analyzed the effects of botulinum toxin type A, or BTX-A, on bruxism. The review included studies on adults (18+) where BTX-A was tested on masseter and/or temporal muscles, compared to placebo (saline) injections or traditional bruxism treatments like occlusal splints, medications or cognitive-behavioral therapy.

Results/conclusion. Treatment groups that received infiltrations of 80 IU of BTX-A in three areas of both masseter muscles reported improvements in pathology when compared to patients who received saline injections in the same area. Both groups reported a decrease in symptoms following a bruxism symptom questionnaire. Across all studies, it was determined that doses of <100 IU of BTX-A resulted in a decrease of bruxism related. Symptoms such as pain during mastication; participants reported a higher quality of life. Minimal to no side-effects were reported, leading researchers to conclude that botulinum toxin injections as treatment for bruxism is a safe and effective option. When comparing the efficacy of traditional bruxism treatments such as drugs, occlusal splints and cognitive-behavioral therapy, it was determined that botulinum toxin is the most effective, especially among patients with severe bruxism.

Validity/applicability. This systematic review evaluates the efficacy of botulinum toxin type A, or BTX-A, in treating bruxism. While it supports BTX-A as a safe and effective treatment, particularly for reducing pain and occlusal force, the review has some limitations. The sample sizes in the included studies are small, and there is variability in methods, outcome measurements and follow-up durations (most under one year). Furthermore, the lack of blinding and homogeneity in some studies increases the risk of bias. Therefore, while BTX-A shows promise for severe bruxism cases, its long-term efficacy and comparative advantage over traditional treatments require further high-quality research.

Level of evidence. Level 1–Systematic literature review

References

1. Saini RS, Ali Abdullah Almoyad M, Binduhayyim RIH, et al. The Effectiveness of Botulinum Toxin for Temporomandibular Disorders: A Systematic Review and Meta-Analysis. PLoS One. 2024;19(3):e0300157. Published 2024 Mar 14. doi:10.1371/journal.pone.0300157.

2. De la Torre Canales G, Câmara-Souza MB, do Amaral CF, Garcia RC, Manfredini D. Is There Enough Evidence to Use Botulinum Toxin Injections for Bruxism Management? A Systematic Literature Review. Clin Oral Investig. 2017;21(3):727-734. doi:10.1007/s00784-017-2092-4.

3. Fernández-Núñez T, Amghar-Maach S, Gay-Escoda C. Efficacy of Botulinum Toxin in the Treatment of Bruxism: Systematic Review. Med Oral Patol Oral Cir Bucal. 2019;24(4):e416-e424. Published 2019 Jul 1. doi:10.4317/medoral.22923.

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

Minimally invasive treatments of TMJ disorders

Nicole O'Dierno '28, Sarah Audi '28, Colby Stevens '28,
Michael Jacobson '28, Abbigael DeRosier '28

Background

Arthrocentesis is a minimally invasive surgical procedure in which a medical professional removes fluid from the TMJ and/or washes the TMJ with a saline rinse prior to fluid removal. This treatment is used in patients experiencing TMJ pain. There are also other non-surgical treatments such as physical therapy and splinting.

Clinical question

In adult patients, with pain associated with temporomandibular joint disorders, or TMDs, is arthrocentesis effective in restoring temporomandibular joint, or TMJ function and reducing pain?

CAT 1

Article. Limited evidence suggests no benefit of temporomandibular joint lavage over conservative treatment for temporomandibular joint pain and dysfunction[1]
Authors. Fahkry, H., et al.
Published. June, 2018
PubMed ID. 29747796

Methods. Surgical and non-surgical groups were compared. The five studies included 135 and 173 patients in the intervention and control groups, respectively.

Results/conclusion. Meta-analysis showed significant pain reduction after six months (−0.63; P < .00001) and after three months (−0.47; P = .001) favoring lavage. However, there was no difference after one month. For mouth opening, no significant difference between the lavage and control groups was found one, three and six months after treatment was completed.

Validity/applicability. Three studies were considered at a high risk and two at a low risk of bias.

Level of evidence. Level 1—Systematic review and meta analysis.

PROBLEM
Pain associated with TMJ disorders

INTERVENTION
Arthrocentesis

COMPARISON
Non-surgical treatments

OUTCOME
Reduced pain and improved TMJ function

Conclusion/reflection. Non-surgical interventions are the first line of defense in treating TMJ disorders

Arthrocentesis is a minimally invasive treatment and effective for treating TMJ pain, not TMJ disfunction

Clinically, arthrocentesis should be utilized over other treatments for TMJ pain reduction

Keywords. Arthrocentesis conservative treatment, TMJ pain management.

Evidence search strategy

MeSH Terms:

- TMJ disorders
- Non-surgical treatments
- Surgical treatments

VOLUME 3 | ISSUE 1 | WINTER 2025

CAT 2

Article. Arthrocentesis versus non-surgical intervention as initial treatment for temporomandibular joint arthralgia: A randomized controlled trial with long-term follow-up[2]
Authors. Tang, YH., et al.
Published. May, 2023
PubMed ID. 36117007

Methods. Eighty-four patients were randomly selected to receive either arthrocentesis (n=41) or nonsurgical intervention (n=43).

Results/conclusion. Pain (100 mm visual analogue scale, VAS) and mandibular function impairment questionnaire scores (MFIQ, 0–100) were recorded at three, 12, and 26 weeks, and ≥ 5 years (median 6.2, interquartile range 5.6–7.4 years). Patients in the arthrocentesis group experienced significantly lower TMJ arthralgia compared to those treated non-surgically (pain during movement: −10.23 mm (95% confidence interval −17.86; −2.60); pain at rest: − 8.39 mm (95% confidence interval −13.70; −3.08)), while mandibular function remained similar in the two groups (MFIQ −2.41 (95% confidence interval −8.61; 3.78)). Thus, initial treatment with arthrocentesis reduced TMJ arthralgia more efficaciously than non-surgical intervention in the long term, while maintaining similar mandibular function.

Validity/applicability. Small sample size limits the ability to apply these results to a wider patient.

Level of evidence. Level 2—Randomized control trial

CAT 3

Article. Arthroscopy versus arthrocentesis and versus conservative treatments for temporomandibular joint disorders: a systematic review with meta-analysis and trial sequential analysis[3]
Authors. Tang, YH., et al.
Published. June, 2024
PubMed ID. 38286713

Methods. Patients from 13 studies, totaling 609 study participants were compared between arthroscopy with both arthrocentesis and conservative treatment. The remaining compared arthroscopy with either arthrocentesis or conservative treatment.

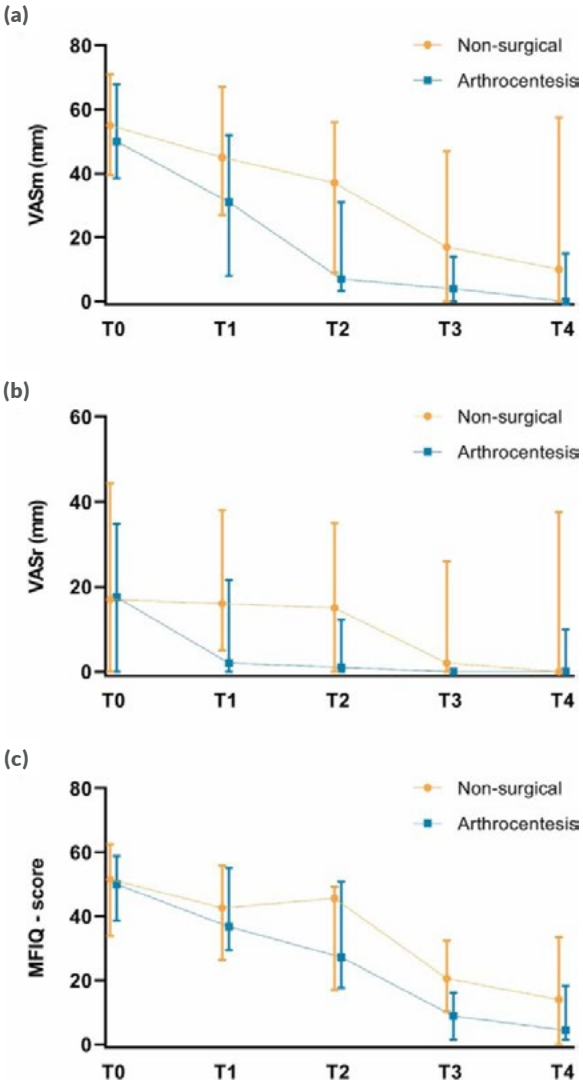


Image 1. Comparison of non-surgical and arthrocentesis in reported pain levels (a) pain during movement (VASm), (b) pain at rest (VASr), and (c) perceived mandibular function (MFIQ score) over time for non-surgical intervention and arthrocentesis.[2]

Results/conclusion. None of the studies had a significant impact on the pain score during mandibular movement at rest. The studies involving both arthroscopy and arthrocentesis displayed significantly improved pain scores compared to baseline. The three studies comparing arthroscopy and arthrocentesis reported improvement in pain from six to 24 months after starting treatment, but no significant difference between the groups. Overall, patients report improvement in clinical symptoms after starting any type of treatment.

Validity/applicability. This meta-analysis was slightly different than a typical meta-analysis as it compared multiple different combinations of treatments, not just two categories, so it can be more widely applied.

Level of evidence. Level 1—Systematic review and meta-analysis

References

1. Fakhry H, Abd-Elwahab Radi I. Limited Evidence Suggests No Benefit of Temporomandibular Joint Lavage Over Conservative Treatment for Temporomandibular Joint Pain and Dysfunction. J Evid Based Dent Pract. 2018;18(2):157-158. doi:10.1016/j.jebdp.2018.03.001.

2. Tang YH, Vos LM, Tuin AJ, et al. Arthrocentesis Versus Non-Surgical Intervention as Initial Treatment for Temporomandibular Joint Arthralgia: A Randomized Controlled Trial with Long-Term Follow-Up. Int J Oral Maxillofac Surg. 2023;52(5):595-603. doi:10.1016/j.ijom.2022.08.018.

3. Tang YH, van Bakelen NB, Gareb B, Spijkervet FKL. Arthroscopy Versus Arthrocentesis and Versus Conservative Treatments for Temporomandibular Joint Disorders: A Systematic Review with Meta-Analysis and Trial Sequential Analysis. Int J Oral Maxillofac Surg. 2024;53(6):503-520. doi:10.1016/j.ijom.2024.01.006.

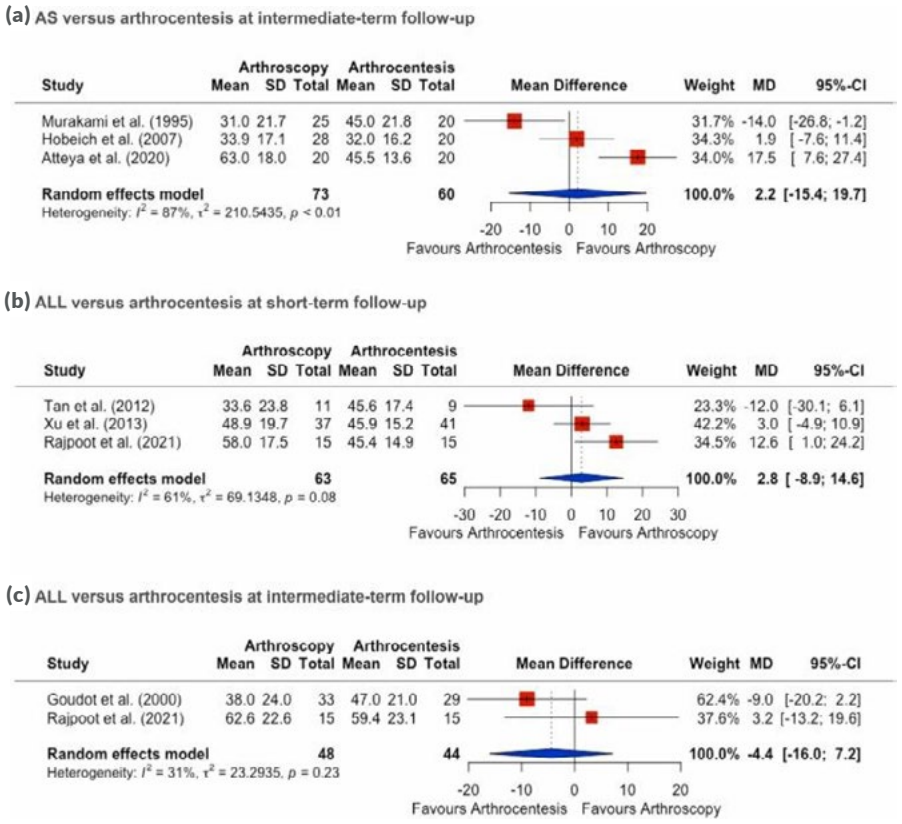


Image 2. Comparison of arthroscopy and various combinations of arthrocentesis and/or conservative treatments viewed in short-term and intermediate-term follow-ups.[3]

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

Use of AI in carious bitewing diagnostics

Hussain Awadh '28, Diyar Dezay '28, Andie Jamison '28, Kellen Olsen '28, Daniel Stratte '28

Background/case scenario

The use of AI-assisted tools in interpreting bitewing radiographs may enhance diagnostic accuracy and sensitivity, particularly in detecting proximal caries, when compared to traditional examination methods. AI implementations in mobile applications and deep learning models also demonstrate promising real-time diagnostic capabilities. However, there are a plethora of different models based on different standards and learning, making generalizing weak.

Clinical question

In adult bitewing radiographs, does AI-assisted interpretation of bitewing radiographs improve diagnostic accuracy and consistency for caries diagnosis compared to traditional methods?

CAT 1

Article. Artificial intelligence for caries detection: Randomized trial[1]
Authors. Mertens, S., et al.
Published. December, 2021
PubMed ID. 34656656

Methods. A cluster-randomized cross-over controlled trial was conducted with a commercially available AI caries detection software employed by 22 dentists. Twenty bitewings were randomly chosen from a pool of 140. Ten were picked at random to be supported by AI, while the other 10 were not. Reference test was established by 4+1 independent experts in a pixel-wise fashion.

Results/conclusion. Dentists using AI showed a significantly higher mean (95% CI) area under the Receiver-Operating-Characteristics curve (0.89;0.87-0.90) than those who did not utilize AI (0.85;0.83-0.86); $p<0.05$). Dentists with AI had a significantly higher sensitivity (0.81; 0.74-0.87 compared with 0.72; 0.64-0.79; $p<0.05$) for enamel lesions, while specificity was not significantly affected ($p>0.05$). Higher sensitivity came with increased treatment decisions ($p<0.05$).

POPULATION
Patients with permanent dentition

INTERVENTION
Use of AI diagnostics on bitewing radiographs

COMPARISON
Traditional examination and interpretation

OUTCOME
Higher accuracy and sensitivity in diagnosing caries on bitewing radiographs when compared to traditional evaluation from a dentist.

Conclusion/reflection. AI diagnostic models enhance diagnostic accuracy and sensitivity in detection of caries on bitewing radiographs. Integration of AI in dental practice may lead to an increase in invasive treatment due to false positives, thus more research is necessary.

Keywords. Artificial intelligence, caries diagnosis, bitewing radiographs, X-rays

VOLUME 3 | ISSUE 1 | WINTER 2025

Validity/applicability. This study is limited due to a small sample size but exhibits relevance to the clinical question and utilizes randomized control.

Level of evidence. Level 1–Randomized controlled trial

CAT 2

Article. Diagnostic performance of artificial intelligence-aided caries detection on bitewing radiographs: A systematic review and meta-analysis[2]
Authors. Ammar N., et al.
Published. December, 2024
PubMed ID. 38450159

Methods. Five databases were used: Medline (via PubMed), Embase, Web of Science, IEEE Xplore and Google Scholar. The search was limited to publications after 2010. Fourteen articles met the inclusion criteria.

Results/conclusion. Utilization of AI models for detection of overall caries can yield greater accuracy than intraoral radiography alone. All studies except for one reported an average SP of 0.63 or higher, indicating overall high specificity in test models.

Validity/applicability. These studies were chosen based on an extensive eligibility assessment process. However, the meta-analysis is limited by the small sample size.

Level of evidence. Level 1–Meta-analysis

CAT 3

Article. Diagnostic accuracy of artificial intelligence for approximal caries on bitewing radiographs: A systematic review and meta-analysis[3]
Authors. Carvalho, B. K. G., et al.
Published. October, 2024
PubMed ID. 39396775

Methods. Systematic searches were conducted in PubMed, Embase and other databases to identify relevant studies. Non-peer-reviewed studies were excluded to ensure the reliability of the data. Key information regarding artificial intelligence, or AI, system characteristics and diagnostic metrics, such as sensitivity and specificity, was extracted. The QUADAS-2 tool was used to assess the risk of bias and the applicability of the included studies.

Evidence search strategy

MeSH terms:

- AI
- Bitewing radiographs
- Caries detection

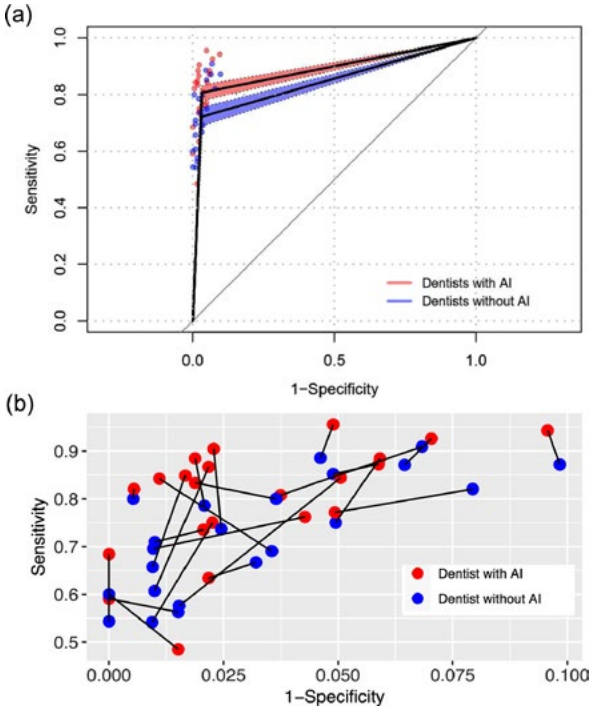


Image 1. (a) Receiver-operating-characteristics, or ROC, curves and operating points of individual dentists without (blue) and with (red) AI. Mean and 95% confidence intervals of the ROC curve are shown. (b) Changes in sensitivity and specificity of each dentist (operating points) when using AI (red) versus no AI (blue) for caries lesion detection. Note the differential scaling of axes.[1]

VOLUME 3 | ISSUE 1 | WINTER 2025

Results/conclusion. The findings demonstrate that AI models achieve clinically acceptable diagnostic accuracy for detecting caries on bitewing radiographs. However, expert dental verification remains crucial for confirming positive findings, as variability was observed in the Positive Predictive Value, or PPV, when identifying true positives. Despite this variability, AI systems were consistently reliable in identifying approximal caries, which underscores their potential as a valuable tool in dental diagnostics.

Validity/applicability. The validity of the AI models was supported by their strong diagnostic performance. Sensitivity, measured at 0.94, indicates a high ability to identify carious lesions, while specificity, at 0.91, reflects a strong ability to recognize healthy teeth. The Positive Predictive Value, or PPV, ranged from 0.15 to 0.87, highlighting variability in identifying true positives. Conversely, the Negative Predictive Value, or NPV, ranging from 0.79 to 1.00, demonstrated high reliability in excluding healthy teeth from diagnosis.

Level of evidence. Level 1–Meta-analysis

Case significance

- AI diagnosis may be used in conjunction with dental professionals to diagnose caries on bitewing radiographs.
- Late-stage lesions, detection (specificity) is comparable if not better than the dentists.
- Early-stage lesions, detection was compromised.
- Needs an increase in availability, further testing and troubleshooting, and accuracy to avoid overtreatment of patients.
- This could revolutionize radiology and fully eliminate the need to send radiographs to specialists.

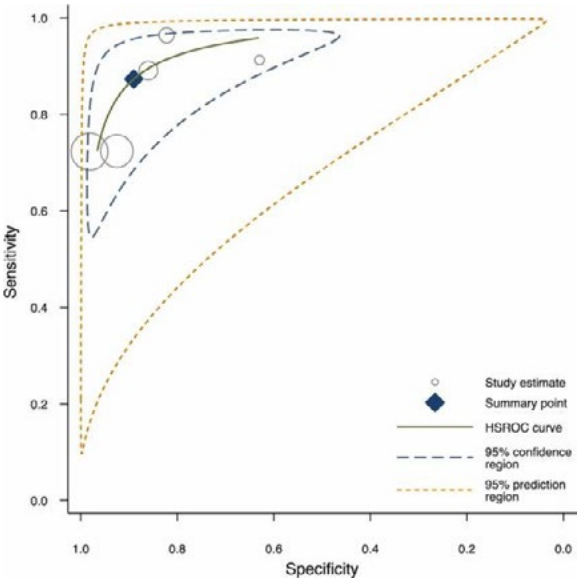


Image 2. HSROC curve showing the summary point for overall caries detection along with 95% confidence region and 95% prediction region estimates. The prediction region is the estimated 95% probability range for the expected performance of future studies conducted similarly to those already analyzed.[2]

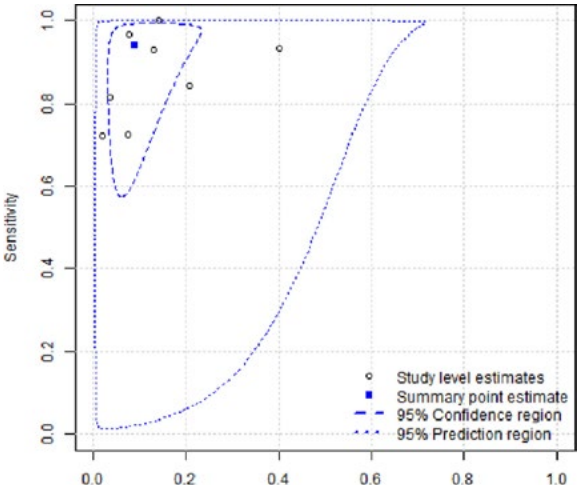


Image 3. Hierarchical summary receiver operating characteristic, or HSROC, plot of artificial intelligence performance accuracy.[3]

References

1. Mertens S, Krois J, Cantu AG, Arsiwala LT, Schwendicke F. Artificial Intelligence for Caries Detection: Randomized Trial. J Dent. 2021;115:103849. doi:10.1016/j.jdent.2021.103849.

2. Ammar N, Kühnisch J. Diagnostic Performance of Artificial Intelligence-Aided Caries Detection on Bitewing Radiographs: A Systematic Review and Meta-Analysis. Jpn Dent Sci Rev. 2024;60:128-136. doi:10.1016/j.jdsr.2024.02.001.

3. Carvalho BKG, Nolden EL, Wenning AS, et al. Diagnostic Accuracy of Artificial Intelligence for Approximal Caries on Bitewing Radiographs: A Systematic Review and Meta-Analysis. J Dent. 2024;151:105388. doi:10.1016/j.jdent.2024.105388.

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

The effects of prenatal tobacco exposure on dental health outcomes

Christine Bynum, Sara Garci '28, Sydney Leinberger '28, Melissa Richards '28, Ana Waxer '28

Background/case scenario

Prenatal tobacco exposure has long been associated with adverse health outcomes, but its impact on dental health, particularly the incidence of childhood caries, is gaining attention. Tobacco uses during pregnancy can disrupt fetal development, including tooth germ formation and mineralization, critical processes occurring as early as 7 to 13 weeks of gestation. This disruption may predispose children to dental issues like caries by affecting enamel quality and saliva production, which are vital for oral health. Understanding this relationship is crucial to informing preventive strategies and raising awareness about the broader risks of prenatal smoking. This caseCAT explores the potential link between in utero tobacco exposure and increased childhood caries, comparing outcomes with those of children not exposed to prenatal tobacco.

Clinical question

Does in utero exposure to tobacco smoke result in higher incidence of caries in those individuals during childhood, compared to those without exposure?

CAT 1

Article. Correlation between maternal smoking during pregnancy and dental caries in children: A systematic review and meta-analysis[1]
Authors. Zhong, Y., et al.
Published. June, 2021
PubMed ID. 35048017

Methods. PubMed, EMBASE, Cochrane, Web of Science and Scopus databases were searched for observational studies assessing the relationship between maternal smoking during the pregnancy and childhood caries. According to predesigned eligibility criteria and items, studies selection, and data extraction were conducted. The effect estimates were pooled using a fixed-effect model or a random-effect model. Newcastle-Ottawa Scale, or NOS, was adopted to evaluate the methodological quality of the studies included. All analyses were carried out through Stata 12.0 software.

POPULATION
Children

INTERVENTION
Exposure to tobacco smoke during entire prenatal period

COMPARISON
No prenatal tobacco smoke exposure

OUTCOME
Increased childhood caries

Conclusion/reflection. Prenatal tobacco exposure has been identified as a risk factor for caries among preschool children (primary dentition), consistent across several surveys and cross-sectional studies. Smoking has adverse effects on salivary flow and oral pH which increases caries susceptibility. There is also an established risk between smoking and low birth weight which can affect tooth eruption and result in increased risk of developmental enamel defects. This may be due to initial tooth germination beginning in the first 7-10 weeks of gestation, and tooth mineralization beginning at 13 weeks of gestation and completing during the first year of life. Many of the included studies do not completely account for the effect of confounding factors. For example, the prevalence of smoking is higher amount groups in poverty and in groups without higher education. These factors should be explored before definitive conclusions can be drawn regarding the link between prenatal tobacco exposure and increased oral diseases.

Keywords. Dental caries, tobacco smoking, pregnancy, children

VOLUME 3 | ISSUE 1 | WINTER 2025

Results/conclusion. The systematic review included a total of 11 studies, of which six cross-sectional studies and three longitudinal studies were included in the final meta-analysis. The pooled estimates indicated maternal smoking during pregnancy was significantly associated with dental caries in children both in cross-sectional studies (OR = 1.57, 95% CI = 1.47-1.67) and longitudinal studies (RR = 1.26, 95% CI = 1.07-1.48). Sensitivity analyses confirmed the overall effect estimates were robust.

There is a significant correlation between maternal smoking during pregnancy and childhood caries. However, the causal relationship between them cannot be determined. More prospective and extensive studies on this theme are needed for verification. Even so, it is necessary for pregnant women and women of reproductive age to quit smoking. Strategies must be developed to raise public awareness about the impact of prenatal smoking on children's oral health.

Validity/applicability. This study has high validity as it accurately assesses the intended purpose of determining the correlation between maternal smoking and childhood caries. The study additionally has high applicability as it included 11 studies from various countries with different patient ages and sample sizes so the results can be generalized across the population.

Level of evidence. Level 1–Systemic review and meta-analysis

Evidence search strategy

MeSH Terms:

- Dental decay
- Dental cavities
- Dental disease
- Carious lesion
- Carious dentin
- Tobacco use/consumption
- Habit smoking
- Behavior smoking
- Pregnancies
- Gestation

CAT 2

Article. Does the trimester of smoking matter in the association between prenatal smoking and the risk of early childhood caries?[2]
Authors. Akinkugbe, A. A. G., et al.
Published. January, 2021
PubMed ID. 33508853

Methods. This study evaluated the association between the trimester of smoking and offspring caries experience at three time points (31, 43 and 61 months) by analyzing data from 1,429 mother-offspring participants in the 1991/92 Avon Longitudinal Study of Parents and Children, conducted in Bristol, England. Prenatal smoking in the first, second and third trimesters were self-reported during pregnancy while offspring caries experience was determined by clinical oral examinations. Adjusted for confounders, log-binomial regression estimated the risk ratio, or RR, and 95% confidence interval, or CI, of the association between trimester of smoking and the risk of offspring caries.

Results/conclusion. Of the participants, 20% smoked in the first trimester of their pregnancy, 15% in the second trimester and 17% in the third trimester. Of the participants, 46% of children whose mothers smoked during pregnancy had caries experience (i.e., dmft ≥1) with a mean dmft count of 1.58, versus children whose mothers did not smoke during pregnancy (33% of whom had dmft ≥1 with a mean dmft count of 0.33). Smoking in the first, second and third trimesters were independently associated with a higher adjusted RR (95% CI) of caries experience at 61 months, i.e., 1.16 (0.93-1.43), 1.11 (0.75-1.65) and 1.60 (1.09-2.32), respectively. Within the limitations of covariates adjusted for, with the caveat that residual confounding and bias from unmeasured covariates are likely present, our findings suggest that smoking during pregnancy may be harmful to the oral health of the offspring irrespective of the trimester during which the smoking occurred. Nevertheless, these results should be interpreted cautiously because the findings might not generalize broadly.

Validity/applicability. This study contains high validity as it accurately determines that the trimester of prenatal smoking impacts the risk of childhood caries. The study has moderate applicability as the data being analyzed was conducted in England about 30 years ago and relied on self-reporting from participants, which could affect the reliability of the data.

Level of evidence. Level 4–Prospective longitudinal study

CAT 3

Article. Maternal smoking during pregnancy and early childhood dental caries in children: A systematic review and meta-analysis[3]
Authors. Samani, D., et al.
Published. July, 2024
PubMed ID. 38997699

Methods. Through a comprehensive search of PubMed, Scopus and Google Scholar databases for studies examining the correlation between maternal smoking during pregnancy and childhood caries, we identified 609 relevant articles up to October 2023. Studies were selected, and data extraction was based on the pre-established eligibility criteria and items. Meta-analysis was executed utilizing Comprehensive Meta-analysis, or CMA, with a random effects model, ensuring a robust synthesis of the gathered evidence.

Results/conclusion. Seven cohorts and five cross-sectional studies, totaling 12 studies, were included in the analysis. The combined results from the studies revealed a significant association between maternal smoking during pregnancy and an increased risk of dental caries in children (OR = 1.78, 95% CI = 1.55-2.05, I2 = 68.53). Sensitivity analyses confirmed the reliability of our results. However, there were indications of publication bias, as suggested by the funnel plot and Egger's test (P = 0.011) concerning the connection between prenatal smoking and childhood caries. This review underscores the association between maternal smoking during pregnancy and childhood dental caries. Nevertheless, confounding variables influence this link, necessitating more large-scale, longitudinal

studies with adjusted factors. Additional randomized control trials are needed to validate these findings due to the observed heterogeneity. Future research should investigate the precise reasons behind this association. It is essential to raise awareness among pregnant women about the risks of smoking through educational programs.

Validity/applicability. This study contains adequate validity as it determines a correlation between prenatal smoking and childhood caries, but it also reveals publication bias and states further research should be conducted. This study does have high applicability as it analyzes 12 unique studies so the results could be generalizable to a common population.

Level of evidence. Level 1–Systematic review and meta-analysis

References

1. Zhong Y, Tang Q, Tan B, Huang R. Correlation Between Maternal Smoking During Pregnancy and Dental Caries in Children: A Systematic Review and Meta-Analysis. Front Oral Health. 2021;2:673449. Published 2021 Jun 16. doi:10.3389/froh.2021.673449.

2. Akinkugbe AA. Does the Trimester of Smoking Matter in the Association Between Prenatal Smoking and the Risk of Early Childhood Caries? Caries Res. 2021;55(2):114-121. doi:10.1159/000513257.

3. Samani D, Ziaei S, Musaie F, et al. Maternal Smoking During Pregnancy and Early Childhood Dental Caries in Children: A Systematic Review and Meta-Analysis. BMC Oral Health. 2024;24(1):781. Published 2024 Jul 12. doi:10.1186/s12903-024-04548-4.

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

Why pediatric patients with under-developed bone may not be the best candidate for dental implants.

Taylor Carpenter '28, Isabella Sandgren '28, Nicholas Merryman '28, Jakob Wilson '28, Sebastian Gattey '28

Background/case scenario

In adolescents, the maturity of dental alveolar bone significantly influences the success rates of dental implants. Studies indicate that implants placed in patients with fully matured alveolar bone demonstrate higher osseointegration success compared to those with immature bone.

Clinical question

What is the relationship between dental alveolar bone maturity and the success of dental implants in youth populations?

CAT 1

Article. Does the timing of implant placement and loading influence biological outcomes of implant-supported multiple-unit fixed dental prosthesis: A systematic review with meta-analysis[1]
Authors. Aiquel, L. L., et al.
Published. October, 2021
PubMed ID. 34642990

Methods. Literature search for studies reporting on >10 patients with FPDs supported by two or more implants with at least three years of follow up. The data was analyzed based on implant survival and other markers such as marginal-bone depth change when viewing different combinations of implant placement timing and loading time.

Results/conclusion. This study used six RCTs, five cohort studies and three case series. We found that any combination of implant placement time and loading time all showed high survival rates and no difference in marginal-bone depth change.

Validity/applicability. This study helps provide a further understanding of which factors are to be considered when proposing implants, as well as implications given.

Level of evidence. Level 2—Systematic review

POPULATION
Adolescents with missing teeth

INTERVENTION
Dental implants placed in mature alveolar bone

COMPARISON
Immature alveolar bone placement

OUTCOME
Higher implant success rate with mature bone

Conclusion/reflection. Timing is crucial for implant survival. Immediate and early placements can work well when done correctly, while delayed placements often show higher predictability in complex cases.

Growth completion is critical for proper implant placement in adolescents. Exceptions exist, but timing must be carefully considered.

Proper placement is essential in growing patients to prevent complications and ensure implant longevity.

Keywords. Dental implant, pediatric patients with implants

VOLUME 3 | ISSUE 1 | WINTER 2025

CAT 2

Article. Anatomical considerations in implant selection and positioning[2]
Authors. Prasad, D. K., et al.
Published. April, 2013

Methods. A literature review on anatomical considerations for dental implant procedures was conducted. Analyzing anatomical structures, implant selection criteria, optimal positioning, advanced imaging techniques and potential complications for successful implant procedures.

Results/conclusion. Implant selection particularly pertaining to youth, where bone is not fully developed, is not encouraged until bone growth has ceased. External factors that may require implant placement prior to age 15 for females and 18 for males include Hereditary Anhidrotic Ectodermal Dysplasia, or HAED, alveolar/orofacial clefts, or OFCs, trauma and tumor resection.

Validity/applicability. The article provides comprehensive, evidence-based guidelines for implant selection and positioning, offering practical advice for clinicians. It serves as a reference for preoperative planning, emphasizing the importance of advanced imaging and careful consideration of bone quality and quantity.

Level of evidence. Level 6—Review article

CAT 3

Article. Dental implants in growing patients: A systematic review and meta-analysis[3]
Authors. Elagib M. F. A., et al.
Published. May, 2023
PubMed ID. 36502352

Methods. A detailed search of literature published from 1980 to 2021 was done to gain information on the outcome of dental implants in adolescents.

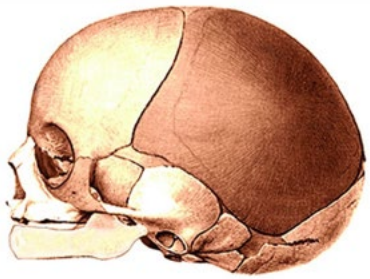
Results/conclusion. It can be concluded from this systematic review that the use of implants in edentulous growing patients is determined by several factors, the patient's health, stage of growth, number of teeth to be replaced and soft and hard tissue features. Use of a conservative treatment in patients with developing jaws is recommended.

Evidence search strategy

MeSH terms:

- Dental implants
- Bone and bones
- Alveolar bone
- Bone density
- Bone maturity
- Success rate
- Failure rate
- Dental implant
- Pediatric dentistry

(a)



(b)

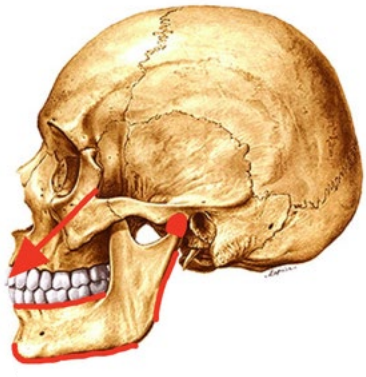


Image 1. (a) Skull of a child with developing jaw. (b) An adult skull with the red highlighted areas showing the major bone growth on the mandible. Image by Jakob Wilson '28.

Validity/applicability. This study provides in overarcing view on how to handle edentulous adolescents by using data collected over 41 years.

Level of evidence. Level 2—Systematic review

References:

1. Aiquel LL, Pitta J, Antonoglou GN, Mischak I, Sailer I, Payer M. Does the Timing of Implant Placement and Loading Influence Biological Outcomes of Implant-Supported Multiple-Unit Fixed Dental Prosthesis: A Systematic Review with Meta-Analyses. Clin Oral Implants Res. 2021;32 Suppl 21(Suppl 21):5-27. doi:10.1111/clr.13860.

2. Shetty M, Prasad DK, Mehra DR. Anatomical Considerations in Implant Selection and Positioning. Int J Oral Implantol Clin Res. 2013;4(1):24-29. doi:10.5005/jp-journals-10012-1088.

3. Elagib MFA, Alqaysi MAH, Almushayt MOS, Nagate RR, Gokhale ST, Chaturvedi S. Dental Implants in Growing Patients: A Systematic Review and Meta-Analysis. Technol Health Care. 2023;31(3):1051-1064. doi:10.3233/THC-220581.

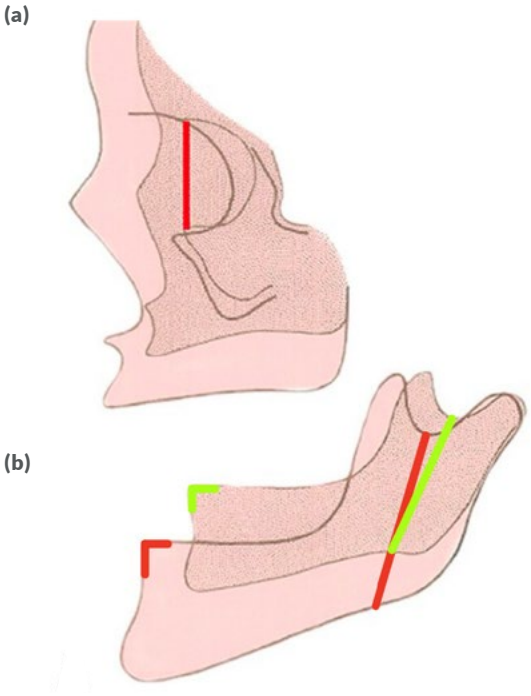


Image 2. Shows the change in mandibular angle throughout development. (a) The nasomaxillary complex maintaining a relatively uniform angle throughout development. (b) Sagittal view of mandible: The red and green lines serve to illustrate the change in ramus angle from adolescent to adult averaging about 3°. Image by Jakob Wilson '28.

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

How are orthodontists navigating the new Oregon Health Plan for orthodontic coverage?

Cherry Choy, D.M.D., M.S.

Introduction. In January 2023, Oregon Health Authority, or OHA, expanded coverage for the Oregon Health Plan, OHP, to include severe handicapping malocclusion for beneficiaries under 21 years old. With OHP's handicapping malocclusion coverage expansion, low Medicaid participation was anticipated to bottleneck access to care.

Objectives. This mixed methods study explored Oregon orthodontists' familiarity with OHP and assessed their attitude toward the OHP program and strategies to increase access to care for OHP beneficiaries.

Methods. Members of the Oregon State Society of Orthodontists (n=131) were emailed surveys and interview invites. Survey responses were evaluated using Fisher's exact tests, chi-square tests and logistic regression analyses with odds ratios. Individual interviews were analyzed with Dedoose software to explore reoccurring themes influencing OHP participation as well as recommendations from orthodontists to OHA and fellow peers.

Results. Out of 41 survey participants, 34% of participants accepted Medicaid and 74% of participants perceived a fair reimbursement rate to be higher than $4,499. Sixty-eight percent of participants reported they would limit OHP cases to 30 patients/year if they were to accept Medicaid. Practice location and setting had statistically significant associations with Medicaid participation with urban, corporate and university practices more likely to accept OHP. Non-Medicaid providers perceived low reimbursement, frequent Medicaid changes and appointment cancellations as greater barriers than Medicaid providers. Themes from 10 semi-structured interviews included confusion with policies, financial considerations and personal choice. Recommendations proposed by orthodontists to OHA included overcompensation in communication and simplification in the screening process.

Conclusions. There is a need to address changes in OHP policy and implementation in order to encourage utilization of the OHP program and increase access to care for eligible OHP beneficiaries.

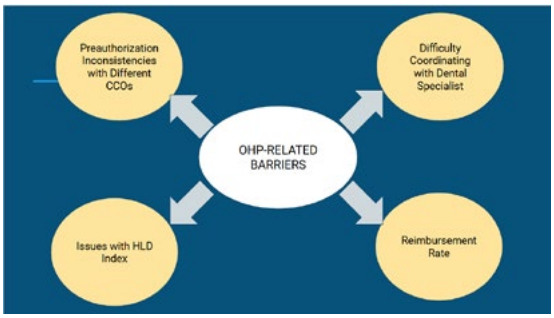


Figure 1. OHP-related barriers.

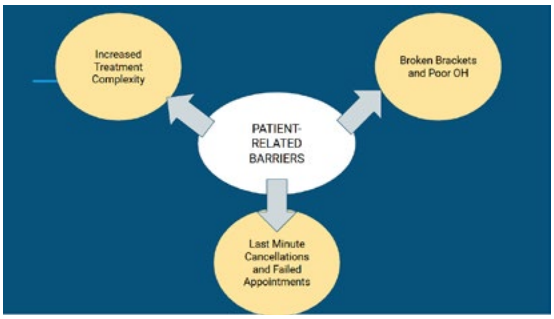


Figure 2. Patient-related barriers.

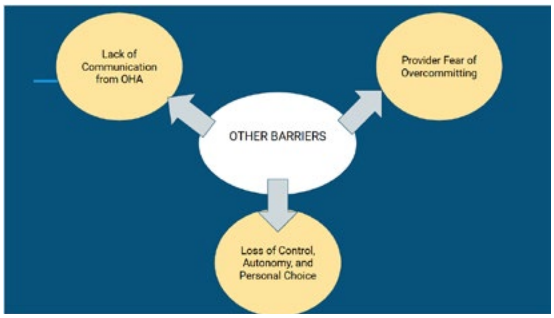


Figure 3. Other barriers.

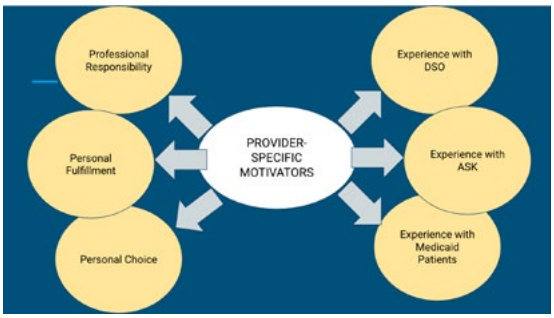


Figure 4. Provider-specific motivators.

VOLUME 3 | ISSUE 1 | WINTER 2025

Evaluation of cleft volume as a predictor of alveolar bone graft success

Elizabeth Gross, D.M.D., M.S.

Objective. To determine if bony fill of alveolar clefts after alveolar bone grafting, or ABG, is correlated with initial cleft volume and other factors.

Materials and Methods. Case records were retrospectively selected for this pilot study according to protocols approved by Institutional Review Boards from three sites. Inclusion criteria were: 7 to 13 years old, unilateral cleft of the maxillary alveolus, pre- and ≥3-month post-ABG surgery cone-beam computed tomography images, or CBCTs. Exclusion criteria were diagnosed underlying diseases or syndromes, ABG previously failed or used to support implants or prostheses, and bilateral clefts. 3D masks of alveolar cleft sites before and after ABG were extracted from CBCTs and used to calculate original and residual cleft volumes (mm3). Bony fill of the cleft site (%) was calculated by (initial–residual cleft volumes)/initial cleft volume x100 and tested for correlation with case-specific factors. Statistical analysis for binary factors was performed using student's t-tests, and linear regression was used for continuous factors. Statistical significance was defined as $p<0.05$.

Results. Records from 13 cases (six females, seven males) met inclusion and did not meet exclusion criteria. Inter- and intra-rater reliability for calculating cleft volumes were excellent (ICC=0.96 and 0.93, respectively). Mean bony fill was 47.6±27.6% overall and significantly larger ($p<0.01$) for females (67.5±24.9%) compared to males (30.6±16.4%) and significantly larger ($p=0.01$) for right-sided clefts (74.9±28.5%) compared to left-sided clefts (35.5±17.3%). Initial cleft volume versus bony fill (%) were inversely correlated ($R2=0.21$, $p=0.11$) overall and the relationship was accentuated in patients with no tooth structure exposed in the cleft ($R2=0.37$, $p=0.12$). Extractions performed at the time of ABG, presence of teeth in the cleft, and patient age were not found to influence bony fill.

Conclusions. Significantly better bony fill of alveolar clefts after ABG was related to smaller initial cleft volume, being female compared to male, and right-sided compared to left-sided clefts.

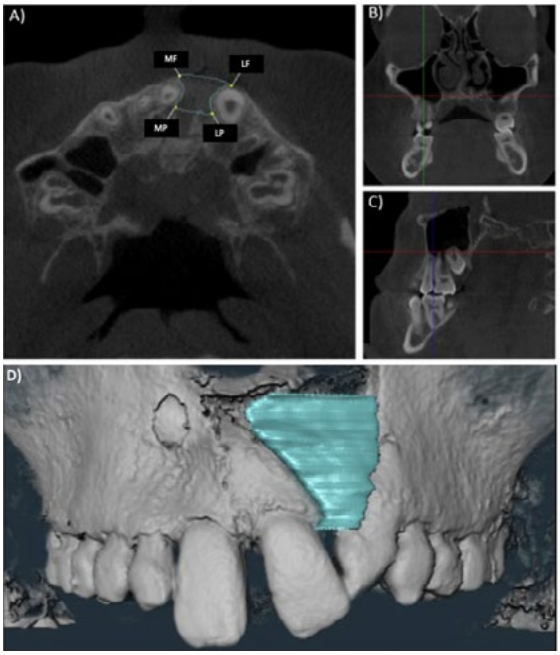


Figure 1. Display of landmarks used to define the alveolar cleft (a) axial CBCT slice showing identification of the most medial-facial border, or MF, and most lateral-facial border, or LF of the alveolar cleft. The medial-palatal landmark was placed 8 mm palatal to medial-facial and lateral-palatal landmark was placed 8 mm palatal of lateral-facial. (b) Coronal, and (c) sagittal slices at the mesial of the maxillary first molar of the non-cleft side showing identification of the most superior portion of the alveolar cleft (red lines) at the lower border of the nasal floor on the non-cleft side. (d) Facial view of 3D cleft mask, extending superiorly from the lower border of the nasal floor and inferiorly to the CEJ of the cleft side central incisor.

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

Temporomandibular disorders and anatomic-psychologic score

Garrett Masuda, D.M.D., M.S.

Objectives. Currently, it is not possible to accurately predict the prognosis of temporomandibular disorders, or TMDs. The objective of this study was to test two hypotheses concerning predicting longitudinal changes in the temporomandibular joint, or TMJ of human subjects. Hypothesis 1: To test if Anatomic-Psychologic Score, or APS, an instrument which utilizes easily measured variables, predicted longitudinal changes in TMJ tissue integrity. Hypothesis 2: To test if Machine Learning Models accurately rank ordered anatomic and psychosocial variables that were associated with longitudinal changes in TMJ tissue integrity.

Methods. According to Institutional Review Board oversight, subjects ≥18 years old were recruited. Baseline and greater than five-year follow-up data were obtained for Axis I (physical assessment) and Axis II (psychosocial status) of Diagnostic Criteria for Temporomandibular Disorders, or DC/TMD. Cone-beam computed tomography, or CBCT, and magnetic resonance imaging, or MRI were used to determine whether there were changes in TMJ integrity. A calibrated radiologist characterized TMJ integrity and created three diagnostic groups based on if the combined hard and soft tissue diagnoses had no change (Group A), got better (Group B), or got worse (Group C). Baseline variables used in APS were from two domains. Firstly, from the psychosocial domain of DC/TMD Axis II, numeric data was derived from the Patient Health Questionnaire-15 (PHQ-15) and 7-Question Behavior Score (7QBS). Secondly, CBCT images which were used to derive anatomic domain measures of (i) sagittal occlusal plane angle and anteroposterior position, (ii) mandibular ramus length, and (iii) variables associated with the axial plane geometry of the mandibular condyle. This included condyle loading area and aspect ratio, and angle of the condyle relative to the midsagittal plane. Means and standard deviations of APS and its component variables at baseline were calculated. To test Hypothesis 1, ANOVA was used to test for significant differences ($p<0.05$) in APS scores among the three diagnostic groups. Hypothesis 2 was tested using three machine learning models, which rank ordered variables of importance in predicting TMJ integrity changes and were evaluated according to accuracy of prediction (>0.90), and sensitivity and specificity (0.70 – 0.90).

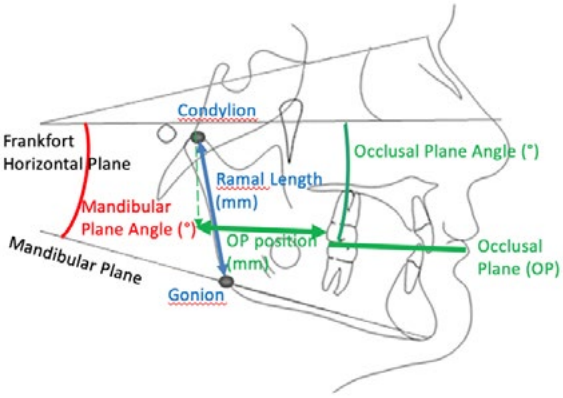


Figure 1. Cephalometric tracing. Cephalometric angular and linear craniomandibular anatomical measurements from cone-beam computed tomography, or CBCT.

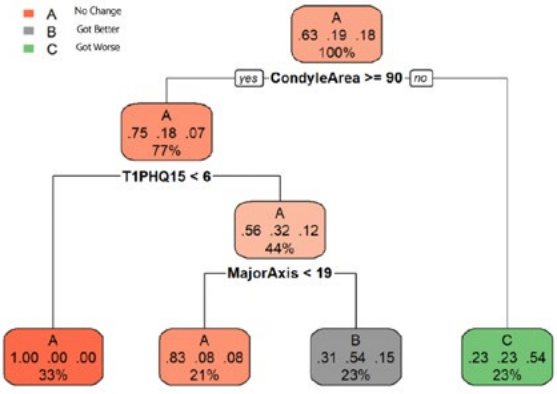


Figure 2. Classification Tree. 'A' represents the no-change group in TMJ integrity, 'B' the got-better group and 'C' the got-worse group. The second row per tile indicates the fractions of TMJs that were predicted to the no-change group (left), got-better group (middle) and got-worse group (right), in comparison to the actual groups that are denoted on the first row per tile. The third row per tile indicates the percentage of overall TMJs at each node of the tree. Darker shades of red for Group A (no-change group), represent higher predictive success.

VOLUME 3 | ISSUE 1 | WINTER 2025

Results. Thirty-one subjects (18 females and 13 males) met the inclusion criteria and right and left condyles were included for each subject resulting in a total of 62 TMJs. MRI and CBCT TMD diagnoses by the radiologist showed that 36 TMJs (58%) had no change from T1 to T2, 11 TMJs (18%) got better, 10 TMJs (16%) got worse, and five TMJs (8%) had no diagnoses. APS was not significantly different amongst TMJ integrity groups A, B or C. Gradient Boosting Machine modeling had a 74% predictive accuracy (sensitivity = 0.66, specificity = 0.81) of TMJ integrity change and had condylar area as the variable of highest importance. Classification Tree modeling a 61% predictive accuracy (sensitivity = 0.53, specificity = 0.77) and had condylar area as the variable of highest importance. Support Vector Machine modeling had a 60% predictive accuracy (sensitivity = 0.45, specificity = 0.70) and had major axis as the variable of highest importance. Classification Tree modeling identified condylar area ≥ 90 mm2, PHQ-15 < 6, and major axis < 19 mm predicted TMJ integrity changes and were 83-100% predictive of TMJs that had no change, 54% predictive of TMJs that got better and 54% predictive of TMJs that got worse. Sample sizes of 88 to 180 TMJs are needed to produce a 95% confidence interval with a width of no more than 0.2 for sensitivity and specificity of 0.7 to 0.9, assuming equal prevalence.

Conclusions. The proposed novel APS equation was not predictive of longitudinal changes in TMJ integrity. Machine learning models reported that condylar area and variables associated with the geometry of mandibular condylar area (major axis, minor axis and aspect ratio) have high relative importance in the predictive accuracy of TMJ changes.

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

A pilot study of contact mechanics of temporomandibular joint alloplastic implants

Kyle Hane, D.M.D., M.S.

Objective. Address the lack of knowledge concerning contact mechanics of temporomandibular joint, or TMJ, alloplastic implants.

Materials and Methods. Subjects were enrolled based on inclusion criteria: 18 years old or older with a history of previous replacement surgery with alloplastic implants of the left, right, or both TMJs, an interval of at least six months since the last surgery. Exclusion criteria included pregnant, planning a pregnancy during the study, currently breastfeeding, drug or alcohol abuse, and conditions that would cause difficulty following procedures of the study, such as those with dementia, psychological disorders or language barriers. Cone-beam computed tomography, or CBCT, images taken and used to construct three-dimensional anatomical geometry files of the positions of the mandibular condyles, teeth and positions and orientations of the medial and lateral pterygoid, masseter, temporalis, and anterior digastric muscles. Computer-assisted numerical models with the objectives of minimization of muscle effort, or MME, and minimization of joint loads, or MJL, were used with subject-specific geometry files to predict TMJ loads for a static bite-force of 10 Newtons applied at a range of biting angles on the mandibular right central incisor, canine and molar. Numbers of predicted ecologically viable biting angles were counted by identifying biting situations when the lateral pterygoid muscle forces were predicted to be zero (% applied bite force) on the same side as the TMJ implant because in vivo, this muscle is removed when the implant is placed. Variables included predicted TMJ loads, lateral pterygoid muscle forces, and numbers of ecologically viable biting conditions being investigated. All variables were derived for the biting conditions being investigated and were compared between models and sides using Analysis of Variance, or ANOVA, and Satterthwaite's t tests. Statistically significant differences were reported at $p<0.05$.

Results. Seven unilateral and eight bilateral TMJ implant replacement subjects met inclusion criteria and did not meet exclusion criteria. For unilateral implant subjects, significantly higher TMJ loads were predicted by MME versus MJL models in the contralateral TMJ for molar, canine and incisor biting, and in the ipsilateral TMJ for incisor and canine biting.

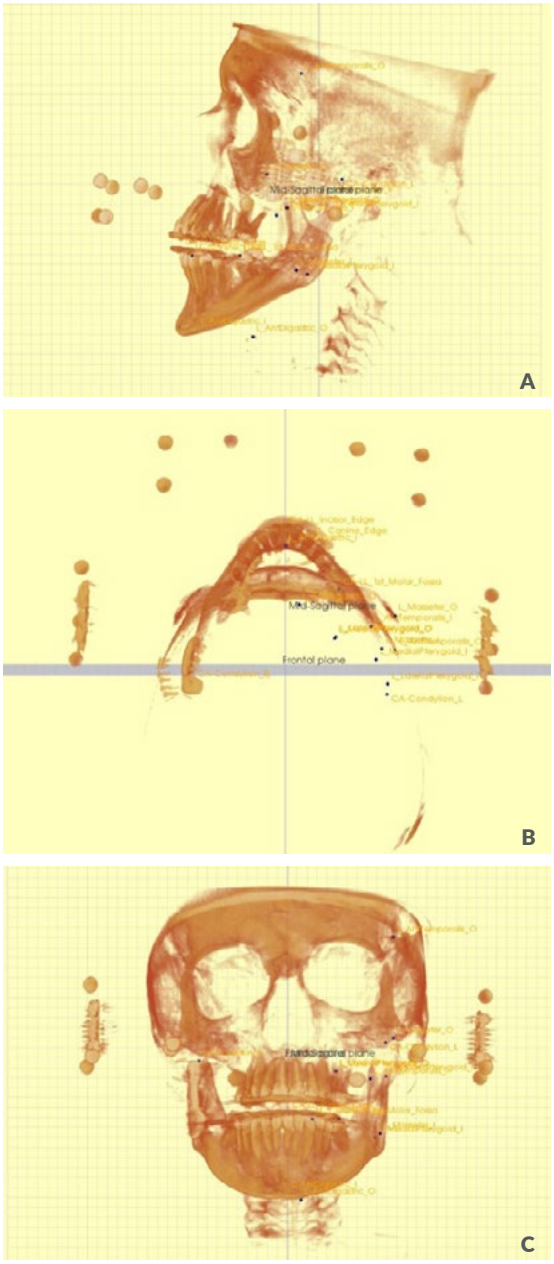


Figure 1. CBCT of unilateral right TMJ implant case with landmarks for geometry file shown on left side (blue dots) in three views, A. left lateral, B. inferior and C. frontal.

Additionally, significantly higher lateral pterygoid muscle forces were predicted by MJL versus MME models for molar, canine and incisor biting. There was a significantly higher number of predicted viable bite-force angles at molar biting for MME versus MJL models. For bilateral implant subjects, significantly higher contralateral TMJ loads were predicted by MME versus MJL models for molar biting and were predicted by MJL versus MME models for incisor biting, while significantly higher ipsilateral TMJ loads were predicted by MJL versus MME models for canine and incisor biting. There was no significant difference seen between MME and MJL models for number of viable bite-force angles at any of the bilateral tested biting locations.

Conclusions. Comparisons between MME and MJL models in a bilateral TMJ replacement population showed:

- No significant difference for the number of ecologically viable biting angles.
- Ipsilateral TMJ loads were not significantly different for molar biting but were significantly smaller during canine and incisor biting.
- Contralateral TMJ loads were significantly larger during molar biting. However, contralateral TMJ loads were not significantly different during canine biting and were significantly smaller during incisor biting.

Comparisons between MME and MJL models in a unilateral TMJ replacement population showed:

- Larger numbers of ecologically viable biting angles for biting at all three positions, although this was only significantly larger during molar biting.
- Larger ipsilateral and contralateral TMJ loads for biting at all three positions, and these were significantly larger for all except for the contralateral TMJ during incisor biting.
- Significantly lower lateral pterygoid muscle forces for biting at all three positions.

Thus, bilateral and unilateral TMJ replacement individuals may exhibit increased TMJ loads depending on the operating neuromuscular objective and biting location. Additional studies are needed to verify the results of this pilot study.

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

Peptidoglycan recognition protein 3 differentially coats microbes in subgingival dental plaque in periodontitis

Jing Yang, D.M.D., M.S., Justin Merritt, Ph.D., Jens Kreth, Ph.D., Sukirth Ganesan, D.D.S., Ph.D., M.P.H., Shareef Dabdoub, Ph.D., Li-Jung Lin, Ph.D., Sivaraman Prakasam, B.D.S., M.S.D., Ph.D.

Objective. Peptidoglycan recognition proteins, or PGRP, a family of pattern recognition proteins are upregulated in response to dysbiotic microbiome. They are hypothesized to have the ability to selectively coat bacteria presumably to facilitate host response and maintain homeostatic balance. This study aims to test the hypothesis and identify the bacterial species that are highly coated with peptidoglycan recognition protein 3, or PGRP3, in human subgingival dental plaque samples obtained from subjects with untreated Stage III/Stage IV periodontitis.

Methods. Twelve participants including eight periodontitis subjects and four non-periodontitis subjects participated in the study. Clinical periodontal examinations were conducted on all subjects and microbial dental plaque samples were collected from the subgingival sulcus prior to periodontal therapy. PGRP3 coated bacteria were separated from non-coated bacteria using two steps of antibody assisted separation, i.e., magnetic activated flow cell sorting, or MACS, and fluorescence activated cell sorting, or FACS. Sorted samples were sent for 16s sequencing to characterize microbiome of each sorted fraction.

Results. All clinical parameters showed significant difference between periodontitis and non-periodontitis populations subjects in terms of probing depth, or PD, bleeding on probing, or BOP, plaque index, and radiographic bone loss. There was a significantly higher number of PGRP3 coated bacteria in periodontitis subjects compared to minimal to no PGRP3 coated bacteria in non-periodontitis subjects. Sorted fractions had significant beta-diversity. PGRP3 coated bacteria identified include *Porphyromonas gingivalis*, *Corynebacterium durum*, *Streptococcus mutans and Neisseria. Sp.*

Conclusion. The results support the hypothesis that PGRP3 selectively coats bacteria in subgingival dental plaque. The identified PGRP3 coated bacteria include putative periodontal pathogens including *P. gingivalis*.

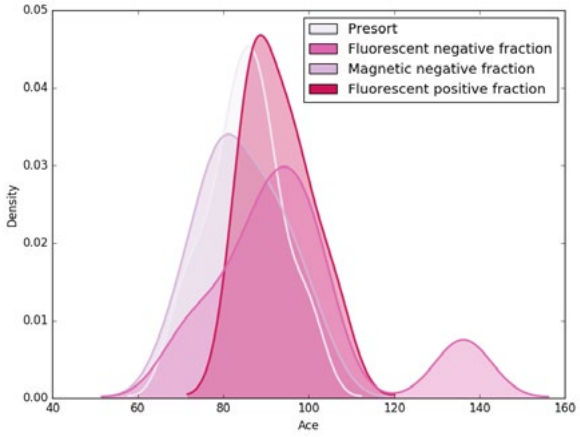


Image 1. Alpha diversity determined by Abundance Coverage Estimator, or ACE metric. From top to bottom: Gray: presort fraction; Pink: PGRP3 fluorescence negative fraction; Purple: magnetic negative fraction control; Red: PGRP3 fluorescence positive fraction. X axis: species richness by ACE. All groups showed similar species richness in the range of 60-120, with slight difference in fluorescence negative fraction (pink). Y axis: Species density. Similar species densities were shown with peaks overlap between all groups.

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

Comparative evaluation of amnion chorion membranes versus platelet rich fibrin membranes in extraction and ridge preservation using the open membrane technique: A pilot randomized clinical trial

LeRoy Horton, D.D.S., M.S., D.I.C.O.I., Curtis Wang, D.M.D., Li-Jung Lin, Ph.D., Yota Stathopoulou, D.D.S., D.M.D., Ph.D., Saulo Sousa Melo, D.D.S., M.S., Ph.D., Harjit Sehgal, B.D.S., M.S., Sivaraman Prakasam, B.D.S., M.S.D., Ph.D.

Objective. Amnion-chorion membranes, or ACM, and platelet rich fibrin, or PRF, membranes have been reported to have inherent biological properties that can favorably influence wound healing, regenerative and patient related outcomes. The aim of this study was to compare the effectiveness of these membranes in ridge preservation, when used in an open membrane technique, with a pilot randomized clinical trial for the primary outcomes of wound closure rates and perceived post operative pain and secondary outcomes of ridge dimensional.

Methods. A double masked randomized controlled clinical trial was used to compare the two membranes in premolar sites undergoing extraction and ridge preservation procedures. Ridge dimensions were measured pre surgery and four months post healing with help of a CBCT and radiographic stent with fiduciary markers. Wound closure tissue closure was documented and compared prospectively using intra oral scanning and digital measurements. Perceived pain was compared with help from the Visual analog scale, which was administered through a web-based survey that the subjects filled out starting day one until day 16 post-surgery.

Results. Radiographic bone level changes and intra oral wound healing rates were not significantly different between the two groups. Statistically significant results were observed in the VAS scores (i.e., perceived pain) with the ACM group subjects reporting significantly less VAS scores in the mornings as well as over 24-hour periods.

Conclusion. Within the limits of the study, both ACM and PRF membranes are effective in ridge dimensional when used with open membrane technique. Wound closure rates are comparable irrespective of the type of membrane. Use of ACM may reduce self-reported perceived pain compared to PRF as evidenced by lower postoperative VAS scores with ACM.

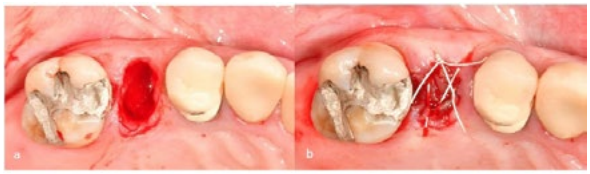


Figure 1. Clinical photograph of surgical protocol. (a) Showing an extraction site prior to grafting. (b) Image showing the grafting procedure open described in this study of allograft and exposed membrane.

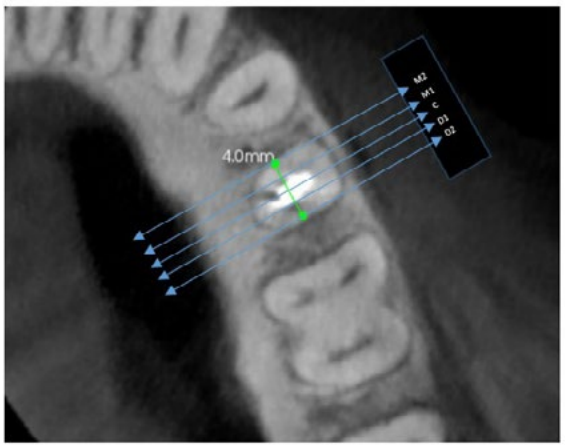


Figure 2. Radiographic analysis. CBCT cross sections analyzed at the center of the tooth to be extracted, and two measurements 1mm apart both mesial and distal to the center section. These have been labeled as C=center M1=1mm mesial to C, M2=2mm mesial to C, D1=1mm distal to C, D2=2mm distal to C.

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

Assessing noise levels of endodontic dental equipment during microscope-assisted procedures: Implications for occupational health and safety of dental professionals

Mohammed Kadhem, B.D.S., D.M.D., Karan Replogle, D.D.S., M.S., Adam Lloyd, B.D.S., M.S.

Objective. Dental clinicians are routinely exposed to noise from various endodontic devices, which may contribute to hearing impairment over time. This study seeks to quantify and compare noise levels generated by endodontic instruments and assess whether these levels exceed the exposure limits established by the National Institute for Occupational Safety and Health, or NIOSH.

Methods. Noise levels were measured for an air-driven high-speed handpiece, a piezoelectric ultrasonic handpiece under load, the Rispisonic® irrigation activation device, and the GentleWave console. Measurements were conducted with and without high-volume suction, or HVS, in a clinical setting. Sound pressure levels (dB) were recorded continuously over 30-second intervals, with each measurement repeated three times. The sound level meter was positioned 12 centimeters from the operator's ear, capturing readings on the left and right sides. Mean noise levels were analyzed via ANOVA, with Tukey pairwise comparisons across devices.

Results. Average noise levels ranged from 60.7 to 82.2 dB. Pairwise comparisons indicated statistically significant differences between most devices, except for GentleWave and Rispisonic ($P = 0.061$). The presence of HVS significantly impacted noise levels for all devices. Peak noise levels demonstrated notable differences between the Rispisonic, and the air-driven high-speed handpiece ($P = 0.002$) and ultrasonic handpiece ($P = 0.002$), including when HVS was used.

Conclusion. Noise levels recorded in this study remained within NIOSH-recommended exposure limits for occupational safety.

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

Assessing the validity of chatbot responses in endodontic diagnosis and treatment plans with clinical vignettes

Seon Young Min, D.D.S., Karan Replogle, D.D.S., M.S., Dongseok Choi, Ph.D., Adam Lloyd, B.D.S., M.S., Eun Hyun Park, D.D.S., Ph.D.

Objective. To assess the accuracy and comprehensiveness of chatbot-generated responses for endodontic diagnoses and treatment plans using clinical vignettes.

Methods. GPT-4o, Copilot, Gemini and Gemini Advanced provided endodontic diagnosis and recommended treatment plans for seven clinical vignettes from the American Association of Endodontists Colleagues for Excellence (2013). Data were collected twice, 10 days apart, resulting in 56 responses. Two faculty endodontists independently evaluated the responses, resolving scoring disagreements through evidence-based discussion. Responses were graded based on: (1) binary accuracy of the pulpal and periapical diagnosis (correct/incorrect) and (2) descriptive accuracy (6-point Likert scale, with one being completely incorrect and six being completely correct) and completeness (3-point Likert scale, with one being incomplete and three being complete with additional context). Scores were analyzed using mixed-effects models. The study, including data analysis, was conducted from June to October 2024.

Results. Overall binary accuracy for pulpal diagnosis was 87.5%, with no significant differences among the chatbots (p=0.100). For periapical diagnosis, it was 76.7%, with a significant difference (p=0.026): Gemini Advanced at 100%, ChatGPT-4o at 85.7%, Copilot at 64.3% and Gemini at 57.1%. Descriptive accuracy differed significantly among chatbots (p=0.001), with Gemini Advanced scoring 6 on the 6-point Likert scale in 92.9% of responses, followed by ChatGPT-4o at 64.3%, and both Copilot and Gemini at 42.9%.

Conclusion. Chatbots demonstrated high accuracy in pulpal diagnosis; however, their performance in periapical diagnosis and descriptive accuracy varied significantly across models, with Gemini Advanced achieving the highest validity.

OHSU School of Dentistry
Anthology
VOLUME 3 | ISSUE 1 | WINTER 2025

Regenerative endodontic therapy of non-vital primary teeth: A systematic review

Hunter Rothfus '27, Yifan Zhang, D.D.S., Ph.D., M.Sc.

Why this paper is important to dentists:

- Dental caries is the most prevalent chronic disease in children, often resulting in pulp necrosis and premature tooth loss due to inadequate treatment options.
- Premature primary tooth loss affects space maintenance, mastication, phonetics and aesthetics.
- Regenerative endodontic therapy can potentially revitalize the pulp of non-vital primary teeth and maintain primary dentition until natural exfoliation.

Introduction. Dental caries, the most common chronic disease among children, can lead to pulp necrosis and subsequent tooth loss if left untreated.[1,2] Premature exfoliation of deciduous teeth disrupts the proper eruption of permanent teeth and has adverse effects on space maintenance, feeding, speech and aesthetics.[3] In this context, treating and preserving necrotic primary teeth play a vital role in the oral health and development of children. It poses a greater challenge to clinicians when the necrotic primary tooth lacks a successor due to congenital hypodontia.

Hypodontia is defined as the congenital absence of one or more teeth, excluding the third molar.[4] Primary molars lacking a permanent successor are often preserved past the point of normal exfoliation until definitive prosthetic rehabilitation can be performed.[5]

This treatment protocol aims to prevent the previously mentioned outcomes associated with premature exfoliation or extraction. Unfortunately, the extended preservation of primary molars, coupled with their thin enamel, increases their vulnerability to dental caries. Additionally, their relatively large pulpal horns increase the likelihood of requiring pulp therapy due to necrosis.[6]

Abstract

Background. Primary teeth with necrotic pulp pose a significant challenge in pediatric dentistry, requiring effective treatment approaches to prevent adverse outcomes. While regenerative endodontic therapy, or RET, has shown promising results in revitalizing necrotic pulp in permanent teeth, its efficacy and clinical outcomes in primary teeth have been explored to a lesser degree.

Aim. This systematic review aims to synthesize evidence on the clinical and radiological outcomes of RET in primary teeth with necrotic pulp.

Design. The electronic databases PubMed, Google Scholar and Cochrane Library were used to explore the literature for pertinent studies, following the application of predetermined inclusion and exclusion criteria. Studies meeting both sets of criteria were incorporated into this systematic review and risk of bias analyses were performed.

(abstract continued on next page)

Currently, the most used nonvital pulp therapy for necrotic primary teeth is pulpectomy where the root canals are debrided, disinfected and filled with a resorbable material such as zinc oxide and eugenol, or ZOE; or calcium hydroxide and iodoform.[7] Resorbable materials accompany the deciduous molars root resorption and prevent interference with the eruption of the successive permanent tooth.[8,9] For primary teeth without permanent successors, the procedure remains largely similar, except non-resorbable filling materials such as gutta-percha and mineral trioxide aggregate, or MTA, are recommended.[10]

The primary objective of these materials is to preserve the tooth and prevent root resorption, ensuring the preservation of the alveolar bone. This is of utmost importance in case an implant becomes necessary in the future.[11] In both cases, a pulpectomy is the recommended procedure as it effectively disinfects and preserves the tooth. However, pulpectomies performed on primary molars have faced criticism for various reasons. The removal of the pulp not only renders the tooth prone to fractures and reinfections but also poses procedural challenges due to the complex internal anatomy of primary molar roots.[12]

Regenerative endodontic therapy, or RET, is an exciting field of endodontics that is designed to revitalize/revascularize teeth with necrotic pulp. The most current (2020) American Association of Endodontists' glossary of endodontic terms defines RET as a "biologically based procedures designed to physiologically replace damaged tooth structures, including dentin and root structures, as well as cells of the pulp-dentin complex."[13] RET is widely used for the treatment of necrotic immature permanent teeth and is quickly gaining traction as an alternative, biologically driven approach to conventional root canal treatment for necrotic mature permanent teeth.[14] In these teeth, RET has been shown to not only eliminate infection but also restore innate immune functions to the tooth undergoing treatment.[15]

While RET has been extensively studied in permanent teeth, investigations into the efficacy of RET for primary teeth are limited, and no systematic reviews summarizing available clinical studies have been identified. Evaluating the success of regenerative endodontics in primary teeth is paramount to guide clinical decision-making and improve treatment outcomes for pediatric patients. By harnessing the regenerative potential of the dental pulp, RET offers the potential to maintain primary teeth until their natural exfoliation and support proper oral development.

(abstract continued from previous page)

Results. Three studies that fulfilled the inclusion and exclusion criteria were included in this review. These studies investigated the use of RET in the management of non-vital primary teeth.

Conclusion. This review concluded that RET shows promising results in managing non-vital primary molars. However, more randomized clinical trials with longer follow-up periods are warranted. These studies should include standardized protocols and defined clinical and radiographic outcomes encompassing symptom resolution, bone healing and vitality.

Keywords. Regenerative endodontics, revascularization, necrotic primary teeth, non-vital pulp therapy

This systematic review aims to synthesize the available evidence to determine the clinical and radiological outcomes of RET in primary teeth with necrotic pulp. The findings of this review will contribute to the existing body of knowledge and provide insights for clinicians in making informed decisions regarding the management of non-vital primary teeth.

Methods

Search strategy. The search was conducted in the Cochrane Library, PubMed and Google Scholar databases. The electronic search strategy was developed by two independent researchers. Any disagreements were resolved by discussion. The search terms used for the Cochrane and PubMed database were *(Regenerative endodontic* OR revascularization OR revitalization) AND (necrotic OR non-vital) AND (primary OR deciduous OR child) AND (teeth OR tooth OR molar OR pulp).* The search terms used for the Google Scholar database were *("Regenerative endodontic*" OR revascularization OR revitalization) AND (necrotic OR non-vital) AND ("deciduous teeth" OR "deciduous tooth" OR "deciduous molar" OR "primary teeth" OR "primary tooth" OR "primary molar").* The last electronic search was performed on August 11, 2023.

Inclusion and exclusion criteria. Studies that met the following criteria were included in this systematic review: (1) Studies in which regenerative endodontic therapy was performed on children with primary non-vital teeth; (2) Randomized clinical trials, nonrandomized studies, case series, case reports cohort, case control and cross-sectional studies; and (3) English and non-English studies for which translations were available. There were no restrictions applied regarding publication dates.

Study selection. After implementing the stated search strategy, potential studies were compiled into EndNote 21.[16] Publish or Perish software was used to transfer studies from Google Scholar to EndNote.[17] Duplicated studies were removed, and the remaining studies were transferred to a master data sheet in Excel. The first screening was performed by reviewing the titles and abstracts. Articles that did not mention RET/revascularization/revitalization treatment or articles that mentioned RET/revascularization/revitalization treatment but only discussed treatment in permanent teeth were excluded. Articles that mentioned RET/revascularization/revitalization treatment but did not specify whether treatment was done on primary or permanent teeth were marked as eligible. The second screening was conducted by reviewing the full text of eligible articles to determine their compliance with the inclusion criteria.

Data extraction. Information regarding tooth characteristics and clinical protocol were extracted from each clinical study. The following information was extracted: number of teeth undergoing RET, whether permanent successors were present, irrigants and their concentrations, intracanal dressing and time inside the canal, formation of blood clots and filling material. Further information regarding the clinical and radiographic outcomes at the last follow-up visit for each study was also extracted. This information includes pain, mobility, response to vitality tests, resolution of radiolucencies and root resorption.

Assessment of methodological quality. As part of the data extraction process, the methodical quality of each study was assessed. This was done by using the revised Cochrane Risk of Bias Tool for randomized control trials, or RCTs, and a tool created by Dr. Murad, et al., for case reports and case series. Dr. Murad's tool utilizes concepts from the Pierson,[18] Bradford Hills[19] and Newcastle Ottawa Scale[20] approaches and assesses four primary domains: selection, ascertainment, causality and reporting.[21]

Results

Study selection. Two thousand, four hundred fifteen potentially relevant studies were obtained through an electronic search of the Cochrane, PubMed and Google Scholar databases. Ninety-six duplicate studies and 2,301 unrelated studies were removed after reviewing the titles and abstracts. The full text of the remaining 18 studies was assessed and 15 studies that did not comply with the inclusion criteria were discarded. The remaining three studies were included in the review (Figure 1).

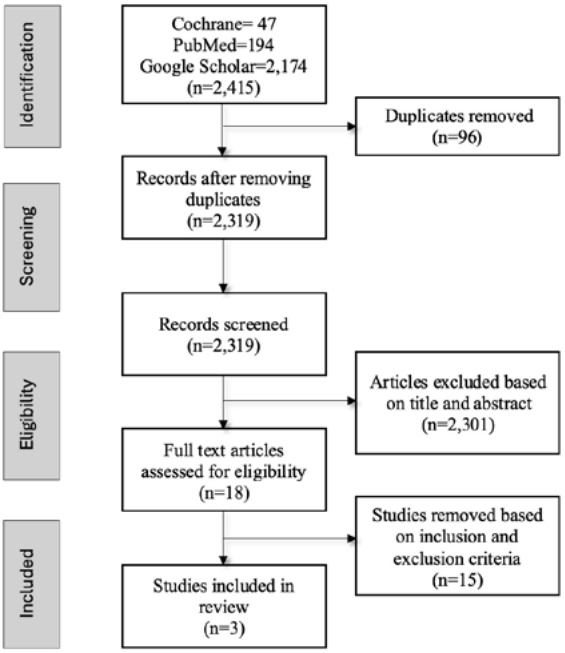


Figure 1. Flowchart of the study selection process according to the PRISMA statement.

Study design. Two studies were case series, and one study was an RCT. Both case series solely performed the experimental RET treatment while the RCT had three treatment groups: one control group in which standard zinc oxide eugenol, or ZOE, pulpectomy was performed and two experimental RET groups that differed in the type of intracanal medicament used. In total, 80 primary teeth were treated with RET, of which only four were missing a permanent successor. The age range of the patients was 4 to 11 years old. All patients were diagnosed with pulp necrosis based on clinical and radiographic findings. No patients exhibited root resorption at baseline.

Although all studies reported clinical and radiographic outcomes at each follow-up, the follow-up timeline varied between studies. Two studies conducted follow-up visits at six and 12 months while one study conducted visits at three, six, 12 and 18 months post-treatment.

Quality analysis of included studies. The RCT was determined to have an overall low risk of bias, whereas both case series demonstrated an overall medium risk of bias. The RCT only showed some concerns for bias in the Measurement of Outcome category of the Cochrane Risk of Bias assessment and showed low risk in all other categories. Both case series demonstrated high risks of bias in Ascertainment and Causality, while Selection and Reporting were low risk. Figures 2 and 3 show the risk of biased summaries for each study.

Primary outcomes. Table 1 shows the characteristics and clinical protocol of the included studies. All studies used sodium hypochlorite, or NaOCl, as a root canal irrigant in varying concentrations ranging from 1.25% to 5.25%. Both case series used a triple antibiotic paste, or TAP, for the intracanal dressing, although the exact mixture of the TAP varied between the two studies. The RCT used another variation of a TAP in one experimental group and Metapextm in the other. The application time varied from two to four weeks. At the second appointment, one case series reported using NaOCl (1.25%), saline and EDTA (17%) as the irrigant. The other case series reported only using NaOCl at an unspecified concentration. For the RCT, EDTA (17%) was used in both experimental groups. Lastly, the formation of a blood clot and the use of MTA as a filling material was utilized in both case series and in both experimental groups of the RCT.

Table 2 includes the clinical and radiographic outcomes at the last follow-up visit for each study included in this review. A total of four teeth were lost to follow-up between the various studies, leaving a remainder of 76 teeth to be assessed. Of the 44 teeth reported in the two reports of case series, all teeth remained symptoms free at the last follow-up. Ulusoy, et al., case series performed an Endo-Ice cold test in which four out of four teeth responded positively. The second case series and the RCT did not report preforming this test. The RCT indicated clinical success rates of 88.9% for the ZOE pulpectomy group, 77.8% for the TAP group, and 83.3% for the Metapextm RET group, with no statistically significant difference.

Both case series saw the resolution of radiolucencies in 100% of treated teeth, while the RCT recorded 88.2%, 64.7% and 86.7% resolution in the ZOE pulpectomy, TAP and Metapextm RET groups, respectively. The RCT reported no statistically significant difference in radiologic success

Figure 2. Risk of bias summary for included RCTs.

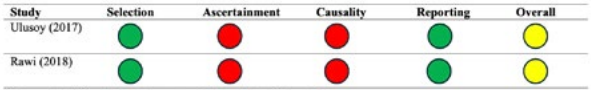


Figure 3. Risk of bias summary for included case series.

Legend for figures 2 and 3.

Table 1. Characteristics and Clinical Protocol of Included Studies

Authors	Number of teeth	Missing permanent successor	Irrigant 1st session (Conc.)	Intracanal dressing (time)	Irrigant 2nd session (Conc.)	Blood clot formed	Filling material
Ulusoy et al (2017)	4	Yes	NaOCl (1.25%)	TAP[1] (3 weeks)	NaOCl (1.25%), Saline, EDTA (17%)	Yes	MTA
Rawi (2018)	40	NR	NaOCl (5.25%)	TAP[2] (4 weeks)	NaOCl (NR)	Yes	MTA
Abdelmoneim et al (2023)	A. 18	NR	NaOCl (1.5%)	TAP[3] (2 weeks)	EDTA (17%)	Yes	MTA
	B. 18	NR	NaOCl (1.5%)	Metapex[tm] (2 weeks)	EDTA (17%)	Yes	MTA

TAP[1]: Clindamycin, ciprofloxacin, and metronidazole. TAP[2]: Minocycline, ciprofloxacin, and metronidazole. TAP[3]: Amoxicillin, ciprofloxacin, and metronidazole. Metapex[tm]: Calcium Hydroxide with Iodoform. NR: Not recorded. A: Experimental group treated with TAP[3]. B: Experimental group treated with Metapex[tm].

Table 1. Characteristics and clinical protocol of included studies.

Table 2. Clinical and Radiographic Outcomes of Included Studies at Last Follow-up

Authors	Number of teeth	Pain	Pathological mobility	Endo-Ice cold test response	Resolution of radiolucencies	Root resorption
Ulusoy et al (2017)	4	0/4 (0%)	0/4 (0%)	Yes	4/4 (100%)	NR
Rawi (2018)	40	0/40 (0%)	0/40 (0%)	NR	40/40 (100%)	0/40 (0%)
Abdelmoneim et al (2023)	A. 17	1/17 (5.9%)	1/17 (5.9%)	NR	11/17 (64.7%)	8/17 (47%)
	B. 15	0/15 (0%)	0/15 (0%)	NR	13/15 (86.7)	3/15 (20%)

A: Experimental group treated with TAP[3]. B: Experimental group treated with Metapex[tm].

Table 2. clinical and radiographic outcomes of included studies last follow-up.

between the three groups. The total resolution of radiolucencies of RET-treated teeth between all studies was 89.5%. Root resorption was not recorded in one of the case series and was seen in 0% of teeth for the other. The RCT reported that 47% of teeth treated with TAP developed root resorption compared to 20% of those treated with Metapextm.

Discussion. This systematic review aimed to comprehensively assess the applicability and effectiveness of regenerative endodontic therapy, or RET, as an alternative treatment for non-vital primary molars. The reviewed studies collectively shed light on the clinical and radiographic success of RET while highlighting various aspects that warrant further investigation. The American Association of Endodontics, or AAE, provides a framework for evaluating RET success, emphasizing the elimination of symptoms, promotion of bone healing, improvements in root wall thickness/root length and positive vitality testing.[22] However, in the case of primary molars with or without permanent successors, as root development is typically completed before endodontic treatment, it is unlikely to observe any gain in root wall thickness/root length. Across the reviewed studies, resolution of symptoms and alveolar bone healing as specified by the AAE were consistently observed, demonstrating the potential of RET to alleviate discomfort and restore oral health.

All studies included in this review recorded patient symptoms at baseline and during subsequent follow-up visits. The findings from this review indicate that the resolution of clinical symptoms, including overall pain and pathological mobility, was achieved for the majority of patients across all studies. It is worth noting that the comprehensive documentation of additional symptoms, such as precise pain upon percussion or palpation and the presence of abscesses, was only reported in one of the three studies. Nevertheless, the significant reduction in reported pain and pathological mobility underscores the positive impact of RET on patient well-being.

Radiographically, the reduction in radiolucencies indicated successful control of inflammation or infection, although the lack of bone density assessment posed a limitation in directly assessing bone healing. While the reduction in radiolucencies is a promising sign, it would be valuable for future studies to incorporate bone density assessment to provide a more comprehensive understanding of the healing process and its impact on the surrounding bone structure. This would further enhance the validity of the radiographic success outcomes in evaluating RET efficacy.

Vitality testing, an essential indicator of treatment success, was reported in only one study, revealing positive responses among all RET-treated patients. Another study reported that vitality testing was not conducted because stainless steel crowns were used to achieve an optimal coronal seal. The remaining study did not discuss why vitality testing was not reported. It is possible that because vitality is considered the third aim of RET, assessing vitality was deemed unnecessary. However, the inclusion of vitality testing in a larger number of studies would provide more comprehensive insight into the regenerative capacity of RET and its effect on restoring tooth vitality.

While not explicitly stated as a goal of RET, two out of the three studies documented the presence of root resorption, an outcome crucial for evaluating the longevity of treated teeth.

Assessing root resorption after RET in primary teeth may be necessary in determining treatment success as the experimental use of RET of primary teeth is performed largely in order to retain teeth at least until natural exfoliation. Both studies reporting on root resorption exhibited contradictory findings likely due to variations in procedures and treatment approaches. The varied results in root resorption rates highlight the need for standardized protocols in RET, including clear guidelines for intracanal medication concentrations and treatment periods.

Standardization would not only enhance treatment consistency but also facilitate more accurate comparison of outcomes across studies. It is also crucial to document the timing of exfoliation with extended follow-up periods.

The majority of studies examined in this review consisted of a case series, a study design that lacks control groups and is susceptible to publication bias. As a result, these studies necessitate cautious interpretation of their findings. The included randomized controlled trial, however, displayed a lower risk of bias and offers more robust evidence, contributing to the overall credibility of the review. The incorporation of further randomized controlled trials in future research endeavors would be instrumental in solidifying the evidence base for RET effectiveness.

Furthermore, the importance of incorporating long-term follow-ups within these studies cannot be understated, as they provide insights into the durability of RET outcomes and the potential impact on successor teeth.

Conclusion. RET presents a promising avenue for preserving the functionality and integrity of non-vital primary molars, providing an alternative to extraction or traditional pulpectomy. However, the current body of evidence underscores the necessity for further research, particularly long-term randomized controlled trials exploring various protocol variations and reporting comprehensive outcomes related to symptom resolution, bone healing and vitality. Only through continued investigation and rigorous study can RET in non-vital primary teeth achieve a well-defined and recommended status within pediatric dentistry practice.

The findings of this systematic review serve as a foundation for future research directions and clinical applications, ultimately advancing the understanding and practice of RET in the management of non-vital primary molars.

References

1. U.S. Department of Health and Human Services. Oral Health in America: A Report of the Surgeon General. 2000.

2. Coll JA, Vargas K, Marghalani AA, et al. A Systematic Review and Meta-Analysis of Nonvital Pulp Therapy for Primary Teeth. Pediatric Dentistry. 2020;42(4):256-461.

3. Vittoba Setty J, Srinivasan I. Knowledge and Awareness of Primary Teeth and Their Importance Among Parents in Bengaluru City, India. Int J Clin Pediatr Dent. 2016;9(1):56-61. doi:10.5005/jp-journals-10005-1334

4. Zhu JF, Marcushamer M, King DL, Henry RJ. Supernumerary and Congenitally Absent Teeth: A Literature Review. The Journal of Clinical Pediatric Dentistry. 1996;20(2):87-95.

5. Ulusoy AT, Cehreli ZC. Regenerative Endodontic Treatment of Necrotic Primary Molars with Missing Premolars: A Case Series. Pediatric Dentistry. 2017;39(3):131-134.

6. Hobkirk JA, Gill DS, Jones SP, et al. Hypodontia: A Team Approach to Management. John Wiley & Sons; 2010.

7. Coll JA, Dhar V, Vargas K, et al. Use of Non-Vital Pulp Therapies in Primary Teeth. Pediatric Dentistry. 2020;42(5):337-349.

8. Subramaniam P, Gilhotra K. Endoflas, Zinc Oxide Eugenol and Metapex as Root Canal Filling Materials in Primary Molars: A Comparative Clinical Study. The Journal of Clinical Pediatric Dentistry. 2011;35(4):365–369. doi:https://doi.org/10.17796/jcpd.35.4.1377v06621143233

9. Silva Junior MF, Wambier LM, Gevert MV, Chibinski ACR. Effectiveness of Iodoform-Based Filling Materials in Root Canal Treatment of Deciduous Teeth: A Systematic Review and Meta-Analysis. Biomaterial Investigations in Dentistry. 2022;9(1):52-74. doi:10.1080/26415275.2022.2060232.

10. Jeevanandan G. Obturation of a Retained Primary Maxillary Second Molar Using Biodentine: A Case Report. Journal of Clinical and Diagnostic Research. 2017;11(1):ZD34–ZD36. doi:https://doi.org/10.7860/JCDR/2017/23966.9218.

11. Bezgin T, Ozgul BM, Arikan V, Sari S. Root Canal Filling in Primary Molars Without Successors: Mineral Trioxide Aggregate Versus Gutta-percha/AH-Plus. Australian Endodontic Journal. 2016;42(2):73-81. doi:10.1111/aej.12132.

12. He L, Kim SG, Gong Q, et al. Regenerative Endodontics for Adult Patients. Journal of Endodontics. 2017;43(9):S57-S64. doi:https://doi.org/10.1016/j.joen.2017.06.012.

13. Glossary of Endodontic Terms. Vol. 8th edition [internet]. 2012. Available from: https://www.aae.org/specialty/clinical-resources/glossary-endodontic-terms.

14. Anegundi R, Kavya K, Tavargeri A, Trasad V, Patil S. Scope of Revascularisation in Pediatric Dentistry. International Journal of Oral Health and Medical Research. 2019;6(2):47-50.

15. Abdelmoneim DD, Abdelaziz AM, Allam GG, Badran AS. A One-year Clinical and Radiographic Assessment of Regenerative Endodontic Therapy for Necrotic Primary Molars: A Randomized controlled Trial. Int J Clin Pediatr Dent. 2023;16(2):295-301. doi:10.5005/jp-journals-10005-2536.

16. EndNote. Version EndNote 21. Clarivate; 2013.

17. Harzing AW. Publish or Perish. https://harzing.com/resources/publish-or-perish.

18. Pierson D. How to Read a Case Report (or Teaching Case of the Month). Respir Care. 2009;54:1372-1378.

19. Hills A. The Environment and Disease: Association or Causation? Proc R Soc Med. 1965;58:295-300.

20. Wells G, Shea B, O'Connell D, et al. The Newcastle-Ottawa Scale (NOS) for Assessing the Quality of Nonrandomized Studies in Meta-Analysis. The Ottawa Health Research Institute; 2011.

21. Murad M, Sultan S, Haffar S, et al. Methodological Quality and Synthesis of Case Series and Case Reports. BMJ Evidence-Based Medicine. 2018;23:60-63.

22. American Association of Endodontists. AAE Clinical Considerations for a Regenerative Procedure. https://www.aae.org/specialty/wp-content/uploads/sites/2/2017/06/currentregenerativeendodonticconsiderations.pdf.

VOLUME 3 | ISSUE 1 | WINTER 2025

Instructions for Authors | Call for Consideration

We are currently accepting manuscripts for future editions of the OHSU School of Dentistry Anthology. Each edition is based on a specific theme and manuscripts are grouped accordingly.

Consider the following before submitting your work

- Are you the sole author of the work? Do you have permission from co-authors to submit the work?
- If you are considering publishing the same or a similar manuscript in a peer-reviewed journal or another format, then you and co-authors are responsible for verifying the policies around sharing work in an institutional repository. The Publishing and Data Services team in the OHSU library can assist you.
- If your work was created as part of your duties at OHSU and might be of commercial value, contact OHSU Technology Transfer before submitting to the School of Dentistry Anthology. Review OHSU's policies about intellectual property for more information.

Student posters

For specifications and timelines, contact Samyia Chaudhry, D.M.D., assistant professor for restorative dentistry, at chaudhry@ohsu.edu.

Manuscript submittals

OHSU Digital Collections instructions

Important | Include in the Notes field of the submission form that your entry is for School ofDentistry Anthology

Manuscript preparation

Technical specifications

Manuscripts submitted to the School of Dentistry Anthology must be prepared in Microsoft Word.

Length

Word limits are dependent on the article type, exclusive of title page, abstract, acknowledgments, references and illustrations (tables, figures, text boxes).

Page setup

Pages should have 1-inch margins and must be numbered consecutively throughout the document.

Title page

Each manuscript should have a title page. The title page must include:

- The complete title of the manuscript and complete information for all authors.
- Each author's first and last name, degrees, professional title and work affiliations including position.
- Acknowledgments, if applicable.

Tables and figures

- Tables and figures should augment, not repeat, the text or broad trends illustrated in a figure.
- Figures and tables should be numbered consecutively according to the order in which they are cited in the text.

Tables

- Variables are to be clearly defined and include the unit of measurement and values for any categories.
- Tables are to use units and phrasing consistent with the manuscript's text.
- Abbreviations are to be defined in table footnotes. Unit of measure abbreviations do not need to be defined.
- Row and column headings are to contain any necessary units of measure that apply to data in the row or column. Measurement abbreviations should conform to the journal's style.

Figures

- Each chart, graph or photograph will be counted as a separate illustration.
- Do all figures have an accompanying legend that describes the content and explains any abbreviations or symbols? Include your figure legends as a separate section in your main text file.
- Are all figures cited in the main text of your article? Ensure all figures are numbered in the order in which they appear.
- Remove any unnecessary white space around figures to reduce the file size.
- The School of Dentistry Anthology accepts digital files (see **Formats** below) of radiographs, magnetic resonance images and magnetic resonance.
- Are all figure files named with their appropriate figure number? Use only the figure number in the file name, such as Figure_1.eps
- Images are to obscure any feature that can identify the patient, including unique physical characteristics, files labeled with patient names or other identifiers.

General points for figures

- Use uniform lettering and sizing in original artwork.
- Use a preferred font: Arial, Helvetica, Times New Roman, Times or Courier.
- Submit individual figure files larger than 10 MB separately.
- Include figure legends at the end of the manuscript file, not on the figure.

Formats for line art and images

Regardless of the application used to create figures, the final artwork should be saved as or converted to one of these formats:

For line art figures. Includes graphs, flowcharts, diagrams, bitmapped line drawings, scatter plots and other text-based figures that are not tables. **Important**: If a figure includes both line art and images, follow guidelines for line art.

- .EPS or PDF. When in doubt, submit a PDF.
- Resolution: 600 - 1000 dpi
- Separate, original files in their original file format are best.

Images. Includes photographs, drawings, imaging system outputs, like MRIs or ultrasounds, and similar graphical representations

- .EPS, .TIFF, .AI, PDF. When in doubt, submit a PDF.
- Resolution and color: Color or grayscale photographs (halftones). Minimum of 300 dpi
- Size: At least 80mm canvas size or 1800 pixels wide.
- Separate, original files in their original file format are best.

Please

- Do not supply files that are optimized for screen use (e.g., GIF, BMP, PICT, WPG).
- Do not supply files that are too low in resolution.
- Do not submit graphics that are disproportionately large for the content.

Supplemental data

This material should be submitted with each submission of the manuscript (original and revisions) to permit full review.

Manuscript style

Basic style/writing requirements

The School of Dentistry Anthology style is based on the 11th edition of the AMA Manual of Style. The purpose of any piece of writing is to deliver information. This requires authors to define their message and present it in a way that is readily understood by and engages the reader. Manuscripts should be written in active voice using declarative sentences for a clear, concise style. The overall tone of these reports should be factual and professional, and thus suitable for a scholarly journal. Authors are allowed to express a personal opinion as long as the basis for that opinion is stated plainly. For example, authors may express an opinion “based on long experience and intensive observation.” Other statements of opinion and all statements of fact require references from the appropriate published literature (dental, medical, epidemiologic, practice management, etc.).

Manuscript title

The title should be brief while clearly conveying the main point or purpose of the article. Short subheads also should be used throughout the article to highlight key points. All submissions, including titles and subheads, are subject to change during the editing process.

Statistical methods reporting

Research manuscripts should include an a priori calculation of the sample size necessary to discern a minimally detectable and clinically meaningful effect and include a description of the methods used for primary and secondary analyses. A pre-specified analysis plan is preferred. Interpretation of observational studies should arise from the results of multivariable models or other methods controlling for potential confounding effect modification and dependencies in the data. Interpretation of data from a randomized clinical trial should arise from the primary outcome measure, as analyzed in the pre-specified statistical analysis plan.

References

All published references should be cited in the text and numbered consecutively in the order in which they are referenced in the text. No references should be cited in the abstract. Each reference should be numbered only once; on subsequent citations, the original number should be used. Personal communications and unpublished data should not be numbered, but should be cited in the text as follows:

(O SoDA, D.M.D., oral communication, November 2023)

Text. Indicate references by (consecutive) superscript Arabic numerals in the order in which they appear in the text. The numerals are to be used outside periods and commas and inside colons and semicolons. For further detail and examples, refer to the AMA Manual of Style, A Guide for Authors and Editors, Eleventh Edition, ISBN 978-0190246556.

Examples

Reference to a journal publication:
1. Van der Geer J, Hanraads JAJ, Lupton RA. The art of writing a scientific article. *J Sci Commun*. 2010;163(1):51-59. https://doi.org/10.1016/j.Sc.2010.00372

Reference to a journal publication with an article number:
2. Van der Geer J, Hanraads JAJ, Lupton RA. The art of writing a scientific article. *Heliyon*. 2018;19:e00205. https://doi.org/10.1016/j.heliyon.2018.e00205

Reference to a book:
3. Strunk W Jr, White EB. *The Elements of Style*. 4th ed. Longman; 2000.

Reference to a chapter in an edited book:
4. Mettam GR, Adams LB. How to prepare an electronic version of your article. In: Jones BS, Smith RZ, eds. *Introduction to the Electronic Age*. E-Publishing; 2009:281-304.

Reference to a website:
5. Zika travel information. Centers for Disease Control and Prevention. January 26, 2016. Updated August 11, 2016. Accessed June 18, 2019. https://wwwnc.cdc.gov/travel/page/zika-travel-information

Reference to software:
7. Coon E, Berndt M, Jan A, et al. Advanced Terrestrial Simulator (ATS) v0.88 (Version 0.88). Zenodo; 2020, March 25. https://doi.org/10.5281/zenodo.3727209

Journal abbreviations source

Journal names should be abbreviated according to the List of Title Word Abbreviations.

Data References

The School of Dentistry Anthology encourages authors to cite underlying or relevant data sets in the text and include a data reference in the reference list. Data references should include author names, data set title, data repository, version (where available), year and global persistent identifier. Add "[data set]" immediately before the reference so we can properly identify it as a data reference. The [data set] identifier will not appear in the published article.

Example

[data set] 5. Oguro, M, Imahiro, S, Saito, S, Nakashizuka, T. Mortality data for Japanese oak wilt disease and surrounding forest compositions, Mendeley Data, v1; 2015. http://dx.doi.org/10.17632/xwj98nb39r.1

Author responsibilities

Ethical approval of studies and informed consent/assent

The School of Dentistry Anthology requires that all manuscripts reporting data from studies involving human participants, human specimens, animals or animal specimens include a description (blinded in the Methods section and in full detail on the separate title page) of formal review and approval or, if appropriate, formal review and waiver by an appropriate institutional review board or ethics committee. Authors may be asked to request that the institutional review board or ethics committee responsible for oversight of the study provide, directly to the editor, documentation of its formal review and recommendation. For investigations involving human participants, authors must state in the Methods section that study participants provided informed consent/assent.

Personal communications and unpublished data

The School of Dentistry Anthology requires authors to obtain permission from each person identified in the manuscript as a source of information in a personal communication or as a source for unpublished data. By submitting a manuscript, authors represent and warrant to the School of Dentistry Anthology that such permission has been obtained, if applicable. The anthology recommends that such permissions be in writing and that authors maintain the signed statements in their records for a reasonable period after publication of the article in the anthology. Authors must specify in the manuscript the date of the communication or the data, as well as whether the communication was written or oral.

Author contributions

All authors are to have made substantial contributions to:

- Conceptions and designs of the study, acquisition of data or analysis and interpretation of data.
- Drafting the article or revising it critically for important intellectual content.
- Final approval of the version that is submitted.

All authors should be listed with their affiliations including positions, their academic degrees and their scientific or clinical contributions to the article. The editor and publisher reserve the right to ask for justification for each author's inclusion.

Practical implications

Authors must ensure that the article describes the practical implications of the findings, answering the question, "What does this mean for oral health care?" This should be included in the abstract.

Use and declaration of AI and AI-assisted technologies

Where authors use artificial intelligence (AI) and AI-assisted technologies in the writing process, they should:

- Only use these technologies to improve readability and language, not to replace key researcher tasks, such as interpreting data or drawing scientific conclusions.
- Apply the technology with human oversight and control, and carefully review and edit the result, as AI can generate authoritative-sounding output that can be incorrect, incomplete or biased.
- Not list AI and AI-assisted technologies as an author or co-author, or cite AI as an author. Authorship implies responsibilities and tasks that can only be attributed to and performed by humans in Elsevier's AI policy for authors.
- Disclose in their manuscript the use of AI and AI-assisted technologies in the writing process by following the instructions below. A statement will appear in the published work. Authors are ultimately responsible and accountable for the contents of the work.

Disclosure instructions

Authors must disclose the use of AI and AI-assisted technologies in the writing process by adding a statement at the end of their manuscript in a new section titled "Declaration of AI and AI-assisted technologies in the writing process." *Statement: During the preparation of this work the author(s) used [NAME TOOL / SERVICE] in order to [REASON]. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.*

NOTE: *This declaration does not apply to the use of basic tools for checking grammar, spelling, references, etc. If there is nothing to disclose, there is no need to add a statement.*
