IN VITRO STUDY

Comparative Evaluation of ScholarGPT and ChatGPT-4 Omni in Pediatric Dentistry: Accuracy and Completeness Analysis

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Abstract: ***Purpose:*** *Evaluate and compare the accuracy and completeness of responses provided by ScholarGPT and ChatGPT-4 Omni (ChatGPT-4o) to clinical questions in pediatric dentistry.* ***Methods:*** *Thirty clinical questions across six clinical topics were developed. Responses were collected from ScholarGPT and ChatGPT-4o and independently evaluated by six experienced pediatric dentists. The evaluators used a five-point Likert scale for accuracy and three-point scale for completeness. Accuracy was rated for factual correctness, relevance, and coherence, while completeness reflected how fully the response addressed the question. Statistical analysis was performed using non-parametric tests, including the Wilcoxon signed-rank and Kruskal-Wallis tests.* ***Results:*** *ScholarGPT received significantly higher median accuracy scores (five, interquartile range [IQR] equals zero) compared to ChatGPT-4o (four, IQR equals one) across all topics (P<0.001). In completeness scores, ScholarGPT (three, IQR equals one) also outperformed ChatGPT-4o (two, IQR equals zero; P<0.001). ScholarGPT showed the highest accuracy in the "fissure sealants" (five, IQR equals zero), while the lowest was observed in "development of dentition and occlusion" (five, IQR equals one). ChatGPT-4o yielded the lowest accuracy in "development of dentition and occlusion" (four, IQR equals two) and the highest in "fluoride" (four, IQR equals one). Accuracy scores varied significantly across topics for both ChatGPT-4o (P=0.012) and ScholarGPT (P=0.001). However, differences in completeness across topics were observed only for ScholarGPT (P=0.008).* ***Conclusions:*** *ScholarGPT provided more accurate and complete responses to pediatric dentistry questions than ChatGPT-4o, suggesting that domain-specific artificial intelligence tools can aid dental education and clinical support, though further refinement is needed.* *(Pediatr Dent 2025;47(6):408-15.E129-E161) Received January 13, 2025 | Last Revision July 21, 2025 | Accepted July 23, 2025*

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Recent advancements in artificial intelligence (**AI**), particularly in natural language processing (**NLP**), have led to the development of sophisticated large language models (**LLMs**) capable of generating human-like text and engaging in complex problem-solving tasks.[1,2] Among these innovations, OpenAI's (San Francisco, Calif., USA) Generative Pre-trained Transformer (**GPT**) models—most notably ChatGPT—have emerged as a leading example, demonstrating exceptional capabilities in language comprehension and generation.[3] These models have significantly enhanced language processing and are now widely used in education, research, and customer service.[4] Additionally, Google's Gemini and Meta's Large Language Model Meta AI (**LLaMA**) series—including LLaMA 1 and LLaMA 2—have become prominent among LLM-based chatbots. LLaMA 2, in particular, has gained popularity due to its open-access policy and scalability, making it widely adopted by diverse user groups.[5] These models facilitate more natural interactions with users, simplifying access to information, and are reshaping digital communication.[6] Today, they are used across a broad spectrum of applications, from personal assistant services to corporate processes.[7,8]

During the coronavirus disease 2019 pandemic, LLMs use in health care accelerated significantly. The increased burden on health care systems accelerated the adoption of LLM-based tools in telemedicine, symptom triage, patient education, and decision support for health care professionals.[9,10] Chatbots were effectively utilized for essential functions, such as symptom monitoring, health education, and providing drug information.[11] The adoption of AI in this domain progressed rapidly, particularly in responding to patient inquiries and offering technical guidance to health care professionals.[12,13]

In dentistry, LLMs are increasingly being explored for their potential to respond to clinical inquiries, assist health care professionals with evidence-based recommendations, and support dental education. Recent studies have evaluated the reliability of AI-generated responses in various medical and dental fields. For example, LLM-based chatbots have been tested for their ability to diagnose oral lesions, provide orthodontic treatment recommendations, and assess risk factors for periodontal diseases.[3,14,15] Similarly, other studies have investigated the accuracy of responses provided by LLM-based chatbots to patient- and parent-oriented questions in pediatric dentistry, including topics such as dental trauma, fluoride, and tooth eruption.[16] Additionally, research has examined the reliability of AI-generated answers to common questions frequently asked by mothers about their children's oral health.[17]

While these applications show potential, certain limitations remain. These models show promise in processing vast amounts of medical literature and generating coherent responses, yet concerns remain regarding their accuracy, bias, and clinical applicability. In particular, their performance in specialized areas

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like pediatric dentistry remains underexplored and uncertain. Understanding how these LLM-based chatbots perform in such domains is essential for evaluating their practical use and limitations.

To help address these gaps, tools such as ScholarGPT (OpenAI) have emerged. ScholarGPT is an AI application based on LLM technology, specifically designed to support academic research and educational processes.[18] Launched in 2023, ScholarGPT facilitates literature searches, generates article summaries, and accelerates academic writing workflows.[19] One of ScholarGPT's most distinctive features is its ability to provide responses with academically accurate language and specific references, setting it apart from general-purpose chatbots such as ChatGPT.[19,20] ScholarGPT can access information from open-access articles and platforms.[18] However, for subscription-based content, users must integrate university proxies or individual subscriptions to enable access. If such access is not available, the platform directs users to suitable open-access alternatives.[19] ScholarGPT may offer meaningful support in clinical decision-making, educational content development, and the dissemination of evidence-based information.[18] Access to accurate, reliable, and up-to-date scientific knowledge is essential for both health care professionals and the general public.[21] In the context of pediatric dentistry, clinicians frequently rely on evidence-based resources to guide diagnosis and treatment decisions, while non-professionals, including parents, seek trustworthy information regarding their children's oral health.[22] ScholarGPT can serve as an efficient tool in bridging this gap by facilitating rapid access to validated knowledge, assisting practitioners in formulating clinical decisions, and enhancing patient education through clear and scientifically grounded explanations.

While LLM-based chatbots are increasingly used in health care, their reliability in pediatric dentistry remains uncertain. This study aims to address this gap by evaluating the performance of these chatbots in providing evidence-based clinical information in response to pediatric dentistry-related questions. The primary objective was to compare the accuracy and completeness of responses provided by ChatGPT-4 Omni (ChatGPT-4o) and ScholarGPT to clinical questions in pediatric dentistry. The secondary objective was to analyze the variation in accuracy across different topics within each chatbot. The null hypothesis stated that there would be no significant difference between ScholarGPT and ChatGPT-4o in terms of accuracy and completeness when responding to pediatric dentistry-related clinical questions.

Methods

This study did not involve human or animal subjects; therefore, ethical review and approval were not required. It is a comparative performance evaluation assessing the accuracy and completeness of responses provided by ChatGPT-4o and ScholarGPT to clinical questions in pediatric dentistry. To achieve this, a structured framework was established involving academic pediatric dentists in both the development and evaluation of the questions. The planning, execution, and reporting of this study were guided by the AI research checklist proposed by Schwendicke et al.,[23] which outlines best practices for transparency, reproducibility, and evaluation in AI studies within dentistry.

Question development and content. Between April 12 and April 15, 2024, the principal investigators conducted a comprehensive review of open-access pediatric dentistry questions available on the official website of the National Dentistry Specialization Exam, administered by the Student Selection and Placement Center in Türkiye. Additionally, 10 academic pediatric dentists, each affiliated with a different university and registered with the Council of Higher Education, were contacted via email. These experts were informed about the study and asked to submit 30 frequently used questions from their teaching materials and exam preparations for both undergraduate and postgraduate students. Responses were collected over a defined period, from May 1 to May 11, 2024. The collected questions, along with those obtained from the National Dentistry Specialization Exam review, were thoroughly analyzed and categorized by two experienced pediatric dentists with at least 10 years of academic experience to ensure validity and relevance. The categorization followed common classification systems used in pediatric dentistry curricula and clinical guidelines, prioritizing frequently tested and clinically significant topics. The final classification included six thematic topics: fissure sealants, fluoride, early childhood caries, oral hygiene practices, development of dentition and occlusion, and pulpal therapy. No formal pilot testing was conducted; however, question appropriateness was ensured through expert consensus and alignment with national exam content and academic curricula. Five representative questions were selected from each topic, yielding a total of 30 clinical questions for the study. The selected questions under each topic are as follows:

1. *Fissure sealants*
   a. What are the types of fissure sealants?
   b. What is the content of resin fissure sealants?
   c. What are the indications of glass ionomer fissure sealants?
   d. What are the reasons for failure in fissure sealants?
   e. To what extent do fissure sealants reduce the risk of dental caries formation?
2. *Fluoride*
   a. What should be the optimal amount of fluoride in drinking water?
   b. What are the treatment options for dental fluorosis?
   c. How to apply fluoride gel?
   d. What is acute fluoride toxicity?
   e. What is chronic fluoride toxicity?
3. *Early childhood caries*
   a. What are the microorganisms responsible for early childhood caries?
   b. What is the window of infectivity associated with early childhood caries?
   c. What are the treatment options for early childhood caries?
   d. Is it possible for microorganisms that cause dental caries to be transmitted from mother to child?
   e. What are demineralization and remineralization?
4. *Oral hygiene practices*
   a. Which is the most effective toothbrushing technique for children?
   b. What are the characteristics of healthy gums in the primary dentition?
   c. What are the causes of gingival bleeding in adolescents?
   d. What are the beneficial foods for maintaining oral health?
   e. What are Nasymth membrane stains?
5. *Development of dentition and occlusion*
   a. What is the ugly-duckling period?
   b. What are the treatment methods for long-term thumb-sucking?
   c. What is Leeway space?

d. What are the types of primary dentition occlusal relationships?
e. What factors are involved in the etiology of bruxism in children?

6. *Pulpal therapy*
a. What are the obturation materials and techniques for primary tooth root canal treatment?
b. What are the materials used in primary tooth pulpotomy?
c. What are the indications for regenerative endodontic treatment?
d. What is lesion sterilization tissue repair?
e. In what cases is Cvek pulpotomy applied?

Response collection. To minimize potential biases related to search algorithms, a new email account was created specifically to access ChatGPT-4o and ScholarGPT through Google's search engine using the "continue with Google" login option. Prior to initiating the question-and-answer session, all browsing history and cookies were cleared from the computer. This was accomplished by selecting the "clear browsing data" option under the "privacy and security" section in the browser's "settings" menu. The checkboxes for "cached images and files," "cookies and other site data," and "browsing history" were selected, with the "time range" set to correspond with the study period. The data were subsequently cleared. Each question was entered as an independent prompt, with no prior context or memory of previous interactions. No persona prompts or pre-conditioning statements were used; both LLM-based chatbots were queried in their default mode to ensure unbiased and generalizable results. The questions were designed to reflect clinical content in pediatric dentistry. Responses were expected to demonstrate scientific accuracy and completeness consistent with professional-level communication. Although no role-based prompting (e.g., "act as a pediatric dentist") was used, this approach was chosen to evaluate baseline model performance in default mode, reflecting typical user behavior. ChatGPT-4o was accessed via the standard interface (*chat.openai.com*) in default mode, with browsing, plugins, and custom instructions disabled. ScholarGPT was accessed through its academic interface in default mode, without enabling personalized filters or advanced prompt settings. ChatGPT-4o was accessed at 11:00 a.m. on July 8, 2024, from Istanbul, Türkiye, and responses to all questions were systematically recorded. The same procedure was repeated for ScholarGPT at noon on the same day. All questions were posed in English, and the responses were documented in English to maintain consistency and eliminate language-based variability. The questions were entered by one of the study's principal investigators.

Response evaluation. LLM-based chatbots can sometimes produce inaccurate or irrelevant information or references, a phenomenon commonly referred to as "hallucination." To minimize this risk in the present study, all questions and responses were independently reviewed by the two researchers conducting the study, with a one-week interval between assessments. Only after confirming by consensus that no false information was present were the responses submitted for evaluation. The responses were evaluated by six academic pediatric dentists, each with a minimum of eight years of experience, who also served as the reference standard. The evaluators were first informed about the study via phone calls and then received the evaluation materials by email. These materials included the chatbot-generated responses and a Microsoft Excel-based evaluation form designed for structured scoring. To reduce potential bias, the identity of the LLM-based chatbot that generated each response was masked.

To ensure scoring reliability, the same evaluators were resent the questions and responses in a randomized order two weeks after the initial assessment. In cases where discrepancies were identified between the initial and follow-up scores, the specific questions and responses were sent once more for additional review. The final score determined during this third round of evaluation was recorded as the definitive score for the corresponding response. The entire evaluation process was carried out over one month, from September 30 to October 30, 2024. Inter-rater agreement among the six independent evaluators was assessed using Cohen's kappa coefficient. The overall kappa value, reflecting inter-rater reliability, was 0.804 ($P<0.01$).

The evaluators assessed the LLM-based chatbot responses based on two criteria. These scoring criteria were adapted from methodologies used in previous studies evaluating LLM-generated medical and dental content.[18,24,25]

Accuracy. A five-point Likert scale (one equals poor, five equals excellent) was used to evaluate the precision and coherence of the responses. Responses scoring four or higher were considered highly accurate, while those scoring three or lower reflected varying levels of limited or moderate accuracy. The scoring definitions were as follows: poor accuracy—the response lacked most relevant information and was not useful for patient education or clinical purposes; limited accuracy—some relevant information was included, but key elements were missing, rendering the response minimally useful; moderate accuracy—the response provided adequate information on certain aspects but was insufficient in others, offering limited applicability; good accuracy—most relevant information was present, making the response generally useful for both patient education and clinical application; and excellent accuracy—the response was highly informative and practical for both patient education and clinical use.

Completeness. A three-point Likert scale (one equals incomplete, three equals comprehensive) was used to evaluate the comprehensiveness of the responses. A response was considered "complete" if it fully addressed all essential aspects of the question (score equals three), while scores of two and one indicated partial or insufficient coverage, respectively. The scoring definitions were as follows: incomplete—the response addressed only part of the question and lacked key elements; adequate—the response sufficiently covered all essential aspects of the question; comprehensive—the response thoroughly addressed all aspects of the question and included additional insights or contextual information.

Statistical analysis. Data analysis was performed using Microsoft Excel (version 16; Microsoft Corp., Redmond, Wash., USA) and SPSS, version 26 (IBM Corp., Chicago, Ill., USA). The normality of the data was assessed using the Kolmogorov-Smirnov test. As the data did not follow a normal distribution, non-parametric tests were applied. Descriptive statistics—including median, minimum and maximum values, interquartile range (**IQR**), and effect size (***r***)—were used to summarize the dataset. Effect sizes were calculated using Cohen's *r*, interpreted as follows: small (*r* equals 0.1 to 0.3), medium (*r* equals 0.3 to 0.5), and large (*r* at least 0.5).[26] To compare the accuracy and completeness scores between ChatGPT-4o and ScholarGPT, the Wilcoxon signed-rank test was used. Differences across topics were evaluated using the Kruskal-Wallis test, and when significant differences were observed, the post hoc Dunn test was conducted to identify pairwise comparisons. Statistical significance was set at a *P*-value of 0.05.

Results

A total of 30 clinical questions spanning six pediatric dentistry topics were included in the study. All questions, along with the corresponding chatbot responses, are provided in the **Supplemental Electronic Data—Appendix**.

The comparison of accuracy scores for responses generated by ChatGPT-4o and ScholarGPT across each topic and overall is summarized in Figure 1. Overall, ScholarGPT achieved significantly higher accuracy scores than ChatGPT-4o (P<0.001). The median accuracy score for ScholarGPT was five (IQR equals zero), while ChatGPT-4o had a median score of four (IQR equals one). The largest effect size (r equals 0.75) was observed in the "oral hygiene practices" topic, indicating a substantial difference in favor of ScholarGPT. ScholarGPT demonstrated the highest accuracy in the "fissure sealants" topic, with a perfect median score of five (IQR equals zero).

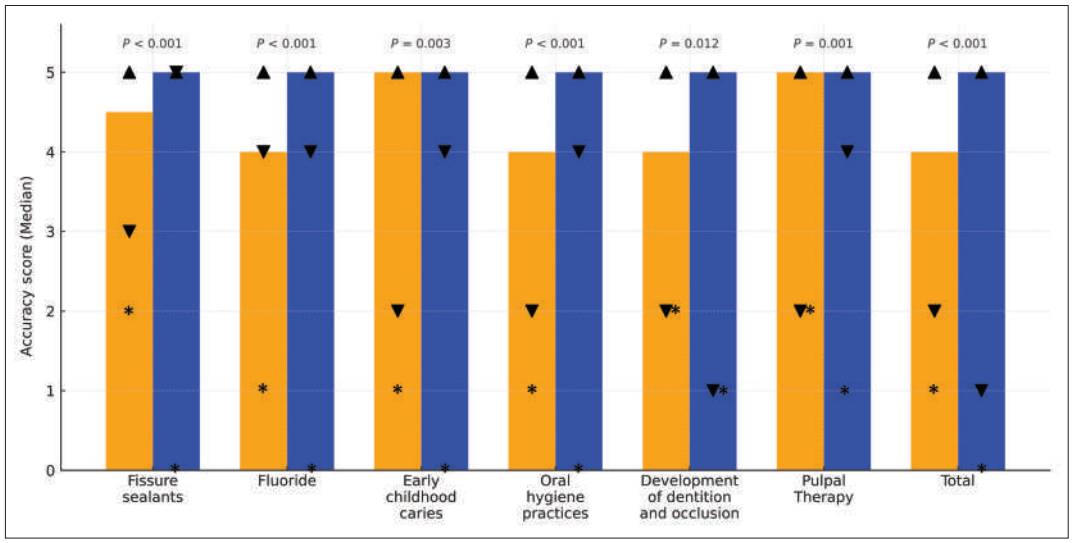


Figure 1. Comparison of accuracy scores of ChatGPT-4o and ScholarGPT across different pediatric dentistry topics and in total. The accuracy scores were derived from expert evaluations of the chatbot-generated responses (Likert score of 1 to 5 with 5 being excellent). Orange bars represent the median accuracy scores of ChatGPT-4o, while blue bars represent those of ScholarGPT. Upward-pointing triangles indicate the maximum values, and downward-pointing triangles indicate the minimum values. Asterisks denote the interquartile range. ScholarGPT demonstrated significantly higher accuracy scores than ChatGPT-4o individually and in total (P<0.001; Wilcoxon signed-rank test).

Figure 2 summarizes the completeness scores of the LLM-based chatbot responses. Overall, ScholarGPT achieved significantly higher completeness scores than ChatGPT-4o (P<0.001). The median completeness score for ScholarGPT was three (IQR equals one), whereas for ChatGPT-4o it was two (IQR equals zero). The largest effect size (r equals 0.86) was observed in the "early childhood caries" topic, indicating a strong difference favoring ScholarGPT. ScholarGPT provided the most complete responses in the "oral hygiene practices" topic (median equals three, IQR equals zero, r equals 0.85), whereas ChatGPT-4o exhibited the lowest completeness in the "development of dentition and occlusion" topic (median equals two, IQR equals two, r equals 0.57).

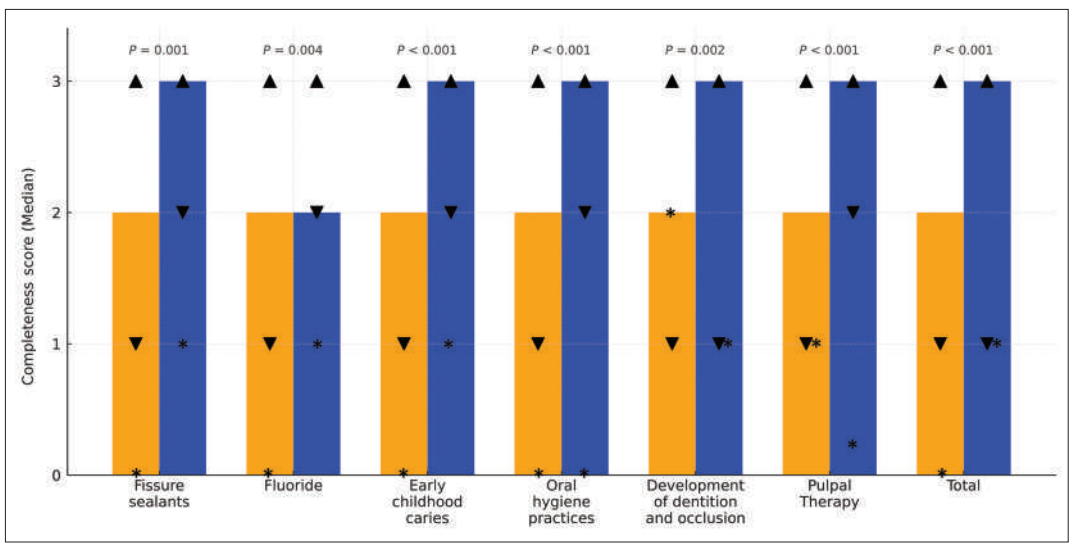


Figure 2. Comparison of completeness scores of ChatGPT-4o and ScholarGPT across different pediatric dentistry topics and in total. The completeness scores were derived from expert evaluations of the chatbot-generated responses (Likert score of 1 to 3 with 3 being excellent). Orange bars represent the median completeness scores of ChatGPT-4o, while blue bars represent those of ScholarGPT. Upward-pointing triangles indicate the maximum values, and downward-pointing triangles indicate the minimum values. Asterisks denote the interquartile range. ScholarGPT demonstrated significantly higher completeness scores than ChatGPT-4o in total (P<0.001; Wilcoxon signed-rank test).

Table 1 presents the comparative analysis of accuracy and completeness scores across different pediatric dentistry topics. A statistically significant difference was observed in the accuracy scores of ChatGPT-4o across topics (P=0.012). Post hoc analysis revealed that the median accuracy score for "development of dentition and occlusion" (three, IQR equals two) was significantly lower compared to "fluoride" (four, IQR equals one) and "early childhood caries" (five, IQR equals one). This indicates that ChatGPT-4o performed notably worse in the "development of dentition and occlusion" topic compared to other topics, with the largest effect size observed in "fluoride" (r equals 0.71), suggesting a substantial difference in accuracy. ScholarGPT's accuracy scores also varied significantly across topics (P=0.001). Post hoc analysis showed that the median accuracy score for "development of dentition and occlusion" (five, IQR equals one) was significantly lower than the scores for all other topics.

For completeness, a statistically significant difference across topics was observed only for ScholarGPT (P=0.008), while ChatGPT-4o's completeness scores did not show significant

Table. ANALYSIS OF THE DIFFERENCE BETWEEN THE PEDIATRIC DENTISTRY-RELATED TOPICS IN ACCURACY AND COMPLETENESS SCORES IN CLINICAL QUESTIONS*

	Accuracy**				Completeness†			
	ChatGPT-4o		ScholarGPT		ChatGPT-4o		ScholarGPT	
Topics	Median (min.-max.)— IQR	*P*-value‡	Median (min.-max.) — IQR	*P*-value‡	Median (min.-max.) — IQR	*P*-value‡	Median (min.-max.) — IQR	*P*-value‡
Fissure sealants	4.5 (3-5) — 2^{AC}		5 (5-5) — 0^{A}		2 (1-3) — 0		3 (2-3) — 1^{AC}	
Fluoride	4 (4-5) — 1^{A}		5 (4-5) — 0^{A}		2 (1-3) — 0		2 (2-3) — 1^{AC}	
Early childhood caries	5 (2-5) — 1^{A}		5 (4-5) — 0^{A}		2 (1-3) — 0		3 (2-3) — 1^{AC}	
Oral hygiene practices	4 (2-5) — 1^{AC}	**0.012**	5 (4-5) — 0^{A}	**0.001**	2 (1-3) — 0	0.451	3 (2-3) — 0^{A}	**0.008**
Development of dentition and occlusion	4 (2-5) — 2^{BC}		5 (1-5) — 1^{B}		2 (1-3) — 2		3 (1-3) — 1^{BC}	
Pulpal therapy	5 (2-5) — 2^{AC}		5 (4-5) — 1^{A}		2 (1-3) — 1		3 (2-3) — 0.25^{AC}	

* Abbreviations in table: Min=minimum, max: maximum; IQR=interquartile range.

** Responses were rated for accuracy using a five-point Likert scale (1=poor, 5=excellent), based on precision and coherence. Scores of 4 or 5 were considered highly accurate, while scores of 3 or lower reflected limited or moderate accuracy.

† Responses were rated for completeness using a three-point Likert scale (1=incomplete, 3=comprehensive). A score of 3 indicated that all essential aspects of the question were fully addressed, while lower scores reflected partial or insufficient coverage.

‡ Kruskal-Wallis test. **Bold** *P*-values mean statistical significance at $P<0.05$ level. Different superscript capital letters indicate a significant difference within the relevant column following post hoc Dunn test.

variation across topics ($P=0.451$). Post hoc analysis revealed that the median completeness score for ScholarGPT's responses to questions on "oral hygiene practices" (three, IQR equals zero) was significantly higher than the score for the "development of dentition and occlusion" topic (three, IQR equals one).

Discussion

ScholarGPT and ChatGPT-4o demonstrated varying levels of success in responding to clinical questions in the field of pediatric dentistry, with notable differences in the quality and depth of their answers. ScholarGPT generally produced more accurate and comprehensive responses, while ChatGPT-4o provided answers with acceptable levels of accuracy but occasionally made factual errors or failed to fully address the clinical intent of the question. Alternatively, ScholarGPT sometimes responded with a metaphorical interpretation, missing the intended clinical context. These findings suggest that completeness may benefit from model fine-tuning and prompt specificity, whereas accuracy depends more heavily on factual grounding and the quality of the model's training corpus. Such distinctions help explain the observed discrepancies in performance between the two models and highlight the importance of aligning input structure with model strengths in clinical applications.

Studies directly comparing ScholarGPT and ChatGPT-4o in health care contexts remain limited. Balel[18] compared ChatGPT-3.5 and ScholarGPT across 60 questions related to impacted teeth, dental implants, temporomandibular disorders, and orthognathic surgery. Based on a modified Global Quality Scale, the study reported that ScholarGPT gave more consistent and higher-quality responses than ChatGPT-3.5 for maxillofacial surgery topics. These findings are consistent with those of the present study and confirm ScholarGPT's ability to produce clinically reliable responses. Accordingly, the null hypothesis—stating that there would be no statistically significant difference between the two models—was rejected based on the results. However, the study also highlighted concerns regarding topic relevance and the quality of cited sources, underscoring the need for continued expert oversight. To the authors' knowledge, this is the first study to evaluate the performance of ScholarGPT specifically on pediatric dentistry content, thereby contributing new evidence regarding the applicability of LLMs in this domain.

Several recent studies have evaluated the use of ChatGPT versions and other LLM-based chatbots in pediatric dentistry, particularly for parental education, dental trauma, fluoride use, and child-specific clinical queries. These studies provide a valuable comparative context for interpreting the present findings. Gugnani et al.[17] assessed the accuracy of ChatGPT's responses to frequently asked questions from a maternal perspective and found most outputs to be clear, complete, and logical. Similarly, Bayraktar Nahir[16] reported that ChatGPT-3.5 provided high-quality responses to pediatric patient/parent questions, particularly those concerning dental trauma and oral health. Kusaka et al.[27] evaluated three different LLM-based chatbots (OpenAI's ChatGPT-3.5, Microsoft Copilot, and Google's Gemini) and found them useful in real-world pediatric dental consultations, especially for questions related to systemic diseases or behavioral concerns. Buldur and Sezer[28] conducted a qualitative comparison of ChatGPT's responses on fluoride with content from the American Dental Association and noted that ChatGPT's responses were detailed and scientifically consistent. Furthermore, Dermata et al.[29] compared six LLM-based chatbots (Google's Gemini and Gemini Advanced, OpenAI's ChatGPT-4, ChatGPT-4o, ChatGPT-3.5, and Microsoft Copilot) by evaluating their responses to questions grounded in current evidence-based guidelines and literature. These questions reflected real-world clinical scenarios commonly encountered in pediatric dentistry, such as managing early childhood caries, dental trauma, behavior guidance, and treatment planning for young patients. Among the models tested, ChatGPT-4 provided the most comprehensive and clinically relevant responses. Rokshad et al.[30] conducted a

pilot study comparing the accuracy and consistency of chatbot-generated responses with those of clinicians when answering true/false questions in pediatric dentistry. The results showed that pediatric dentists achieved the highest accuracy, followed by general dentists and students. Among the tested chatbots, ChatGPT had the highest accuracy, and most models showed acceptable internal consistency. Although the authors concluded that chatbots may be valuable as educational tools and sources of information, they emphasized that these models are not yet suitable substitutes for clinicians in diagnostic decision-making. These findings generally support the reliability of ChatGPT in delivering foundational knowledge in pediatric dentistry.

There are several studies comparing the accuracy and completeness of responses generated by different LLM-based chatbots to theoretical questions and clinical scenarios across various dental specialties, not limited to pediatric dentistry. For instance, the pilot study conducted by Molena et al.[31] found that, while ChatGPT generally provided accurate responses to general dentistry-related questions, instances of incomplete or incorrect information were also noted. This underscores the potential of AI models as supportive tools in clinical decision-making, while also raising concerns about their reliability as standalone decision-makers. Similarly, the study by Alsayed et al.[15] evaluated ChatGPT's performance in oral surgery, preventive dentistry, and oral cancer. Although ChatGPT performed well in delivering information on preventive dentistry, it exhibited lower accuracy in oral surgery and oral cancer topics.[15] Tomo et al.[32] demonstrated that ChatGPT-4 provides a level of diagnostic accuracy comparable to specialists when generating differential diagnoses for oral and maxillofacial conditions. However, its consistency in producing diagnostic hypotheses remains moderate, which limits its use in clinical settings. Moreover, the performance of ChatGPT is significantly affected by the quality of case documentation and descriptions.[32] Providing detailed and accurate clinical information is essential for improving the diagnostic accuracy and clinical usefulness of LLM-based chatbots.

Hatia et al.[33] reported that ChatGPT-4o's responses to questions involving orthodontic treatment planning, dentofacial anomalies, and occlusion development were frequently incomplete or only partially accurate. Although the model performs well in delivering basic explanations, it lacks sufficient depth when addressing complex clinical scenarios and cross-disciplinary knowledge requirements.[33] Orthodontic treatments require detailed evaluation of patient-specific factors, which are essential for creating individualized treatment plans. However, ChatGPT-4o's general responses often failed to incorporate critical elements such as growth prediction, biomechanical principles, or patient compliance—factors essential for the success of orthodontic outcomes.[33] In the present study, both LLM-based chatbots demonstrated the lowest median accuracy scores for the topic "development of dentition and occlusion," which also showed the smallest effect size among all evaluated topics, following a similar pattern observed in the aforementioned study. This divergence may be partly explained by the lack of explicit domain cues in the prompts. While ChatGPT-4o identified the orthodontic context but included factual inaccuracies (e.g., incorrect age range), ScholarGPT responded with a metaphorical interpretation, missing the intended clinical meaning. These findings highlight the importance of precise contextual framing to guide language model responses in specialized domains.

In specific subject areas, ChatGPT-4 has demonstrated adequate—and occasionally high—performance, especially when supported by structured prompting techniques such as the chain of thought approach, which facilitates step-by-step reasoning.[34] Ji et al.[34] reported that ChatGPT-4's performance on oral and maxillofacial queries improved significantly when supported by structured prompting techniques, leading to enhanced accuracy, coherence, and a more professional tone. These advancements may be partially attributed to technical enhancements and the application of domain-specific training approaches. For instance, Uribe et al.[35] demonstrated that fine-tuning a GPT-based model on postoperative dental care queries resulted in notable gains in both accuracy and clinical relevance. Similarly, Batool et al.[35] achieved high performance in radiographic interpretation and patient classification tasks through the use of sentence embedding optimization strategies. ScholarGPT, in particular, was developed as a research-oriented language model tailored for academic tasks and scientific writing. Unlike general-purpose models such as ChatGPT-4o, ScholarGPT is specifically designed to produce literature-informed and source-referenced content with higher levels of accuracy and completeness, underscoring the potential of targeted model training in improving clinical and academic utility.

The limitations of LLM-based chatbots in complex clinical scenarios have been well-documented in the literature.[37] Schwendicke et al.[38] noted that, although these models are effective in analyzing large datasets, they demonstrate considerable weaknesses in situations requiring advanced clinical reasoning. Similarly, Suarez et al.[39] emphasized that ChatGPT-4 is not yet capable of replacing dentists in clinical decision-making in endodontics. These general limitations of LLM-based chatbots are also evident in the present study. While ScholarGPT outperformed ChatGPT-4o in all topics, both models showed limitations in processing clinical content that demands detailed analysis, particularly in topics such as "development of dentition and occlusion." These findings underscore the importance of training LLM-based chatbots with more comprehensive and representative datasets to improve their accuracy and consistency. Until such improvements are achieved, human oversight remains essential, particularly when interpreting model outputs for clinical decision-making.

This study has certain limitations that should be acknowledged. Although factual accuracy was explicitly evaluated, the risk of artificial hallucinations—where models generate seemingly plausible but incorrect or fabricated information—remains a significant concern in clinical applications of AI. While expert evaluators classified such responses as incomplete or inaccurate, their occurrence highlights the need for caution when interpreing AI-generated content in health care contexts. Despite efforts to standardize the evaluation process, some degree of subjectivity in expert scoring is inevitable. The analysis was also based on a predefined set of task scenarios and relied on single-turn prompting, without the use of advanced techniques such as chain of thought reasoning. Additionally, the comparison between ScholarGPT and ChatGPT-4o focused on selected question types and clinical topics. Previous studies have shown that, while ScholarGPT may outperform in certain technical tasks, it can be less effective in terms of literature relevance and citation quality. An additional limitation is the absence of persona-based prompting (e.g., "act as a pediatric dentist"), which may have influenced the contextual depth of responses. As a result, the outputs may not fully reflect the level of nuance expected in context-aware clinical advice. The relatively small number of clinical questions evaluated is another limitation, which may restrict the generalizability of the findings across the full spectrum of pediatric dentistry topics. The rapidly evolving nature of LLMs further limits the

longterm generalizability of the findings, which should be revisited as newer versions become available. It is also important to note that the evaluation was based on expert judgments using a specific set of questions, which may not fully capture the models' broader performance in practical clinical settings. Nonetheless, a key strength of this study lies in the use of blinded expert reviewers, which helped reduce potential bias. Moreover, by offering a comparative analysis of two widely used language models in pediatric dentistry—a relatively underexplored area—this study contributes valuable insight into the reliability and limitations of AI tools in child-focused dental care.

The findings of this study suggest that LLMs such as ScholarGPT and ChatGPT-4o may serve as supportive tools in pediatric dental practice, offering preliminary information for both clinicians and patients. ScholarGPT's more consistent and comprehensive performance indicates its potential utility in assisting dentists with concise overviews or initial guidance on clinical topics. However, occasional misinterpretations—such as metaphorical answers—underscore the need for expert validation prior to clinical integration. Meanwhile, ChatGPT-4o's tendency to offer general yet moderately accurate responses highlights its potential role in delivering simplified, patient-facing explanations. Nonetheless, both tools should be used with caution and never be considered as substitutes for professional judgment or evidence-based decision-making.

Future studies could focus on evaluating the performance of LLM-based chatbots in other dental specialties and explore how their capabilities evolve with training on larger and more diverse datasets. In addition, research should examine how these models perform in more complex clinical scenarios and situations that require the integration of interdisciplinary knowledge. Investigating the ethical, clinical, and patient safety implications of AI technologies in health care settings will also be a critical area for further exploration. Moreover, future work should also address the frequency, characteristics, and clinical consequences of artificial hallucinations generated by LLM-based chatbots and develop strategies to detect and mitigate such errors in practice.

Conclusions

Based on the findings of this study, the following conclusions can be drawn:

1. ScholarGPT's superior performance suggests it may be more suitable for use in clinical decision-support systems within pediatric dentistry, especially in areas where accurate and complete information is essential for safe patient care.
2. The models' difficulties with topics requiring individualized interpretation demonstrate the need for AI tools to be used alongside, not in place of, clinical judgment. Until such tools can account for patient-specific variables, reliance on AI in complex diagnostic or treatment planning scenarios should remain cautious.
3. The variation in model performance across topics suggests that task complexity alone may not fully account for the observed differences. Some topics are governed by relatively standardized protocols, making them more accessible to LLMs. In contrast, areas requiring individualized evaluation may pose greater challenges for current AI systems.
4. While LLM-based chatbots show promise as decision-support tools, human oversight remains essential—particularly in high-stakes or patient-specific contexts. Ongoing collaboration between clinicians, AI developers, and researchers is crucial to ensure the safe and effective use of these technologies in pediatric dental care.

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Disclaimer. Authors declare that they have no conflict of interest. In writing this paper, ChatGPT-4o was used only to check grammar and spelling rules. After using this tool, the authors reviewed and edited the content and takes full responsibility for the content of the publication.

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Supplemental Electronic Data—Appendix

Clinical Questions	ChatGPT-4o Response	Scholar GPT Response
1- What are the types of fissure sealants?	Fissure sealants are protective coatings applied to the grooves and fissures of teeth to prevent decay. They can be categorized based on their composition and polymerization method. Here are the main types of fissure sealants: Based on Composition: Resin-based Sealants: Unfilled Resin Sealants: These sealants are composed of resin without any filler particles. They have a low viscosity, which helps them flow easily into the pits and fissures of the teeth.Filled Resin Sealants: These contain filler particles, such as glass or quartz, which provide additional strength and wear resistance compared to unfilled resin sealants.Fluoride-releasing Resin Sealants: These sealants release fluoride over time, providing an added benefit of enhancing remineralization and preventing decay.Glass Ionomer Sealants:These sealants are made from a mixture of glass and organic acids. They release fluoride, which can help in preventing tooth decay. Glass ionomer sealants are often used when moisture control is difficult. Polyacid-modified Resin Sealants (Compomers): These are hybrid materials that combine elements of resin-based sealants and glass ionomer sealants. They release fluoride and have improved mechanical properties compared to glass ionomer sealants. Based on Polymerization Method: Light-cured Sealants: These sealants require a curing light to initiate the polymerization process. The curing light hardens the sealant material quickly, allowing for immediate setting. Self-cured (Autopolymerized) Sealants: These sealants polymerize through a chemical reaction between two components mixed together. They do not	Fissure sealants are preventive dental materials applied to the grooves and pits of teeth, especially molars, to protect against cavities by sealing off areas where food particles and bacteria often accumulate. There are several types of fissure sealants, each with unique properties and applications in dentistry. Here's a breakdown of the primary types: **1. Resin-Based Sealants** • **Description**: These are the most commonly used sealants, made of a resin material similar to composite fillings. • **Properties**: They are durable, bond well to tooth enamel, and provide a strong, long-lasting seal. • **Application**: They typically require a dry working area and may need a bonding agent to ensure good adhesion. • **Advantages**: High resistance to wear and effective in caries prevention. • **Disadvantages**: They can be moisture-sensitive, which may compromise bonding. **2. Glass Ionomer Sealants** • **Description**: Made of a glass ionomer material that bonds chemically to tooth structure. • **Properties**: They release fluoride over time, which can help strengthen the surrounding tooth enamel and prevent decay. • **Application**: Easier to place in a moist environment than resin-based sealants, making them ideal for children or individuals with difficulty maintaining a dry field.
	require a curing light and typically take a few minutes to set. Based on Color: Clear Sealants: These sealants are transparent, making it easier to see the underlying tooth structure. Opaque or Tinted Sealants: These sealants are colored (usually white or off-white), making them more visible during application and follow-up examinations. Choosing the appropriate type of fissure sealant depends on various factors, including the patient's caries risk, the tooth's location, and the ability to maintain a dry field during application.	• **Advantages**: Fluoride release provides added protection, and they adhere well in moist conditions. • **Disadvantages**: They are generally less durable than resin-based sealants and may need to be reapplied more frequently. **3. Compomer Sealants** • **Description**: Compomer, or polyacid-modified composite resin, combines properties of both composite resins and glass ionomers. • **Properties**: They offer some fluoride release and improved moisture tolerance compared to traditional resin-based sealants. • **Application**: Applied similarly to resin-based sealants but can tolerate slightly more moisture. • **Advantages**: Fluoride release and moderate wear resistance. • **Disadvantages**: Not as durable as pure resin-based sealants and may wear out more quickly. **4. Polyacid-Modified Resin Sealants** • **Description**: A variation of compomer sealants, these materials aim to combine resin-based sealant properties with fluoride release. • **Properties**: Provides moderate fluoride release and bonding similar to resin-based sealants. • **Application**: Applied like traditional resin-based sealants with similar protocols. • **Advantages**: Combines the benefits of fluoride release with the strength of resin materials. • **Disadvantages**: Their durability and fluoride release are moderate compared to pure resin or glass ionomer materials.

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		5. Self-Etching Sealants • **Description**: These are newer types of sealants that contain a self-etching component, which eliminates the need for a separate etching step. • **Properties**: They simplify the application process, as they don't require a separate etching agent. • **Application**: Easier and quicker to apply, especially useful in a clinical setting with children. • **Advantages**: Faster application and better tolerance to moisture. • **Disadvantages**: May not bond as strongly as traditional resin-based sealants, and fluoride release is generally limited. **6. Colored vs. Transparent Sealants** • **Description**: Sealants come in both colored (often white or opaque) and transparent forms. • **Properties**: Colored sealants allow for easier monitoring of sealant integrity over time, while transparent sealants are more aesthetic. • **Application**: No difference in application; choice depends on dentist preference and patient needs. • **Advantages**: Colored sealants make it easier to identify wear and the need for reapplication. • **Disadvantages**: Transparent sealants may be harder to detect during routine examinations. In practice, the choice of fissure sealant often depends on individual patient needs, clinical setting, and the dentist's preference. Resin-based and glass ionomer sealants are the most widely used, given their complementary properties for caries prevention and wear resistance.
2- What is the content of resin fissure sealants?	Resin fissure sealants are dental materials used to prevent tooth decay in the pits and fissures of teeth, especially molars. The primary components of resin fissure sealants include: Bis-GMA (Bisphenol A-Glycidyl Methacrylate): This is the base resin material providing the sealant's strength and wear resistance. UDMA (Urethane Dimethacrylate): Another type of resin that may be used to provide flexibility and reduce brittleness. Filler Particles: These are added to improve the mechanical properties and wear resistance. The filler content can vary and may include quartz, silica, or glass particles. Photoinitiators: These are chemicals that enable the resin to harden or cure when exposed to a specific light source, usually blue light. Camphorquinone is a common photoinitiator used in dental sealants. Monomers: These are the building blocks of the resin matrix, which polymerize to form the solid sealant. Examples include TEGDMA (Triethylene Glycol Dimethacrylate) and HEMA (Hydroxyethyl Methacrylate). Fluoride: Some sealants are formulated with fluoride to provide additional protection against caries by releasing fluoride ions over time. Coloring Agents: These may be added to make the sealant more visible during application and check-ups, ensuring proper placement and retention. These components work together to create a durable, effective barrier against decay in the occlusal surfaces of teeth.	Resin fissure sealants are dental materials applied to the occlusal surfaces of teeth, particularly molars, to protect them from decay by sealing the grooves and pits where plaque and food particles can accumulate. These sealants are commonly used in pediatric and preventive dentistry. The content of resin fissure sealants generally includes several key components, each serving a specific function in the material's properties and effectiveness. **Key Components of Resin Fissure Sealants** 1. **Bisphenol A-Glycidyl Methacrylate (Bis-GMA)**: o This is the primary monomer used in most resin-based sealants. It provides the sealant with excellent bonding properties and a hard, durable surface that can withstand the forces of chewing. o Due to some concerns over Bisphenol A (BPA) release, BPA-free variants and alternative monomers like urethane dimethacrylate (UDMA) are also used. 2. **Urethane Dimethacrylate (UDMA)**: o An alternative to Bis-GMA, UDMA is used to create BPA-free sealants. It contributes to the resin's strength, flexibility, and adhesion, reducing concerns about BPA exposure while maintaining similar performance. 3. **Diluent Monomers (e.g., Triethylene Glycol Dimethacrylate, TEGDMA)**: o These monomers adjust the viscosity of the sealant to improve handling and flow. They help the sealant penetrate into the grooves and fissures of teeth more effectively. o However, higher levels of diluent monomers can increase shrinkage upon

		polymerization, potentially affecting the sealant's longevity. 4. **Inorganic Fillers**: o Resin fissure sealants may contain inorganic fillers like silica, which increase the material's wear resistance and enhance mechanical strength. Sealants with fillers are generally thicker and more wear-resistant, but some unfilled sealants exist, providing a lower viscosity option that is easier to apply. 5. **Photoinitiators**: o Photoinitiators, such as camphorquinone, enable the resin to harden or cure when exposed to specific wavelengths of light (typically blue light in the 470 nm range). This light-curing process is rapid and enables immediate polymerization, which is beneficial in a clinical setting. 6. **Stabilizers and Inhibitors**: o Compounds like butylated hydroxytoluene (BHT) are added to prevent premature polymerization of the resin during storage, ensuring the material remains stable and effective until application. 7. **Pigments and Fluorescent Agents** (optional): o Some sealants contain pigments to make them visible after application, making it easier for clinicians to monitor the sealant over time. Fluorescent agents can help the sealant appear under ultraviolet light for better detection. 8. **Fluoride**: o Certain resin sealants incorporate fluoride-releasing materials. These act as an additional preventive measure by slowly releasing fluoride ions over time,
		which can help remineralize enamel and provide added protection against decay. **Variations in Resin Sealant Composition** While Bis-GMA-based sealants remain the most common, recent advancements in dental materials have led to alternative resin-based sealants designed to address specific concerns, such as BPA exposure and ease of application. Resin-modified glass ionomer sealants, for example, combine resin with glass ionomer components, offering fluoride release but with a different adhesion mechanism. **Benefits and Considerations** • **Durability**: Resin sealants are durable and withstand the forces of chewing, providing long-term protection when properly maintained. • **Adhesion**: The chemical composition ensures a strong bond to the tooth surface, though proper application techniques are essential to minimize gaps and ensure full coverage. • **Concerns about BPA**: Research suggests minimal BPA exposure from dental sealants, but BPA-free formulations are available for those seeking alternatives. In summary, resin fissure sealants are highly effective preventive dental materials with a composition designed for durability, adhesion, and ease of application. Innovations continue to refine their safety profile and enhance their caries-preventive properties.

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3- What are the indications of glass ionomer fissure sealants?	Glass ionomer fissure sealants are used in dentistry for a variety of reasons due to their unique properties. Here are some key indications for their use: Preventive Measures:Used as a preventive measure in patients with a high risk of dental caries, particularly in children and adolescents.Suitable for sealing pits and fissures on occlusal surfaces of molars and premolars to prevent decay.Erupted Teeth:Applied on newly erupted permanent teeth, which are more prone to decay due to deep pits and fissures that can trap food and bacteria.Compromised Oral Hygiene:Ideal for patients with compromised oral hygiene practices, where the risk of caries is higher.High Caries Risk:Indicated for individuals with a history of dental caries, as the fluoride release from glass ionomer can help in remineralization and protection against decay.Hypomineralized Teeth:Used in teeth with enamel hypomineralization or developmental defects where the enamel is weaker and more susceptible to caries.Orthodontic Patients:Beneficial for patients undergoing orthodontic treatment, where maintaining oral hygiene is more challenging, increasing the risk of caries around brackets and bands.Primary Teeth:Often used in primary teeth as a preventive measure in children, particularly on molars which have deep pits and fissures.Non-Cavitated Lesions:Indicated for sealing non-cavitated carious lesions, helping to arrest the progression of decay.Special Needs Patients:Suitable for patients with special needs who may have difficulty maintaining optimal oral hygiene, thus requiring additional preventive measures. The advantages of using glass ionomer fissure sealants include their ability to release fluoride, their adhesion to enamel and dentin, and their biocompatibility. They are also less technique-sensitive compared to resin-based sealants, making them a practical choice in various clinical situations.	Glass ionomer fissure sealants are used in preventive dentistry to protect teeth, especially molars, from decay by sealing pits and fissures that are susceptible to caries. Here are the primary indications for the use of glass ionomer sealants: 1. **Primary Prevention of Caries in Children**: Glass ionomer fissure sealants are commonly used in pediatric dentistry to seal the pits and fissures of primary and permanent molars in children. They help reduce caries incidence by acting as a barrier to plaque and food particles. 2. **High-Risk Caries Patients**: Patients with a high risk of dental caries, including those with poor oral hygiene, low socioeconomic status, or limited access to dental care, benefit significantly from glass ionomer sealants. The fluoride-releasing properties offer additional protection, making them suitable for this group. 3. **Occlusal Surface Protection**: These sealants are recommended for the occlusal (biting) surfaces of teeth that are deeply grooved or have narrow fissures, which are more susceptible to food entrapment and bacterial colonization, leading to caries development. 4. **Partially Erupted Molars**: For molars that are partially erupted and difficult to access for proper cleaning, glass ionomer sealants are preferred because they bond well to moist surfaces, unlike resin-based sealants, which require a dry environment for optimal adhesion. 5. **Patients with Reduced Salivary Flow**: Patients with reduced salivary flow due to medical conditions, medications, or radiation therapy have a higher risk of dental caries, making fissure sealants particularly beneficial. The fluoride release from glass ionomer materials can help remineralize early carious lesions.
		6. **Alternative to Resin Sealants in Young Patients or Allergies**: Glass ionomer sealants are also a good alternative for young children or patients who may have an allergy to resin-based materials. 7. **Intermediate Solution for Dental Phobias or Limited Cooperation**: In cases where patients are unable to fully cooperate due to age, disabilities, or dental anxiety, glass ionomer fissure sealants can be quickly applied as a short-term preventive measure. **Advantages of Glass Ionomer Sealants:** • **Fluoride Release**: They continuously release fluoride, which enhances remineralization and strengthens enamel, helping to protect teeth against decay. • **Moisture Tolerance**: They bond well in the presence of slight moisture, unlike resin-based sealants, which require a dry environment. • **Biocompatibility**: They are less likely to irritate the gums and are more suitable for young children or patients with allergies to other sealant materials. However, it's worth noting that glass ionomer sealants may not be as durable as resin-based sealants and might require more frequent replacement or repair.
4- What are the reasons for failure in fissure sealants?	Fissure sealants, used to prevent dental caries, can sometimes fail due to several reasons. Here are some common causes: Moisture Contamination: During the application of fissure sealants, the tooth surface must be kept dry. Saliva contamination can prevent proper bonding of the sealant	sider.ai ile konuşuldu Fissure sealants are preventive treatments designed to protect the pits and fissures of teeth from decay, particularly in children and young adults. However, several factors contribute to their failure, ranging from procedural

	to the enamel, leading to sealant failure. Incomplete Curing: If the sealant material is not adequately cured with the curing light, it may not harden properly, resulting in weak bonding and potential failure. Poor Retention: Sealants may not adhere well to the enamel if the tooth surface is not properly prepared or etched before application. This can lead to early loss of the sealant. Suboptimal Application Technique: Inadequate application techniques, such as insufficient cleaning of the tooth surface or improper sealant placement, can result in sealant failure. Material Properties: The type and quality of the sealant material used can impact its longevity. Some materials may be more prone to wear and degradation over time.Occlusal Stress: High occlusal forces from chewing can cause the sealant to wear down or fracture, leading to failure.Caries Underneath the Sealant: If caries are not completely removed or if there is decay beneath the sealant that was not detected, the sealant can fail as the underlying caries progresses.Age of the Patient: Younger patients might have more difficulty keeping their mouths dry during the procedure, increasing the risk of moisture contamination.Follow-Up and Maintenance: Lack of regular dental check-ups and maintenance can lead to unnoticed wear or chipping of the sealant, which can eventually result in its failure.Anatomy of the Fissures: Deep, narrow fissures might be more difficult to clean and seal effectively, increasing the risk of failure. Addressing these factors during the application and follow-up care can help improve the success rate of fissure sealants.	issues to material limitations. The main reasons for fissure sealant failure include: 1. **Retention Failure**: Studies highlight that retention failure is a frequent cause, often due to inadequate bonding between the sealant material and the tooth surface. Inadequate acid-etching, saliva contamination during application, or moisture on the etched enamel can compromise adhesion, leading to early sealant loss (Yildiz et al., 2004). 2. **Marginal Discoloration and Adaptation Issues**: Inconsistent marginal adaptation or discoloration at the sealant edges can indicate that the sealant is failing, as noted in a 12-month follow-up study. This failure often relates to the sealant's ability to adhere and seal the tooth surface effectively (Behroozian & Aghazadeh, 2022). 3. **Material-Specific Limitations**: Some materials, such as glass-ionomer sealants, though beneficial for caries protection, exhibit higher rates of early failure compared to resin-based sealants. Resin-based sealants are generally more durable but may be compromised by incorrect application techniques (Markovic et al., 2018). 4. **Technique Sensitivity**: Fissure sealant application is technique-sensitive; slight deviations in protocol, such as insufficient etching time or overfilling of the sealant material, increase the likelihood of gaps, weakening the seal (Geiger et al., 2000). 5. **Suboptimal Application Environment**: In dental practices with limited control over isolation from saliva and moisture, especially in pediatric cases, the risk of sealant failure rises significantly. This is commonly reported in general practices, where conditions might not always be ideal for sealant retention (Hevinga et al., 2010).
		6. **Clinical Evaluation and Monitoring**: Research stresses the need for routine clinical evaluations of sealants post-application. Sealants that are partially lost are often left untreated, increasing the risk of caries in unsealed areas (Simonsen, 2002). 7. **Surface Contamination**: Saliva and moisture contamination can interfere with the sealant's bonding strength, which is critical for successful fissure sealant application. Contamination often results in gaps, reducing the sealant's longevity (Nilchian et al., 2011). 8. **Cost-Effectiveness and Access to Care**: In some regions, access to sealants may be limited due to high costs or lack of reimbursement, which can indirectly affect the quality and consistency of application (Mitchell & Murray, 1989). Overall, successful fissure sealant retention requires meticulous application, proper material selection, and ongoing dental evaluations to ensure the longevity of the sealant and protection against dental caries.
5- To what extent do fissure sealants reduce the risk of dental caries formation?	Fissure sealants are highly effective in reducing the risk of dental caries, particularly on the occlusal surfaces of molars and premolars, which are prone to decay due to their deep pits and fissures. Several studies have shown that sealants can significantly lower the incidence of caries in children and adolescents. Key Findings: Reduction in Caries Incidence: Sealants have been shown to reduce the risk of caries by up to 80% in the first two years after application, and this effect can last for up to four years with proper maintenance. Long-term Effectiveness: While the effectiveness of sealants	Fissure sealants play a significant role in reducing the risk of dental caries, particularly on occlusal surfaces of molars and premolars, where natural pits and fissures are prone to decay. These sealants create a physical barrier that blocks out bacteria and food particles, thereby limiting one of the primary pathways for caries development. Research consistently highlights the effectiveness of fissure sealants in both children and adolescents, who are often most vulnerable to caries on newly erupted permanent molars. **Key Findings**

Appendix continued on the next page.

	diminishes over time, they still provide a protective benefit for several years. A review by the Cochrane Collaboration reported that sealants could reduce caries by 50% up to four years after application.Preventive Strategy:Sealants act as a physical barrier, preventing food particles and bacteria from accumulating in the fissures and pits of teeth, which are areas where toothbrush bristles cannot reach effectively.Cost-Effectiveness:Sealants are considered a cost-effective preventive measure, particularly in high-risk populations, as they can prevent the need for more extensive and expensive dental treatments later. Clinical Recommendations: Application in High-Risk Individuals:Sealants are particularly recommended for children and adolescents who are at higher risk for caries, such as those with a history of caries or poor oral hygiene.Follow-Up and Maintenance:Regular dental check-ups are essential to monitor the condition of the sealants and reapply them if necessary to maintain their protective effect.Fluoride Use:Combining sealant application with fluoride treatments can enhance caries prevention, as fluoride helps remineralize enamel and protect against decay on other tooth surfaces. Conclusion: Fissure sealants are a proven, effective measure for reducing the risk of dental caries, especially in the molars and premolars of children and adolescents. Their application as part of a comprehensive preventive dental care regimen can lead to significant long-term reductions in caries incidence and associated dental treatment costs.	1. **Long-term Effectiveness**: Fissure sealants have demonstrated a significant preventive effect over time. According to a recent study published in *Kerala Dental Journal* (2024), the application of pit and fissure sealants on molar teeth in children results in a notable reduction in the incidence of caries for several years post-application. The protection persists especially when paired with regular fluoride therapy and oral hygiene practices (N. Jose, E. Joseph, J. John, 2024). 2. **Multifactorial Prevention Strategy**: The development of dental caries is a multifactorial issue involving plaque formation, dietary habits, and oral hygiene. Sealants address the physical vulnerability of teeth rather than the biological process alone, effectively reducing caries risk when combined with other preventive measures such as fluoride and proper oral hygiene. A study from *epublications.vu.lt* emphasizes that sealants are essential within a broader preventive approach (Z. Oezdemir, 2024). **Summary** Overall, the application of fissure sealants has a robust and lasting impact on caries prevention, particularly when used in combination with other preventive strategies. The protective effect of sealants on the occlusal surfaces of molars, especially in children and young adults, is one of the most effective clinical interventions in preventive dentistry. These findings support the continued use and promotion of fissure sealants within comprehensive caries management programs.
6- What should be the optimal amount of fluoride in drinking water?	The optimal amount of fluoride in drinking water is generally considered to be around 0.7 parts per million (ppm). This level is recommended by the U.S. Public	The optimal amount of fluoride in drinking water is carefully determined to maximize dental health benefits while minimizing potential risks. In general, the

	Health Service and is designed to help prevent tooth decay while minimizing the risk of dental fluorosis. The specific optimal level may vary slightly depending on local climate, water consumption patterns, and other factors, but 0.7 ppm is widely accepted as a guideline for effective and safe fluoridation.	recommended level of fluoride in drinking water is approximately: • **0.7 milligrams per liter (mg/L)**, or **0.7 parts per million (ppm)**, according to the U.S. Public Health Service (USPHS) and the Centers for Disease Control and Prevention (CDC). This level is deemed sufficient to prevent tooth decay and promote oral health in a population without posing significant health risks. **Why 0.7 mg/L?** 1. **Dental Health**: Fluoride at this concentration is effective in preventing tooth decay by strengthening enamel, making it more resistant to acid attacks from bacteria in plaque. 2. **Safety**: The level is low enough to avoid adverse health effects, such as dental fluorosis, while maximizing protection against cavities. 3. **Climate Considerations**: The recommendation is adapted for all climates, as it accounts for varying levels of water consumption due to temperature differences. **Health Risks of Higher Fluoride Levels** At higher concentrations (above 2.0 mg/L), fluoride can cause **dental fluorosis** (a cosmetic condition resulting in streaking or spots on teeth) and, at excessive levels (above 4.0 mg/L), may contribute to **skeletal fluorosis**, a condition that affects bone structure. **International Recommendations**

		Other countries may have slightly different guidelines based on climate, dietary habits, and baseline fluoride levels in the local environment. For instance: • **European Union**: Recommended fluoride levels are generally between 0.5 to 1.0 mg/L. • **World Health Organization (WHO)**: Recommends a maximum fluoride concentration of 1.5 mg/L in drinking water. **Key Takeaway** For most populations, **0.7 mg/L** is the optimal fluoride concentration to promote dental health safely.
7- What are the treatment options for dental fluorosis?	Dental fluorosis is a condition caused by excessive exposure to fluoride during tooth development, leading to changes in the appearance of the enamel. The treatment options for dental fluorosis vary depending on the severity of the condition and the patient's cosmetic concerns. Here are some common treatment options: 1. Mild Fluorosis Teeth Whitening/Bleaching: Professional teeth whitening can help reduce the appearance of mild fluorosis by lightening the stains and making them less noticeable. Microabrasion: This technique involves the removal of a small amount of enamel using a combination of abrasion and a mild acidic solution. It is effective for removing superficial stains and discoloration. 2. Moderate Fluorosis Composite Bonding: A tooth-colored resin is applied to the surface of the teeth to cover discoloration and improve the appearance. This is suitable for moderate cases where the	Dental fluorosis, a condition caused by excessive fluoride intake during tooth development, results in varying degrees of enamel discoloration and structural changes, from mild white spots to severe brown stains and pitting. Treatment options vary based on the severity and aesthetic concerns of the individual. Here's an overview of effective approaches: 1. **Microabrasion**: o This minimally invasive technique is suitable for mild to moderate cases, where the outer layer of enamel is removed with a mixture of hydrochloric acid and pumice. o It's effective for superficial white or yellow spots and typically achieves good cosmetic results with minimal enamel loss. 2. **Bleaching**: o Professional bleaching can reduce discoloration by whitening the
	enamel has more noticeable discoloration or defects. Porcelain Veneers: Thin shells of porcelain are bonded to the front surface of the teeth. Veneers can effectively cover more significant stains and irregularities, providing a natural and aesthetically pleasing appearance. 3. Severe Fluorosis Crowns: In cases of severe fluorosis where the enamel is significantly damaged, crowns may be necessary. Crowns cover the entire tooth, restoring its shape, function, and appearance. Enamel Microabrasion Combined with Bleaching: For severe cases, a combination of enamel microabrasion and bleaching can be used to improve the appearance of the teeth. This approach helps in reducing deep stains and achieving a more uniform color. Additional Considerations Oral Hygiene: Maintaining good oral hygiene practices is essential for managing fluorosis. Regular brushing with fluoride-free toothpaste, flossing, and professional cleanings can help prevent further discoloration and maintain overall dental health. Dietary Adjustments: Reducing the intake of fluoride from drinking water and other sources can help prevent the progression of fluorosis, especially in children who are still developing their teeth. It's important for patients with dental fluorosis to consult with a dental professional to determine the most appropriate treatment based on the severity of their condition and their cosmetic goals.	surrounding enamel to make the spots less noticeable. o For fluorosis, **in-office bleaching** (stronger, controlled agents) often yields better results than at-home kits. Dentists typically use carbamide peroxide or hydrogen peroxide for more uniform whitening. 3. **Veneers**: o For moderate to severe fluorosis, **porcelain or composite veneers** are applied to the surface of the teeth, covering stains and defects completely. o Porcelain veneers offer durable, stain-resistant results, although they are more costly and require removal of a small amount of enamel. 4. **Bonding**: o Composite resin bonding covers fluorosis stains and mild structural defects, providing immediate improvement. o This method is more affordable than veneers, though bonding may stain or wear over time and require periodic maintenance. 5. **Crowns**: o Reserved for severe cases with extensive enamel damage or pitting, crowns offer full coverage but require significant enamel removal. o This method is typically a last resort due to its cost, invasiveness, and long-term impact on dental structure. 6. **Enamel Microabrasion Combined with Bleaching**: o A combination of microabrasion and bleaching is sometimes used, especially for moderate cases with diffuse discoloration. This dual approach first

Appendix continued on the next page.

		removes surface stains and then whitens the teeth for a more even tone. 7. **Laser Therapy**: o Some dentists use lasers to enhance the effectiveness of bleaching agents or to perform microabrasion, potentially improving outcomes by increasing enamel permeability or removing deeper stains. 8. **Icon Resin Infiltration**: o A newer, minimally invasive approach, this method uses resin to penetrate and fill porous enamel caused by fluorosis, blending the spots with the surrounding enamel for a more uniform appearance. o Icon infiltration is especially useful for mild cases with white spots and doesn't require drilling or significant enamel removal. **Factors to Consider When Choosing a Treatment** • **Severity**: Mild cases may respond well to bleaching or microabrasion alone, while severe cases may require veneers or crowns. • **Aesthetic Goals**: Patients with high aesthetic standards might prefer veneers for the most natural look. • **Durability and Maintenance**: Veneers and crowns are more durable but require greater initial commitment. Bonding may require periodic touch-ups. • **Cost**: Veneers and crowns are costlier than bleaching or microabrasion, so budget considerations may influence the choice. These treatments offer options to improve the aesthetic appearance of teeth affected by fluorosis, and consulting with a dental professional can help tailor the approach to individual needs and the specific characteristics of the fluorosis.
8- How to apply fluoride gel?	Applying fluoride gel is a simple procedure that can be performed either in a dental office or at home with the right instructions. Here's a step-by-step guide on how to apply fluoride gel: Materials Needed Fluoride gel (as prescribed by your dentist) Toothbrush or custom dental traysTimer Steps for Application Preparation: Brush your teeth thoroughly with toothpaste and rinse your mouth with water to remove any debris. Ensure your teeth are dry. You can use a piece of gauze or a cotton roll to help keep your teeth dry if needed. Application Using a Toothbrush: Squeeze a small amount of fluoride gel (about the size of a pea) onto your toothbrush. Apply the gel evenly to all the surfaces of your teeth. Make sure to cover the front, back, and chewing surfaces. Brush your teeth gently with the fluoride gel, focusing on spreading it over the enamel surfaces. Application Using Dental Trays: Fill the custom dental trays with the prescribed amount of fluoride gel. Usually, a thin ribbon of gel is sufficient. Place the trays over your teeth, making sure they fit snugly. Leave the trays in place for the recommended time, usually 4-5 minutes. Post-Application: After the recommended time, remove the trays or stop brushing.Spit out any excess gel. Avoid swallowing the gel. Do not rinse your mouth, eat, drink, or smoke for at least 30 minutes after application to allow the fluoride to fully absorb into the enamel. Frequency: Follow the frequency of application as recommended by your	Applying fluoride gel correctly is important for maximizing its dental benefits while minimizing potential side effects. Here's a step-by-step guide on how to use it safely and effectively: **1. Prepare Your Supplies** • Obtain a fluoride gel prescribed by your dentist, or an over-the-counter gel if appropriate. • You will need a toothbrush or custom-made dental tray (if recommended by your dentist). **2. Brush and Floss Teeth** • Start by thoroughly brushing and flossing to ensure clean teeth for the fluoride to adhere well. **3. Apply the Gel** • **With a Toothbrush**: o Apply a small amount of gel to the toothbrush. o Gently brush the gel onto your teeth, ensuring full coverage on all tooth surfaces. • **With a Tray**: o Place a small amount of fluoride gel in the custom dental tray. o Insert the tray over your teeth and make sure it fits snugly.

	dentist. This can vary from once a week to every few months, depending on your individual needs. Important Tips Consult Your Dentist: Always follow the specific instructions given by your dentist regarding the type and frequency of fluoride gel application. Proper Storage: Store the fluoride gel as directed, usually in a cool, dry place, away from direct sunlight. Supervision for Children: If the fluoride gel is being applied to children, ensure it is done under adult supervision to prevent swallowing. Regular application of fluoride gel can help strengthen tooth enamel and prevent cavities, especially for individuals at high risk for dental caries.	**4. Allow Gel to Set** • Keep the gel on your teeth for the recommended time, usually around 1–4 minutes, as directed by your dentist or the product instructions. **5. Spit Out Excess Gel** • After the set time, spit out as much of the fluoride gel as possible. • Avoid swallowing, as ingesting too much fluoride can be harmful. **6. Do Not Rinse Immediately** • Avoid eating, drinking, or rinsing your mouth for at least 30 minutes after application to allow the fluoride to absorb. **Tips for Best Results:** • **Frequency**: Use fluoride gel only as often as recommended, usually once or twice a week unless otherwise directed by a dentist. • **Storage**: Store fluoride gel at room temperature, away from children, as it can be toxic if ingested in large quantities. Regular application as per dental advice helps in strengthening tooth enamel, reducing sensitivity, and protecting against decay.
9- What is acute fluoride toxicity?	Acute fluoride toxicity refers to the condition caused by the ingestion of a large amount of fluoride in a short period of time. It is characterized by a range of symptoms that can vary depending on the dose of fluoride ingested and the	Acute fluoride toxicity is a condition resulting from the ingestion or exposure to a high dose of fluoride over a short period. Unlike chronic fluoride exposure, which involves lower doses over long periods, acute toxicity
	individual's sensitivity. Here are the main aspects of acute fluoride toxicity: Causes: Accidental ingestion: Often occurs in children who may consume large amounts of fluoride-containing toothpaste or mouth rinses. Industrial exposure: Inhalation of fluoride-containing fumes or dust in certain industrial settings. Overdosage of fluoride supplements: When supplements are incorrectly prescribed or administered. Symptoms: Gastrointestinal: Nausea, vomiting, diarrhea, and abdominal pain are common initial symptoms due to the corrosive effect of fluoride on the stomach lining. Neurological: Headaches, muscle weakness, and tremors can occur. Systemic: Severe cases can lead to hypocalcemia (low calcium levels), hyperkalemia (high potassium levels), and hypomagnesemia (low magnesium levels). Cardiovascular and Respiratory: Can include irregular heartbeats, respiratory depression, and, in extreme cases, cardiac arrest. Diagnosis: Clinical presentation: Based on the history of fluoride exposure and presenting symptoms. Laboratory tests: Blood tests to measure electrolyte levels and kidney function, as well as fluoride concentration in the blood and urine. Treatment: Immediate medical attention: Acute fluoride toxicity is a medical emergency. Gastric lavage: To remove unabsorbed fluoride from the stomach. Calcium or magnesium: Administered orally or intravenously to bind	occurs rapidly and can lead to serious health complications. Fluoride, commonly found in water, toothpaste, and industrial products, is typically safe in low doses, but when consumed or absorbed in excessive amounts, it disrupts several physiological processes. **Mechanism and Symptoms of Acute Fluoride Toxicity** Acute fluoride toxicity interferes with essential body processes, including: 1. **Enzyme Inhibition**: Fluoride inhibits various enzymes by binding to metal ions necessary for enzymatic function, particularly calcium and magnesium. This interference affects cellular functions and leads to symptoms like muscle weakness and spasms. 2. **Metabolic Acidosis**: Fluoride ions can disturb the acid-base balance, leading to metabolic acidosis, which affects blood pH, respiration, and cardiac function. 3. **Calcium and Magnesium Imbalance**: High fluoride levels decrease calcium and magnesium in the blood, leading to hypocalcemia and hypomagnesemia, which can cause muscle cramps, numbness, and cardiac irregularities. **Symptoms and Stages of Toxicity** The symptoms of acute fluoride toxicity vary with the level of exposure but generally progress through stages: • **Mild Exposure**: Includes nausea, vomiting, diarrhea, abdominal pain, and headache. These symptoms occur as the fluoride irritates the stomach and intestinal lining.

Appendix continued on the next page.

	fluoride and reduce its absorption. Supportive care: Including intravenous fluids, monitoring and correction of electrolyte imbalances, and respiratory support if necessary. Prevention: Proper use and storage: Keeping fluoride-containing products out of reach of children and using appropriate amounts of toothpaste. Education: Informing the public about the potential risks of fluoride and the importance of following dosage recommendations for supplements. Acute fluoride toxicity is rare but can be serious. Immediate medical intervention is crucial to manage the symptoms and prevent complications.	• **Moderate Exposure**: Fluoride absorption into the bloodstream can lead to symptoms like muscle weakness, tremors, and spasms due to calcium depletion. • **Severe Exposure**: In high doses, fluoride toxicity can lead to serious neurological symptoms (seizures, respiratory failure), cardiovascular issues (hypotension, arrhythmias), and even death. **Sources of Acute Fluoride Exposure** While acute toxicity is relatively rare, certain situations increase the risk: • **Accidental Ingestion of Fluoridated Products**: Consuming large quantities of fluoridated toothpaste, mouth rinses, or dietary fluoride supplements can lead to acute toxicity. • **Industrial Exposure**: Occupational settings where fluoride compounds are used, like aluminum production, can expose workers to high fluoride concentrations. • **Contaminated Water**: In rare cases, water sources may contain dangerously high fluoride levels due to contamination, leading to accidental overexposure. **Treatment of Acute Fluoride Toxicity** Immediate treatment is essential to prevent severe complications and typically involves: 1. **Gastrointestinal Decontamination**: Inducing vomiting or performing gastric lavage to remove fluoride from the stomach.
		2. **Calcium Administration**: Administering calcium gluconate or calcium chloride to counteract hypocalcemia and reduce fluoride absorption. 3. **Supportive Care**: Providing fluids and monitoring heart function, as electrolyte imbalances can impact cardiac and respiratory systems. *Prevention* Preventing acute fluoride toxicity primarily involves regulating fluoride use, especially in consumer products, and educating the public on the safe use of fluoride-containing products, particularly in households with young children. Understanding and managing fluoride exposure, particularly for vulnerable populations, is essential to minimize risks associated with both acute and chronic fluoride toxicity.
10- What is chronic fluoride toxicity?	Chronic fluoride toxicity, also known as skeletal fluorosis, is a condition that results from long-term exposure to high levels of fluoride. Fluoride is a naturally occurring mineral found in water, soil, and various foods. While fluoride is beneficial in small amounts, particularly for dental health, excessive exposure over extended periods can lead to toxicity. Here are key points about chronic fluoride toxicity: Causes:Prolonged ingestion of water with high fluoride levels (more than 1.5 mg/L, which is the WHO guideline for drinking water).Consumption of fluoride-rich foods or beverages.Use of fluoride-containing dental products, especially if swallowed.Occupational exposure in industries such as aluminum smelting or phosphate fertilizer production.Symptoms:Skeletal effects: Stiffness and pain in joints, increased bone density, abnormal bone growths, and calcification of ligaments and tendons.Dental	Chronic fluoride toxicity, also known as fluoride poisoning, occurs when fluoride accumulates in the body over a prolonged period, leading to toxic effects. While fluoride is beneficial in small amounts, particularly for dental health, excessive intake can cause adverse health effects. Chronic exposure to high levels of fluoride, especially through drinking water, certain foods, dental products, or industrial exposure, is associated with various health issues. **Key Aspects of Chronic Fluoride Toxicity:** 1. **Sources of Exposure**: ○ The most common source of fluoride exposure is through drinking water, especially in regions with high natural fluoride levels.

	effects: Dental fluorosis in children, characterized by mottling and discoloration of teeth.Neurological effects: Muscle weakness, fatigue, and impaired cognitive function in severe cases.Diagnosis:Clinical examination and history of fluoride exposure.Radiographic imaging to detect changes in bone structure.Blood and urine tests to measure fluoride levels.Treatment:Reducing or eliminating exposure to fluoride.Supportive treatments for pain and joint stiffness.In severe cases, orthopedic interventions may be necessary.Prevention:Monitoring and regulating fluoride levels in drinking water.Educating the public about the sources and risks of excessive fluoride exposure.Using fluoride-containing dental products as directed and ensuring they are not ingested. Chronic fluoride toxicity is preventable with proper management of fluoride levels in the environment and awareness of its sources.	○ Other sources include certain foods, dental products (like toothpaste and mouth rinses), industrial pollution, and exposure to certain medications. ○ In some areas, fluoride is also added to drinking water for dental health benefits; however, high levels of supplementation or natural fluoride can lead to toxicity. 2. **Health Implications**: ○ **Dental Fluorosis**: Chronic fluoride exposure during childhood can cause dental fluorosis, a condition where tooth enamel becomes discolored and mottled. Although largely cosmetic, it indicates excessive fluoride exposure. ○ **Skeletal Fluorosis**: Long-term exposure can lead to skeletal fluorosis, where fluoride accumulates in bones, causing pain, stiffness, and, in severe cases, deformities and reduced joint mobility. ○ **Neurological Effects**: Some studies suggest that chronic exposure to high fluoride levels may affect neurological development, particularly in children, potentially impacting cognitive functions and lowering IQ. ○ **Kidney and Liver Damage**: High levels of fluoride intake over time can also strain the kidneys and liver, which are responsible for processing and excreting fluoride. Individuals with compromised kidney function are especially vulnerable. ○ **Endocrine Effects**: Fluoride exposure has been associated with potential impacts on the thyroid gland, which regulates many of the body's hormones. 3. **Mechanism of Toxicity**: ○ Fluoride is toxic at high levels because it disrupts cellular functions. It can inhibit
		enzymes, alter mineral metabolism, and cause oxidative stress, leading to cellular damage. ○ In bones, fluoride replaces calcium in the mineral structure, leading to abnormal bone formation and brittleness. 4. **Diagnosis and Treatment**: ○ Chronic fluoride toxicity can be challenging to diagnose due to its gradual onset and nonspecific symptoms. Dental and skeletal fluorosis can often be diagnosed by examining teeth and bones, respectively. ○ Reducing fluoride exposure is the primary treatment. This may involve using fluoride-free water for drinking and cooking, reducing the use of fluoride-containing dental products, and dietary adjustments. ○ In advanced cases, supportive therapies like physical therapy, calcium and vitamin D supplementation, or surgery in severe skeletal fluorosis cases might be necessary. 5. **Prevention**: ○ Regular monitoring of fluoride levels in drinking water is essential in regions with naturally high fluoride. ○ Health organizations set limits on fluoride levels in public drinking water to balance the benefits for dental health against the risks of toxicity. ○ Public education on the sources and risks of fluoride exposure helps prevent overconsumption, especially for vulnerable populations like children. Chronic fluoride toxicity is a global public health concern in areas with high natural fluoride levels in water. It

Appendix continued on the next page.

		underscores the importance of careful regulation and monitoring of fluoride exposure to maintain its dental benefits while avoiding toxic levels.
11- What are the microorganisms responsible for early childhood caries?	Early childhood caries (ECC) is primarily caused by the interaction of dietary sugars with specific microorganisms that colonize the mouth. The key microorganisms responsible for ECC include: Streptococcus mutans: This is the main bacterium associated with the initiation of ECC. It is highly cariogenic due to its ability to produce acid from dietary sugars, leading to demineralization of tooth enamel. Streptococcus sobrinus: This bacterium also plays a significant role in the progression of ECC. It shares similar cariogenic properties with S. mutans. Lactobacillus species: These bacteria are involved in the progression of carious lesions. They thrive in acidic environments created by S. mutans and contribute to the further breakdown of tooth structure. Actinomyces species: These bacteria are often found in early dental plaque and contribute to the initial colonization and development of carious lesions.Bifidobacteria: These bacteria have also been implicated in ECC, particularly in more severe cases. They are capable of producing acid and are often found in carious lesions. The interplay between these microorganisms, dietary habits (particularly the frequent consumption of sugary foods and drinks), and inadequate oral hygiene practices significantly contributes to the development and progression of ECC.	Early childhood caries (ECC) is a prevalent dental issue among young children, primarily caused by specific microorganisms that form biofilms on tooth surfaces, leading to acid production that demineralizes enamel. The main microorganisms associated with ECC include: 1. **Streptococcus mutans**: This is the primary bacterium linked to ECC. S. mutans is highly acidogenic (produces acid) and aciduric (can survive in acidic environments), allowing it to thrive in the cariogenic environment of the oral cavity. It adheres well to tooth surfaces and forms biofilms, initiating the caries process by breaking down dietary sugars and producing lactic acid. 2. **Streptococcus sobrinus**: Often found alongside S. mutans, S. sobrinus also contributes to dental caries, especially in children with high levels of these bacteria. It similarly metabolizes sugars into acids, contributing to enamel demineralization. 3. **Lactobacillus species**: These bacteria play a more significant role in the progression rather than the initiation of ECC. Lactobacilli are acidogenic and can survive in acidic conditions, promoting caries development in deeper layers of tooth structure once the enamel surface has been compromised. 4. **Actinomyces species**: While Actinomyces is less directly associated with ECC than S. mutans or Lactobacillus, it can contribute to the early stages of biofilm formation on tooth surfaces, aiding in the initial adherence and colonization of more cariogenic bacteria.
		5. **Veillonella species**: Although Veillonella itself is not cariogenic, it can enhance caries progression by consuming lactic acid produced by other bacteria, altering the biofilm's environment in a way that supports acidogenic bacteria. This interaction can contribute to an environment favorable for S. mutans and Lactobacillus to proliferate. 6. **Candida albicans**: A yeast rather than a bacterium, C. albicans can interact with S. mutans, forming a biofilm that promotes adherence and acid production, further enhancing the cariogenic potential of the microbial community. **Mechanisms of Caries Formation by these Microorganisms** These microorganisms metabolize fermentable carbohydrates (like sucrose) into acids, particularly lactic acid. This acid demineralizes the tooth enamel, leading to the formation of carious lesions. The interaction of bacteria in biofilms amplifies the cariogenic process by creating a stable, acidic environment that continually supports demineralization and limits remineralization. **Preventive Measures** Preventing ECC involves reducing the presence and activity of these bacteria through good oral hygiene, minimizing sugar intake, and regular dental check-ups. Fluoride treatments can also help strengthen enamel against acid attacks. Understanding the specific microorganisms involved in ECC helps to tailor preventive and therapeutic

		approaches to better manage this prevalent condition among young children.
12-What is the window of infectivity associated with early childhood caries?	The window of infectivity associated with early childhood caries (ECC) refers to the period during which young children are most susceptible to acquiring cariogenic bacteria, particularly Streptococcus mutans, from their environment, primarily through their caregivers. This critical period is generally considered to be between the ages of 19 to 33 months. During this time, the colonization of cariogenic bacteria is most likely to occur, which can lead to the development of ECC if proper oral hygiene practices are not followed and dietary habits are not well managed.	sider.ai ile konuşuldu The "window of infectivity" in early childhood caries (ECC) refers to a specific period when children are particularly susceptible to infection by mutans streptococci (MS), a bacterial group strongly linked to dental caries. This period typically occurs between 19 and 31 months of age, with many studies pointing to the 2-year mark as a critical time for MS colonization. During this window, the primary caregiver often transmits MS to the child, making caregiver oral health practices influential on ECC development. Preventive measures during this time can significantly impact caries prevalence in children. Key studies illustrate this concept: 1. **Caufield et al. (1993)** identified the median age of MS acquisition as around 26 months in children, emphasizing the presence of this "window of infectivity" and its impact on caries risk (Journal of Dental Research). 2. **Dasanayake et al. (2000)** also described an early, critical period in infancy when MS colonization is most likely, highlighting potential ecological approaches to caries prevention (Infection and Immunity). 3. **Tinanoff and O'Sullivan (1997)** documented ECC as heavily influenced by early bacterial colonization, typically during this infection-prone period (Pediatric Dentistry). 4. **Gussy et al. (2006)** reported that infection timing, particularly in early childhood, could influence long-term caries risk, supporting the role of the
		infectivity window in ECC onset (Journal of Paediatrics and Child Health). 5. **Edelstein et al. (2012)** used simulations to model ECC intervention impacts, identifying this early period as critical in designing effective prevention programs (Preventing Chronic Disease). 6. **Ramos-Gomez and Weintraub (2003)** observed that early interventions within this period can delay or prevent cariogenic bacterial colonization (Journal of Clinical Pediatric Dentistry). 7. **Riedy et al. (2000)** studied MS colonization within this window in relation to other caries risk factors, finding that delaying colonization could reduce ECC risk (Community Dentistry and Oral Epidemiology). 8. **Colak et al. (2013)** reinforced the link between low early-life infection levels and lower long-term caries risk, advocating for protective oral hygiene during this period (Journal of Natural Science, Biology, and Medicine). This research indicates that interventions targeting the "window of infectivity"—such as caregiver oral health education and reducing MS transmission—could be essential strategies for lowering ECC prevalence in early childhood.
13- What are the treatment options for early childhood caries?	Early childhood caries (ECC) is a significant dental health issue in young children, often requiring a multifaceted approach for effective treatment and prevention. Here are the primary treatment options for ECC: Preventive Measures:Oral Hygiene Education: Teaching parents and caregivers proper brushing and flossing techniques for their children.Dietary Counseling: Advising on limiting sugary snacks and drinks, promoting healthy eating habits to reduce the risk of caries.Fluoride Use:	Treatment options for early childhood caries (ECC) include a combination of preventive, minimally invasive, and restorative approaches, emphasizing the reduction of future decay risk through preventive care and proper dental hygiene. Here's a summary of some key treatment strategies from recent research: 1. **Preventive Care and Education**: Foundational prevention includes caregiver education on oral hygiene practices for children, as studies indicate

	Topical fluoride treatments, fluoride varnishes, and the use of fluoride toothpaste to strengthen tooth enamel and prevent decay.Minimally Invasive Treatments:Silver Diamine Fluoride (SDF): A topical agent that can arrest caries and prevent further decay.Sealants: Applying dental sealants to the chewing surfaces of the teeth to protect against decay.Remineralization Agents: Using products that contain calcium and phosphate to promote the natural repair of enamel.Restorative Treatments:Fillings: Removing the decayed portion of the tooth and filling it with materials such as composite resin or glass ionomer.Crowns: Placing stainless steel or tooth-colored crowns on severely decayed teeth to restore function and appearance.Pulpotomy: A procedure to remove the diseased pulp tissue from the crown portion of the tooth, often followed by a crown placement.Behavior Management:Non-Pharmacological Techniques: Using positive reinforcement, tell-show-do, and distraction to help children cope with dental treatments.Pharmacological Techniques: Sedation or general anesthesia for children who are unable to cooperate due to age, anxiety, or extensive treatment needs.Regular Dental Visits:Routine Check-Ups: Scheduling regular dental visits to monitor oral health, catch early signs of caries, and perform professional cleanings.Professional Cleanings: Removing plaque and tartar buildup to prevent the progression of caries.Parental Involvement:Education and Support: Providing parents with the knowledge and tools to support their child's oral health at home.Monitoring and Supervision: Encouraging parents to supervise brushing and flossing until children have the dexterity to do it effectively on their own. These treatment options, when combined, can help manage early childhood caries effectively and promote long-term oral health in children.	that routine dental care can help prevent caries (Berkowitz, 2003). 2. **Fluoride and Silver Diamine Fluoride Applications**: Topical fluoride treatments are standard for strengthening enamel, and silver diamine fluoride has emerged as an effective agent for halting caries progression without invasive procedures (Duangthip et al., 2017). 3. **Atraumatic Restorative Treatment (ART)**: ART is a non-invasive method that uses hand instruments and fluoride-releasing materials, suitable for young children and those with limited access to dental care. Studies highlight ART as both cost-effective and less traumatic for children, especially in resource-limited settings (Tonmukayakul & Arrow, 2017). 4. **General Anesthesia for Severe Cases**: When ECC is extensive, treatment under general anesthesia can be necessary to complete comprehensive restoration safely and effectively, although recurrence risk remains without ongoing preventive care (Foster & Perinpanayagam, 2006). 5. **Microbiota Management**: Research into the oral microbiota's role in ECC suggests targeting specific bacteria as a therapeutic strategy, potentially using pre- and probiotics to promote a healthier oral environment (Tanner et al., 2011). 6. **Minimally Invasive Restorative Techniques**: Minimally invasive treatments are often recommended for young children, using materials and techniques that conserve healthy tooth structure while restoring decayed areas (Misra et al., 2007). 7. **Behavioral and Diet Counseling**: Education on dietary choices, particularly reducing sugar intake, is essential, as diet significantly influences caries development. Caregiver involvement is critical to
		ensure adherence to dietary guidelines that support oral health (Simón-Soro & Mira, 2015). 8. **Community and School-based Programs**: Implementing community-level programs, particularly in high-risk areas, offers a broader reach in preventing and managing ECC. These programs often include screenings, fluoride varnish applications, and educational sessions (Casamassimo et al., 2009). Each of these treatments aligns with recent advances in pediatric dentistry that emphasize the importance of comprehensive care combining preventive and restorative measures to manage and mitigate ECC effectively. Here are the links to key articles on ECC treatments: • Berkowitz, 2003 - CDA • Duangthip et al., 2017 - MDPI • Tonmukayakul & Arrow, 2017 - Wiley • Foster & Perinpanayagam, 2006 - Ingentaconnect • Tanner et al., 2011 - NIH • Misra et al., 2007 - ResearchGate • Simón-Soro & Mira, 2015 - Academia • Casamassimo et al., 2009 - MAM Baby
14- Is it possible for microorganisms that cause dental caries to be transmitted from mother to child?	Yes, it is possible for microorganisms that cause dental caries to be transmitted from mother to child. The primary bacterium associated with dental caries is Streptococcus mutans. This bacterium can be transmitted through activities such as sharing utensils, kissing, or any other activity that involves the exchange of saliva. This transmission typically occurs in early childhood, making it crucial for parents and caregivers to maintain good oral hygiene practices to reduce the risk of passing on cariogenic bacteria to their children.	Yes, it is possible for microorganisms that cause dental caries, particularly *Streptococcus mutans*, to be transmitted from mother to child. This process is referred to as "vertical transmission" and can happen through close contact, such as kissing, sharing utensils, or tasting food before feeding the child. Here's how this transmission typically occurs and why it's significant in the context of early childhood dental health:

	Practices to minimize the risk include: Avoiding sharing utensils, straws, and other items that come into contact with saliva. Maintaining good oral hygiene by brushing and flossing regularly.Reducing the consumption of sugary foods and drinks, which promote the growth of cariogenic bacteria.Regular dental check-ups to monitor and manage oral health effectively. By taking these steps, the risk of transmitting cariogenic microorganisms from mother to child can be significantly reduced.	1. **Maternal Microbial Transfer**: The most common bacteria associated with dental caries, *Streptococcus mutans*, is often found in a mother's oral cavity. These bacteria can transfer to the infant's oral microbiome through saliva-sharing activities. 2. **Timing and Susceptibility**: Infants generally acquire *S. mutans* as their teeth begin to erupt, around 6-12 months of age. This period is considered a "window of infectivity," as the child's oral environment starts to support colonization of cariogenic bacteria due to the presence of tooth surfaces. 3. **Impact on Early Childhood Caries (ECC)**: Studies indicate that higher levels of *S. mutans* in mothers are associated with a greater risk of early childhood caries (ECC) in their children. ECC can progress rapidly, particularly if the child's diet includes frequent sugar intake, which feeds the bacteria and leads to acid production and tooth decay. 4. **Preventive Measures**: Good maternal oral hygiene, limiting saliva-sharing activities, and regular dental check-ups for both mother and child are recommended. Additionally, reducing the frequency of sugar exposure and implementing early oral care for children can help reduce the risk of transmission and caries development. 5. **Broader Implications for Oral Health**: Understanding this transmission dynamic is crucial as it underscores the importance of maternal oral health in the prevention of early childhood dental problems. Public health measures often emphasize early education for mothers on oral hygiene and dietary habits to minimize bacterial transmission risks. Overall, the vertical transmission of *S. mutans* is a well-documented phenomenon, and preventive strategies
		targeting both mother and child can significantly reduce the risk of early dental caries.

15- What are demineralization and remineralization?	Demineralization and remineralization are processes that occur in the tooth enamel, involving the loss and gain of minerals, primarily calcium and phosphate, from the tooth structure. These processes are crucial in the development and progression of dental caries (tooth decay).
	
	Demineralization
	
	Demineralization is the process where minerals are lost from the tooth enamel. This occurs when the pH level in the mouth drops below a critical level (approximately 5.5) due to the production of acids by bacteria (such as Streptococcus mutans) that metabolize sugars and carbohydrates from the diet. The acid environment dissolves the mineral content (primarily calcium and phosphate) from the enamel, leading to the weakening and breakdown of the tooth structure. If this process continues without interruption, it can lead to the formation of cavities.
	
	Remineralization
	
	Remineralization is the natural repair process of replacing lost minerals in the tooth enamel. This process can occur when the pH in the mouth is neutral or slightly alkaline, allowing calcium and phosphate from saliva and other sources to be redeposited into the demineralized enamel. Fluoride plays a significant role in enhancing remineralization by forming a more acid-resistant surface on the enamel (fluorapatite) and promoting the deposition of minerals. Effective remineralization can reverse early stages of tooth decay and restore the enamel's integrity.
	
	Balance Between Demineralization and Remineralization
		Demineralization and remineralization are two opposing processes that play essential roles in the health of hard tissues like bones and teeth. These processes involve the loss and gain of minerals, primarily calcium and phosphate, which impact the structural integrity and resilience of these tissues. In dental science, understanding these processes is crucial for managing tooth decay and promoting oral health. Here's a closer look at each process:
		
		1. Demineralization
		
		• **Definition**: Demineralization is the process by which minerals (mainly calcium and phosphate) are removed from hard tissues. This often happens when the pH level in the mouth drops, creating an acidic environment that erodes the mineral structure of the tooth enamel.
		• **Causes**: The primary cause of demineralization in teeth is acidic exposure. This acid can come from:
		  ○ **Diet**: Sugary and acidic foods and beverages (like soda, candy, and citrus fruits) contribute to acid production.
		  ○ **Bacterial Metabolism**: Certain bacteria in the mouth (such as *Streptococcus mutans*) metabolize sugars and produce acid as a byproduct, which erodes the enamel.
		  ○ **Acid Reflux**: Stomach acids reaching the oral cavity due to reflux can also lead to enamel erosion.
		• **Effects**: Demineralization weakens the enamel, leading to cavities, tooth sensitivity, and in severe cases, tooth decay. As the enamel thins, it loses

Appendix continued on the next page.

	The balance between demineralization and remineralization is essential for maintaining healthy teeth. Factors that influence this balance include: Diet: High consumption of sugary and acidic foods and drinks increases demineralization. Oral Hygiene: Regular brushing and flossing help remove plaque and reduce the risk of acid production.Saliva: Saliva naturally buffers acids, provides minerals for remineralization, and helps wash away food particles and bacteria.Fluoride: The use of fluoride in toothpaste, mouth rinses, and professional treatments strengthens enamel and promotes remineralization. Maintaining a favorable balance between these processes is crucial for preventing dental caries and ensuring oral health.	its protective ability, exposing the softer dentin underneath to further decay. **2. Remineralization** • **Definition**: Remineralization is the process of restoring minerals to the tooth structure, particularly to areas that have experienced minor demineralization. It essentially reverses early damage by reintroducing calcium, phosphate, and sometimes fluoride ions, strengthening the enamel. • **Mechanism**: This process occurs naturally through saliva, which contains calcium and phosphate ions that can redeposit on the enamel surface. Fluoride, often found in toothpaste and drinking water, enhances remineralization by helping these ions adhere to the enamel more effectively. • **Sources of Support for Remineralization**: o **Fluoride**: This mineral is often included in toothpaste, mouthwash, and some drinking water supplies. It enhances the remineralization process and makes the enamel more resistant to future acid attacks. o **Saliva**: The mouth's natural saliva flow also aids in remineralization, as it provides a steady source of calcium and phosphate. o **Diet**: Foods rich in calcium (like dairy products) and non-acidic fruits and vegetables can support remineralization by contributing minerals and balancing pH in the mouth. • **Effects**: Remineralization helps strengthen weakened enamel, prevents the progression of cavities, and can even repair small areas of early
		decay. Effective remineralization practices can greatly improve overall oral health and reduce the risk of decay. **Importance in Dental Health** Both demineralization and remineralization are continuous processes in the mouth, with demineralization often occurring after eating, especially when consuming sugary or acidic foods. Remineralization, supported by healthy saliva and fluoride, can help counteract this effect. However, if demineralization outweighs remineralization over time, it can lead to tooth decay. Therefore, maintaining a balance between these two processes through good oral hygiene, dietary choices, and regular dental care is essential for preserving dental health.
16- Which is the most effective tooth brushing technique for children?	The most effective tooth brushing technique for children is generally considered to be the Modified Bass Technique. Here are the key steps for this technique: Angle the Bristles: Position the toothbrush bristles at a 45-degree angle to the gum line.Gentle Circular Motions: Use small, gentle circular motions to brush the outer and inner surfaces of each tooth, focusing on the gum line to remove plaque.Brush Chewing Surfaces: Brush the chewing surfaces of the teeth with back-and-forth strokes.Clean the Inner Surfaces of Front Teeth: Tilt the brush vertically and use up-and-down strokes to clean the inner surfaces of the front teeth.Brush the Tongue: Gently brush the tongue to remove bacteria and freshen breath. This technique is effective because it ensures thorough cleaning of the gum line and all tooth surfaces, which helps to prevent plaque buildup and gingivitis. For children, it's also important to use a toothbrush with soft bristles and a small head to fit their mouths comfortably.	Effective tooth-brushing techniques for children have been the focus of many studies, each aiming to identify the most suitable method that combines ease of use with optimal plaque removal. Here's a breakdown of the findings from recent literature, highlighting the key techniques often recommended and their effectiveness for young children. **Overview of Common Brushing Techniques for Children** 1. **Fones Technique (Circular Method)**: This is one of the simplest methods, where the child is instructed to move the brush in circular motions. It's particularly popular among young children due to its simplicity and ease of learning. 2. **Bass Technique (Sulcular Brushing)**: In this method, the bristles are positioned at a 45-degree angle toward the gum line with gentle horizontal strokes. It's effective in removing plaque but can

	It's also beneficial to supervise and assist young children while they brush their teeth to ensure they are using the correct technique and brushing for the recommended two minutes.	be challenging for young children to execute correctly. 3. **Modified Stillman Technique**: This technique involves a sweeping motion from the gum line toward the edge of the tooth. It's recommended for slightly older children who have developed fine motor skills. 4. **Charters Technique**: In this technique, the brush is angled toward the occlusal or biting surfaces. It's useful for cleaning around orthodontic appliances, making it effective for children with braces. **Findings from Recent Studies on Brushing Techniques for Children** 1. **Fones Technique for Simplicity and Plaque Removal** Studies suggest the **Fones technique** is highly effective for young children due to its simplicity. It's easier for children aged 3–7 to perform and understand, promoting consistency in brushing. Research has shown it significantly reduces plaque on all surfaces, although it may be less thorough along the gum line compared to techniques like Bass. 2. **Bass Technique for Enhanced Plaque Removal** While the **Bass technique** is effective at plaque removal, especially near the gum line, studies indicate it may be challenging for younger children to master. Children over the age of 8, who have developed more precise motor skills, are often better suited for this technique. When performed correctly, the Bass method has shown to reduce gingivitis and periodontal issues. 3. **Modified Stillman Technique for Older Children**
		The **Modified Stillman technique** is often recommended for children transitioning to adolescence. Research indicates it's effective in reducing plaque, especially along the gum line, but it requires fine motor control, making it more suitable for children aged 10 and above. 4. **Comparative Studies** A 2021 study published in the *Journal of Clinical Pediatric Dentistry* compared Fones and Bass techniques and found that children using the Fones technique demonstrated a higher overall plaque reduction. However, children aged 8–12 who used the Bass technique were better at cleaning the gum line, suggesting that age and motor skills play a role in the technique's effectiveness. 5. **Electric vs. Manual Brushing** Recent research has shown that electric toothbrushes can improve plaque removal efficiency, regardless of the technique. Studies indicate that the oscillating-rotating design helps children achieve better results with less precision, making it beneficial for children still developing motor skills. **Recommendations Based on Research** • **For Young Children (Ages 3–7)**: The Fones technique is generally recommended due to its simplicity and effectiveness. Parents should supervise to ensure thorough brushing. • **For Older Children (Ages 8+)**: The Bass technique can be introduced once children have improved motor skills. Supervision remains essential to ensure they're angling the brush correctly. • **Electric Toothbrush Use**: For both age groups, electric toothbrushes are effective at enhancing

Appendix continued on the next page.

		plaque removal, especially for children who struggle with manual techniques. **Conclusion** In summary, the **Fones technique** is most effective for young children due to its simplicity, while the **Bass technique** offers greater plaque control for older children with the motor skills to perform it correctly. Using an electric toothbrush can also improve results across all techniques, providing an alternative to manual brushing. By introducing age-appropriate brushing techniques and tools, parents can help children develop effective oral hygiene habits that will last into adulthood.
17- What are the characteristics of healthy gums in the primary dentition?	Healthy gums in primary dentition have the following characteristics: Color: Healthy gums are typically a coral pink color, although variations can occur due to ethnic background. Texture: They have a firm and resilient texture. Healthy gums in children may appear slightly more smooth compared to adult gums. Contour: The gum margin is well-defined and fits snugly around each tooth. The papillae (the part of the gum between the teeth) are pointed and fill the space between the teeth without signs of swelling. Absence of Bleeding: Healthy gums do not bleed during brushing or flossing. Bleeding can be a sign of inflammation or disease. Moisture: Healthy gums are moist due to adequate salivary flow, which helps in maintaining the tissue's health and hydration.Lack of Discomfort: There is no pain or tenderness in the gums, indicating that there is no underlying inflammation or infection.Absence of Inflammation: Healthy gums are not swollen or red, indicating an absence of gingivitis or other inflammatory conditions.	Healthy gums in primary dentition (baby teeth) are crucial for a child's overall dental health and set a foundation for the proper development of permanent teeth. Here are the key characteristics: 1. **Color**: Healthy gums are generally a light pink color in children, though they can vary slightly based on an individual's skin tone. Darker gums can still be healthy as long as they aren't red or pale. 2. **Texture**: The surface of healthy gums is smooth and firm, not swollen, inflamed, or puffy. It should have a consistent texture without any bulging or irregular contours. 3. **Moisture**: Normal, healthy gums are slightly moist, indicating proper hydration and blood flow. Dryness or flakiness can indicate an underlying issue. 4. **Firmness**: Gums should feel firm, not soft or spongy. Healthy gums are resilient and spring back quickly when touched.
	Maintaining these characteristics involves good oral hygiene practices, including regular brushing, flossing, and dental check-ups.	5. **No Bleeding**: When gums are healthy, they do not bleed easily, especially when brushing or flossing gently. Bleeding may signal inflammation, infection, or early signs of gum disease. 6. **No Pain or Sensitivity**: Healthy gums do not exhibit any discomfort, tenderness, or sensitivity to touch or temperature. Pain can indicate inflammation or infection. 7. **Adequate Gum Margins**: In healthy gums, the gumline should fit snugly around the teeth without noticeable recession or pulling away from the tooth surface. 8. **Minimal or No Plaque Accumulation**: Regular brushing and flossing should maintain minimal plaque around the gumline. Plaque buildup can lead to bacterial growth, causing gingivitis and other gum diseases. 9. **No Signs of Infection or Ulcers**: Healthy gums are free from sores, ulcers, or signs of infection, such as pus or visible pockets between the gums and teeth. In children, healthy gums are essential as they support the spacing, alignment, and development of primary teeth, which in turn influence the alignment and health of permanent teeth. Good oral hygiene practices like regular brushing, flossing, and professional dental check-ups help maintain these characteristics and prevent gum disease even at an early age.
18- What are the causes of gingival bleeding in adolescents?	Gingival bleeding in adolescents can be caused by various factors. Some of the most common causes include: Poor Oral Hygiene: Inadequate brushing and flossing can lead to the accumulation of plaque and tartar, which can cause gingivitis, an inflammation of the gums that results in bleeding.Hormonal Changes: Adolescents undergo	sider.ai ile konuşuldu Gingival bleeding in adolescents is typically influenced by a combination of oral hygiene practices, underlying systemic conditions, and lifestyle factors. Major causes include poor oral hygiene leading to plaque-induced

	significant hormonal changes, which can increase blood flow to the gums and make them more sensitive and prone to bleeding.Improper Brushing or Flossing Techniques: Aggressive brushing or flossing can damage the gums and cause them to bleed.Vitamin Deficiencies: Deficiencies in certain vitamins, particularly vitamin C (scurvy) and vitamin K, can lead to weakened gums and increased bleeding.Medications: Some medications, such as anticoagulants, can increase the risk of gum bleeding.Systemic Conditions: Certain systemic conditions, such as diabetes and blood disorders (e.g., leukemia), can affect gum health and lead to bleeding.Infections: Viral or bacterial infections can cause gum inflammation and bleeding.Orthodontic Appliances: Braces and other orthodontic devices can cause irritation to the gums, leading to bleeding.Tobacco Use: Smoking or using other forms of tobacco can irritate the gums and increase the risk of gingival bleeding.Trauma or Injury: Physical trauma to the gums from accidents, sports, or other activities can cause bleeding. It's essential for adolescents experiencing gingival bleeding to maintain good oral hygiene, have regular dental check-ups, and seek medical advice if the bleeding persists or is associated with other symptoms.	gingivitis, hormonal changes, diabetes, socioeconomic factors, and other health conditions affecting immunity. 1. **Plaque-Induced Gingivitis**: The primary cause of gingival bleeding in adolescents is often plaque-induced gingivitis. Inadequate brushing and flossing can lead to plaque accumulation, causing inflammation and bleeding in the gums (Tsilingaridis & Vagdouti, 2018, PDF). 2. **Diabetes**: Adolescents with poorly controlled diabetes experience increased gingival bleeding due to hyperglycemia, which impairs immunity and encourages bacterial growth in the oral cavity (Karjalainen & Knuuttila, 1996, PDF). 3. **Systemic Health Conditions**: Conditions like liver disease can cause oral manifestations, including gingival bleeding, indicating potential progression of the disease (Olczak-Kowalczyk et al., 2018, Wiley Online Library). 4. **Socioeconomic Factors**: Adolescents from lower socioeconomic backgrounds may have higher rates of gingival bleeding due to limited access to dental care and oral health resources (Sfreddo et al., 2019, Wiley Online Library). 5. **Hormonal Changes**: Puberty and related hormonal changes can increase the risk of gingival bleeding by causing more pronounced inflammatory responses to plaque (Al-Ghutaimel et al., 2014, PDF). 6. **Psychosocial Impact**: Adolescents who experience gingival bleeding may feel self-conscious, affecting their social interactions and quality of life, and in some cases, leading to incidents of bullying (Knorst et al., 2021, ResearchGate). 7. **Medication-Induced Gingival Overgrowth**: Certain medications, such as anticonvulsants and immunosuppressants, can lead to gingival overgrowth, which increases the likelihood of
		bleeding when inflamed (Oh et al., 2002, Wiley Online Library). 8. **Oral Hygiene Behaviors and Education**: Many adolescents report lack of awareness regarding the proper techniques of oral hygiene, leading to conditions like gingivitis. Educative interventions to promote awareness can significantly reduce incidences (Chrysanthakopoulos, 2016, Thieme Connect). 9. **Presence of Dental Calculus**: Dental calculus, often observed in adolescents with inconsistent oral hygiene practices, is another contributor to gingival bleeding and gingivitis (Chen et al., 2020, Springer). These factors collectively indicate that gingival bleeding in adolescents is often multifactorial, with both behavioral and systemic health components playing key roles.
19- What are the beneficial foods for maintaining oral health?	Maintaining oral health is crucial, and diet plays a significant role in achieving this. Here are some beneficial foods for maintaining oral health: Dairy Products: Milk, cheese, and yogurt are high in calcium and phosphates, which help rebuild tooth enamel and strengthen bones. Crunchy Fruits and Vegetables: Apples, carrots, and celery stimulate saliva production, which helps wash away food particles and bacteria. They also have a natural scrubbing action on teeth.Leafy Greens: Spinach, kale, and other leafy greens are rich in calcium, folic acid, and other essential vitamins and minerals that promote oral health.Nuts and Seeds: Almonds, walnuts, and sesame seeds provide essential nutrients such as calcium, phosphates, and vitamin D, which are crucial for healthy teeth and gums.Green and Black Tea: These teas contain polyphenols that can kill or suppress bacteria and plaque formation.Chewing Gum	Maintaining good oral health relies heavily on dietary choices that promote healthy teeth and gums while minimizing the risk of decay and gum disease. Certain foods offer beneficial nutrients that help strengthen teeth, protect enamel, stimulate saliva production, and fight bacteria. Here's an overview of some of the top foods for oral health: **1. Dairy Products (Milk, Cheese, and Yogurt)** • **Benefits**: Dairy products are rich in calcium, phosphates, and casein, which strengthen tooth enamel and bones. Cheese and yogurt, especially, are known to increase saliva production, which helps neutralize acids in the mouth and wash away food particles.

Appendix continued on the next page.

	with Xylitol: Xylitol is a natural sweetener that reduces cavities and increases saliva flow.Water: Drinking water, especially fluoridated water, helps wash away food particles and bacteria and keeps the mouth hydrated.Fatty Fish: Salmon, mackerel, and sardines are high in omega-3 fatty acids and vitamin D, which help reduce inflammation and support overall gum health.Berries and Citrus Fruits: These fruits are high in vitamin C, which helps maintain the health of the gums and other soft tissue in the mouth.Onions: They contain antibacterial sulfur compounds that kill various types of bacteria in the mouth. Incorporating these foods into your diet can help maintain and improve your oral health.	• **Nutrients**: High in calcium, phosphorus, and protein. **2. Leafy Greens (Spinach, Kale, and Broccoli)** • **Benefits**: Leafy greens are packed with vitamins and minerals that benefit oral health, especially calcium, which strengthens enamel. They also provide folic acid (a type of B vitamin) that may be beneficial for gum health, particularly for pregnant women. • **Nutrients**: Rich in calcium, folic acid, and fiber. **3. Apples and Pears** • **Benefits**: Apples and pears have high water content and are fibrous, which stimulates gums and promotes saliva flow, helping to wash away bacteria and food particles. The act of chewing these fruits also scrubs plaque from teeth. • **Nutrients**: High in fiber and vitamin C, which supports gum health. **4. Nuts and Seeds (Almonds, Walnuts, and Sesame Seeds)** • **Benefits**: These are high in minerals such as calcium and phosphorus, which help to remineralize and protect tooth enamel. Chewing nuts also promotes saliva production. • **Nutrients**: High in protein, calcium, and healthy fats. **5. Carrots and Celery** • **Benefits**: Crunchy vegetables like carrots and celery act as natural teeth cleaners. Their fibrous
		texture helps scrub away plaque, and they stimulate saliva production, which naturally reduces cavity-causing bacteria. • **Nutrients**: High in fiber, vitamin A (in carrots), and water content, supporting both enamel and gum health. **6. Fatty Fish (Salmon, Mackerel, and Tuna)** • **Benefits**: Fatty fish are a great source of vitamin D, which aids in calcium absorption. This vitamin supports healthy teeth and bones, and its anti-inflammatory properties benefit gum health. • **Nutrients**: High in omega-3 fatty acids, vitamin D, and phosphorus. **7. Green and Black Teas** • **Benefits**: These teas contain polyphenols, which have antibacterial properties that help reduce plaque and prevent tooth decay. They also contain fluoride, which strengthens enamel. • **Nutrients**: Rich in polyphenols, which fight harmful bacteria, and often contain fluoride, beneficial for enamel. **8. Oranges and Other Citrus Fruits** • **Benefits**: Citrus fruits, especially oranges, are high in vitamin C, which is essential for maintaining healthy gums. Vitamin C strengthens blood vessels and reduces inflammation, helping to prevent gum disease. • **Nutrients**: High in vitamin C, supporting connective tissue health in the gums.

		9. Whole Grains (Brown Rice, Whole Wheat Bread, and Oats) • **Benefits**: Whole grains are lower in simple sugars, reducing the risk of decay compared to refined grains. They are also high in magnesium, which helps strengthen teeth and bones. • **Nutrients**: High in fiber and magnesium, beneficial for tooth structure and general oral health. **10. Water** • **Benefits**: Staying hydrated is key for good oral health, as water helps wash away food particles and bacteria from the mouth. Drinking fluoridated water also strengthens tooth enamel. • **Nutrients**: Fluoride (in some water supplies) protects teeth from decay, while water itself aids in flushing out acids and sugars that cause cavities. **Tips for Optimal Oral Health Through Diet:** • **Limit Sugary and Acidic Foods**: Foods high in sugar and acid, like candies, soda, and citrus, can contribute to tooth decay and erosion. • **Chew Sugar-Free Gum**: Chewing gum after meals stimulates saliva production, which helps neutralize acids and wash away food particles. • **Eat Vitamin-Rich Foods**: A balanced diet rich in vitamins C and D, calcium, and phosphorus is crucial for strong teeth and healthy gums. Incorporating these foods into a balanced diet can help maintain a healthier oral environment, reducing the risk of cavities, gum disease, and enamel erosion while promoting strong, healthy teeth.
20- What are Nasymth membrane stains?	Nasmyth membrane stains refer to discolorations on the enamel of newly erupted teeth due to the presence of Nasmyth's membrane. Nasmyth's membrane, also known as the enamel cuticle or reduced enamel epithelium, is a thin tissue layer that covers the enamel surface of unerupted and newly erupted teeth. Here's more detailed information about Nasmyth membrane stains: Formation: Nasmyth's membrane is formed by the remnants of the ameloblasts (enamel-forming cells) and the enamel organ. It is present on the surface of the enamel until it is worn away by mastication (chewing) or cleaning. Appearance: The stains appear as a grayish or yellowish film on the surface of newly erupted teeth. They can also present as brownish or greenish discolorations in some cases.Causes: These stains are not true intrinsic stains but are instead due to the deposition of Nasmyth's membrane and its subsequent interaction with oral bacteria and food debris.Removal: The stains are typically temporary and can be removed with regular oral hygiene practices such as brushing and professional dental cleaning.Clinical Relevance: While not harmful, Nasmyth membrane stains can be a cosmetic concern for patients and may be one of the reasons parents bring children to the dentist shortly after the eruption of their teeth.	Nasymth membrane stains refer to discoloration caused by the "Nasmyth's membrane," a thin, organic film that initially covers the teeth of infants and young children. This membrane, also known as the "primary enamel cuticle" or "Nasmyth's membrane," is a remnant of the tissue that forms the enamel layer of teeth during development. It is particularly present at the time of tooth eruption and can lead to a superficial stain or coating on the teeth. **Key Points about Nasmyth's Membrane Stains:** 1. **Origin and Composition**: o Nasmyth's membrane consists mainly of enamel proteins and remnants of epithelial cells, specifically originating from the reduced enamel epithelium. o This film is usually thin and transparent but can sometimes take on a yellow or brownish tint, leading to visible stains on newly erupted teeth. 2. **Appearance and Duration**: o The membrane can appear as a light staining on the teeth, which may be brown, yellow, or even greenish. o Over time, this membrane typically wears away due to normal brushing, chewing, and exposure to the oral environment. 3. **Impact and Treatment**: o Nasmyth membrane stains are generally harmless and do not affect dental health. o Regular oral hygiene practices, including brushing, are often sufficient to remove the membrane as it naturally exfoliates.

Appendix continued on the next page.

		○ In cases where the stains are persistent, a dentist can assist in cleaning and polishing the teeth, but invasive treatments are typically unnecessary. 4. **Distinction from Other Dental Stains**: ○ Nasmyth's membrane stains differ from other common dental stains, such as those caused by dietary factors (coffee, tea, or smoking) or from intrinsic stains related to tooth structure. ○ These stains are temporary and primarily observed in younger children during the early stages of tooth eruption. This phenomenon is named after the Scottish anatomist Alexander Nasmyth, who made significant contributions to the understanding of tooth structure and development.
21- What is the ugly-duckling period?	The "ugly-duckling period" refers to a phase during a child's development, typically around the ages of 11 to 14, when their facial and dental appearance may temporarily appear awkward or unattractive. This term, derived from the story of "The Ugly Duckling" by Hans Christian Andersen, is used particularly in orthodontics and pediatric dentistry. During this period, children often experience: Mixed Dentition: The transition from primary (baby) teeth to permanent (adult) teeth, leading to an uneven or crowded appearance of the teeth. Jaw Growth: Rapid growth of the jaws and face, which may result in disproportionate facial features. Eruption of Permanent Teeth: The appearance of larger permanent teeth compared to the smaller primary teeth, often resulting in temporary spacing or crowding issues. This phase is usually temporary, and as growth continues, the teeth and facial features tend to become more	The "ugly-duckling period" typically refers to a stage in an individual's life—often during adolescence or early development—where their appearance, behavior, or skills might be seen as awkward or less appealing, but eventually, with growth and development, they transform into a more confident, skilled, or attractive version of themselves. This concept is derived from Hans Christian Andersen's famous fairy tale *The Ugly Duckling*, where a young, awkward-looking bird, often ridiculed by others, eventually matures into a beautiful swan. In modern contexts, the term can be used in various domains, including: 1. **Personal Development**: Adolescents may experience a phase where physical changes, self-consciousness, and emotional adjustments make them feel awkward. This is often a natural and
	harmonious and aesthetically pleasing. Orthodontic evaluation and potential intervention during this period can help address any significant issues and guide proper dental development.	temporary phase, followed by growth in confidence, social skills, and self-image. 2. **Professional Growth**: In careers, the "ugly-duckling period" can refer to a time when an individual may struggle to fit in, develop skills, or gain recognition. With experience, mentorship, and effort, they can evolve into a capable, successful professional. 3. **Artistic or Creative Pursuits**: Creative works sometimes go through "ugly-duckling" phases where early drafts or concepts seem unpolished or underdeveloped, but with refinement, they transform into something more impressive. In essence, the "ugly-duckling period" reflects the concept of hidden potential and eventual transformation, emphasizing patience and resilience in the face of challenges or self-doubt.
22- What are the treatment methods for long-term thumb sucking?	Long-term thumb sucking in children can lead to dental and orthodontic issues if not addressed. Here are some effective treatment methods: Positive Reinforcement: Praise and reward the child when they refrain from thumb sucking.Use a reward chart to track progress and give small incentives for reaching milestones.Behavioral Strategies:Distract the child with activities that keep their hands busy.Identify and address triggers that cause thumb sucking, such as stress or boredom.Thumb Guards or Finger Guards:Use a thumb guard or a finger guard to physically prevent thumb sucking. These devices are typically worn over the thumb or finger.Bitter-Tasting Nail Polish:Apply a safe, bitter-tasting nail polish to the thumb to discourage sucking.Positive Parenting Techniques:Offer comfort and support, focusing on positive reinforcement rather than punishment.Explain the reasons for stopping thumb	Long-term thumb-sucking, if persistent beyond early childhood, can lead to dental, speech, and behavioral challenges. For children who struggle to stop the habit, several treatment methods exist, combining psychological, behavioral, and physical interventions to support cessation effectively. Here are key treatment strategies used by health professionals and caregivers to address thumb-sucking in a supportive way: 1. **Positive Reinforcement**: ○ Rewards and praise can effectively reinforce a child's efforts to stop thumb-sucking. This might include sticker charts, praise, or small incentives for "thumb-free" days or hours. ○ Behavioral contracts, where the child and caregiver set goals and rewards for not thumb-sucking, can also build motivation.

	sucking in a way that the child can understand.Consultation with a Pediatric Dentist:Regular dental check-ups can help monitor the effects of thumb sucking.A pediatric dentist can provide guidance and, if necessary, fit the child with a dental appliance to discourage the habit.Orthodontic Intervention:In severe cases, orthodontic appliances like a palatal crib or a tongue crib may be used to prevent thumb sucking and guide proper oral development.Counseling or Therapy:If thumb sucking is related to emotional or psychological issues, professional counseling or therapy might be necessary to address underlying causes. Each child is unique, and a combination of these methods might be needed to effectively stop long-term thumb sucking. Consistency and patience are key to helping a child overcome this habit.	2. **Habit-Reversal Therapy**: o This approach involves teaching the child to become aware of the habit and replace it with a different, less harmful behavior, like squeezing a small toy or fidget tool. o Therapists often work on improving the child's self-control and impulse management, making it easier for the child to gradually reduce thumb-sucking. 3. **Dental Appliances**: o In cases where thumb-sucking is persistent and has caused dental issues, orthodontists may use devices like a "palatal crib" or "thumb guard." These are placed in the mouth to make thumb-sucking uncomfortable, often reducing the appeal of the habit. o These devices are typically recommended when other, less invasive methods have been unsuccessful. 4. **Physical Barriers**: o Covering the thumb with a bandage, sock, or special thumb guard can remind the child not to suck their thumb, especially during times they are more likely to engage in the behavior (e.g., bedtime). o These barriers are often used in combination with other methods to support overall behavior change. 5. **Counseling or Play Therapy**: o For children with underlying anxiety or emotional factors contributing to thumb-sucking, counseling or play therapy can be helpful. Therapists work with children to address stress or anxiety triggers and find alternative coping mechanisms. o Children are also encouraged to express feelings they might not know how to
		handle, making them less reliant on thumb-sucking for comfort. 6. **Bitter-Tasting Solutions**: o Some caregivers apply safe, bitter-tasting solutions (available over the counter) to the child's thumb to discourage sucking. The unpleasant taste serves as a gentle deterrent. o This method is generally more effective with older children who are consciously trying to stop the habit. 7. **Behavioral Timing**: o Some children suck their thumb at specific times, such as bedtime or when feeling anxious. Understanding these patterns allows caregivers to introduce alternative calming routines, such as reading or cuddling with a stuffed animal at night. o Creating a relaxing bedtime routine can reduce anxiety, making the child less likely to need thumb-sucking for self-soothing. 8. **Gradual Reduction Plans**: o Gradually reducing the frequency of thumb-sucking can be less stressful for children. For example, caregivers may agree with the child that they'll only suck their thumb during specific times, gradually reducing it over time. o This approach can help children slowly break the habit without feeling overwhelmed. 9. **Parental Modeling and Support**: o Parental guidance and positive modeling are essential; children benefit from having their caregivers as allies in the process rather than facing criticism or frustration.

Appendix continued on the next page.

		○ Caregivers can discuss thumb-sucking with empathy, providing reassurance and understanding as the child works through the process. Each child's reasons for thumb-sucking and ability to stop vary, so it's often a combination of methods that proves most effective.
23- What is Leeway space?	Leeway space refers to the difference in the combined mesiodistal widths of the primary canine, first molar, and second molar and their permanent successors (canine, first premolar, and second premolar). This space is crucial in orthodontics for proper alignment and occlusion of permanent teeth. Here are some key points about leeway space: Purpose: Leeway space helps accommodate the larger permanent teeth that replace smaller primary teeth, ensuring there is sufficient room for proper alignment.Differences in Size: The primary molars are generally larger than the premolars that replace them, creating extra space when the primary teeth are shed and replaced by permanent teeth.Orthodontic Importance: Proper management of leeway space can prevent or reduce the need for future orthodontic treatment by allowing the permanent teeth to erupt in a more favorable position.Typical Measurements: Leeway space typically measures about 1.5 mm per side in the mandible and about 0.9 mm per side in the maxilla, though this can vary. In summary, leeway space is a natural developmental feature that aids in the proper alignment of permanent teeth by utilizing the extra space left by the smaller primary teeth.	Leeway space is a dental term that refers to the extra space available in the dental arch created when the larger primary molars are replaced by the smaller permanent premolars. This space is essential in the development of a child's dental alignment and helps accommodate the larger permanent teeth as they erupt. Here's a breakdown of how it works: 1. **Primary vs. Permanent Tooth Size**: The primary (baby) molars are typically wider than the permanent (adult) premolars that replace them. When these larger baby molars are shed, the permanent premolars that take their place are smaller, leaving additional space in the arch. 2. **Importance in Dental Alignment**: The leeway space is significant because it allows for a natural correction of alignment issues. It provides additional room in the dental arch, which can help reduce crowding and allow proper alignment of the larger permanent teeth, particularly the canines and second molars. 3. **Clinical Relevance**: Dentists and orthodontists often monitor and manage leeway space, as it plays a critical role in determining whether a child will require orthodontic treatment to correct crowding or misalignment. Preserving this space, especially in cases where early tooth loss occurs,
		can help minimize future orthodontic interventions. Typically, the leeway space is around **1.5 mm per side in the upper arch** and **2.5 mm per side in the lower arch**. It varies among individuals but is a key factor in dental arch development and alignment. This concept is particularly important in pediatric dentistry and orthodontics, as proper use of leeway space can contribute to more favorable alignment of teeth without the need for extensive orthodontic treatment.
24- What are the types of primary dentition occlusal relationships?	Primary dentition occlusal relationships refer to the ways in which the upper and lower teeth come together in young children. The common types of primary dentition occlusal relationships include: Flush Terminal Plane: The distal surfaces of the upper and lower second primary molars are in the same vertical plane. This relationship often transitions into a class I permanent molar relationship. Mesial Step: The distal surface of the lower second primary molar is mesial to that of the upper second primary molar. This usually leads to a class I or class III permanent molar relationship. Distal Step: The distal surface of the lower second primary molar is distal to that of the upper second primary molar. This relationship is less common and can lead to a class II permanent molar relationship. Primate Spaces: These are naturally occurring spaces between primary teeth, specifically between the maxillary lateral incisor and canine, and the mandibular canine and first molar. These spaces are important for the proper alignment of permanent teeth. Leeway Space: This refers to the difference in size between the primary molars and the permanent premolars that replace them. This space helps in the proper alignment of the permanent molars.	Primary dentition occlusal relationships are classifications that describe the alignment and position of the upper and lower teeth in children's primary (baby) teeth. These relationships are essential for evaluating dental health, growth patterns, and predicting future occlusal development in permanent teeth. The primary types of primary dentition occlusal relationships include: **1. Flush Terminal Plane** • In the flush terminal plane, the distal surfaces (or back edges) of the primary second molars in both the upper and lower arches are aligned in a straight or "flush" position. • This alignment is relatively common in primary dentition and typically results in a class I or end-to-end molar relationship as permanent teeth start to erupt. **2. Mesial Step** • The mesial step is characterized by the distal surface of the lower primary second molar being

	Understanding these relationships is crucial for predicting future occlusal patterns and planning early orthodontic interventions if necessary.	positioned slightly forward (mesial) compared to the upper primary second molar. • This relationship often promotes a favorable transition to a class I permanent molar relationship and is a preferred occlusal feature. • In some cases, a pronounced mesial step can lead to a class III (underbite) occlusal relationship if the forward growth of the mandible is significant. **3. Distal Step** • A distal step relationship occurs when the distal surface of the lower primary second molar is located behind (distal) the upper primary second molar. • This is generally considered an unfavorable occlusal relationship, as it can lead to a class II permanent molar relationship (overbite). • Children with a distal step are more likely to develop malocclusions in their permanent teeth, which may require orthodontic intervention. **4. Excessive Overjet and Overbite** • These occlusal characteristics refer to the horizontal (overjet) and vertical (overbite) relationships between the upper and lower front teeth. • An excessive overjet is where the upper teeth protrude significantly over the lower teeth, while an excessive overbite describes a situation where the upper teeth overlap the lower teeth vertically to a large extent. • Both conditions can indicate underlying malocclusion tendencies, such as class II occlusion, and can affect function and aesthetics.
		5. Open Bite • In an open bite relationship, there is a lack of vertical overlap between the upper and lower anterior (front) teeth when the posterior teeth are in contact. • Open bites can be anterior (front teeth don't touch) or posterior (back teeth don't touch), and they can arise from habits like thumb-sucking or abnormal tongue positioning. • An open bite can interfere with proper chewing and speech development and may require correction depending on its severity. **6. Crossbite** • A crossbite occurs when one or more upper teeth bite inside the lower teeth, either in the anterior or posterior regions. • Crossbites can be unilateral (on one side only) or bilateral (on both sides) and are generally a sign of potential malocclusion. • This condition can affect jaw growth and function, sometimes resulting in facial asymmetry or discomfort. **Clinical Importance** Understanding these primary occlusal relationships helps dental professionals assess a child's likelihood of developing malocclusion in their permanent teeth. Early diagnosis allows for preventive or interceptive orthodontic treatments if necessary. Proper occlusal relationships in primary teeth also support good oral health, proper mastication, speech, and facial aesthetics.

Appendix continued on the next page.

25- What factors are involved in the etiology of bruxism in children?	Bruxism, or teeth grinding, in children can be caused by a variety of factors. These factors can be broadly categorized into psychological, physiological, and genetic components. Here are the main factors involved in the etiology of bruxism in children: Psychological Factors:Stress and Anxiety: Children who experience high levels of stress or anxiety may grind their teeth as a way to cope with these feelings.Behavioral Issues: Hyperactivity or other behavioral disorders can be associated with bruxism.Physiological Factors:Sleep Disorders: Conditions such as sleep apnea, snoring, and other sleep disturbances are commonly linked to bruxism.Malocclusion: Misalignment of the teeth or jaw can lead to bruxism as the body attempts to correct the bite.Pain: Earaches or teething pain can cause children to grind their teeth as a response to discomfort.Neurological Conditions: Certain neurological disorders may predispose children to bruxism.Genetic Factors:Family History: There may be a hereditary component to bruxism, as it can run in families.Other Factors:Lifestyle and Habits: Factors such as excessive caffeine consumption or poor oral habits (e.g., thumb sucking, nail biting) may contribute to bruxism.Medications: Some medications, particularly those affecting the central nervous system, can lead to bruxism as a side effect. Understanding these factors can help in the diagnosis and management of bruxism in children, often involving a multidisciplinary approach including dental, psychological, and sometimes medical interventions.	sider.ai ile konuşuldu Bruxism in children—a condition characterized by involuntary grinding or clenching of teeth, often during sleep—has a multifactorial etiology influenced by physical, psychological, and genetic factors. Research indicates that this condition arises from a combination of dental, psychosocial, and neurobiological elements rather than a singular cause. Here are some of the primary etiological factors discussed in recent studies: 1. **Psychological Factors**: Stress, anxiety, and emotional disturbances have been consistently linked to bruxism in children. Behavioral studies, such as those by Cardoso et al., highlight a significant correlation between stress and the manifestation of bruxism, indicating that emotional stress may exacerbate this condition Cardoso et al., 2012, Brazilian Dental Journal. 2. **Malocclusion and Dental Issues**: Malocclusion, or improper alignment of the teeth, is another possible contributor, though its role remains contentious. Some studies, like the review by Vanderas, suggest a potential link between dental occlusion issues and bruxism, though it may not be the primary factor Vanderas & Manetas, 1995, Pediatric Dentistry. 3. **Sleep Disorders and Parasomnias**: Studies suggest that bruxism is often associated with other sleep disorders. Research by Castroflorio et al. connects sleep bruxism in children with other parasomnias like night terrors and sleepwalking, proposing a neurological basis for the disorder Castroflorio et al., 2015, Archives of Oral Biology. 4. **Genetic Predisposition**: Genetic factors also play a role, with specific polymorphisms potentially influencing susceptibility to bruxism. Küchler et al. discovered that certain genetic
		markers might make children more prone to bruxism, thus implicating hereditary components Küchler et al., 2020, Journal of Clinical Pediatric Dentistry. 5. **Neurological and Central Nervous System (CNS) Factors**: CNS disorders and neurodevelopmental conditions may also contribute to bruxism, as seen in the study by Manfredini et al., where abnormal neurotransmitter levels and motor control issues are implicated Manfredini et al., 2017, International Orthodontics. 6. **Temporomandibular Joint (TMJ) Disorders**: The association between temporomandibular disorders (TMD) and bruxism is explored by Souza Barbosa et al., who suggest that TMJ dysfunction can lead to or exacerbate bruxism, particularly in children with musculoskeletal issues Souza Barbosa et al., 2008, International Journal of Pediatric Dentistry. 7. **Developmental Phases and Dental Transition**: Bruxism has been linked to phases of dental development, particularly during the transition from primary to permanent teeth. Studies like those by Machado et al. suggest that children experiencing occlusal instability may exhibit higher rates of bruxism Machado et al., 2014, Dental Press Journal. 8. **Other Risk Factors**: Environmental factors, such as caffeine intake and exposure to certain medications, may also increase the likelihood of bruxism, as discussed in comprehensive reviews like that of Guo et al. Guo et al., 2018, Archives of Oral Biology. In sum, the etiology of bruxism in children is complex and multifactorial, necessitating a holistic approach to

		diagnosis and management that considers psychological, genetic, dental, and neurological aspects. For more in-depth exploration, you may access some of these studies directly: • Bruxism in children: a warning sign for psychological problems (Journal of the Canadian Dental Association, 2006) • Sleep bruxism in children, from evidence to the clinic (Frontiers in Oral Health, 2023)
26- What are the obturation materials and techniques for primary tooth root canal treatment?	Obturation materials and techniques for primary tooth root canal treatment are designed to fill and seal the root canal system after it has been cleaned and shaped. The goal is to prevent the re-entry of microorganisms and to promote healing. Here are some commonly used materials and techniques: Obturation Materials: 1. Zinc Oxide Eugenol (ZOE): Widely used due to its good sealing ability and antimicrobial properties. Has anti-inflammatory properties.Easy to manipulate and remove if necessary.However, it can be resorbed faster than the primary tooth, potentially leading to voids. 2. Calcium Hydroxide: Known for its antimicrobial properties and ability to promote healing. It resorbs at a similar rate to the primary tooth. Used in paste forms and often combined with iodoform to enhance its properties. 3. Iodoform-based Pastes (e.g., Vitapex, Metapex):	sider.ai ile konuşuldu For primary tooth root canal treatment, obturation materials and techniques are carefully chosen to provide a hermetic seal while considering the tooth's unique anatomy and the biological requirements of primary teeth. Below is a summary of some widely researched materials and techniques used for primary teeth. **Commonly Used Materials** 1. **Zinc Oxide Eugenol (ZOE)**: A traditional material with antimicrobial properties, widely used due to its sealing ability and biocompatibility. ZOE is favored for its efficacy but is associated with some concerns regarding resorption and delayed exfoliation of primary teeth (Bawazir & Salama, 2006). 2. **Calcium Hydroxide**: Known for its ability to induce hard tissue formation, this material is effective but resorbs faster than the primary tooth's natural resorption, which may be unsuitable for long-term outcomes (Chonat et al., 2018).
	These pastes are pre-mixed and easy to apply. Have excellent radiopacity and antibacterial properties. They resorb in a manner consistent with the resorption of primary teeth. Suitable for primary teeth due to their resorbable nature. 4. Resilon: A thermoplastic, synthetic polymer-based root canal filling material. Similar to gutta-percha in handling but designed to be resorbable. Provides a good seal and biocompatibility. 5. Endoflas: A combination of ZOE, iodoform, and calcium hydroxide. Offers antimicrobial properties and good resorption characteristics. Obturation Techniques: 1. Lentulo Spiral: Used to place the obturation material deep into the root canal. Helps to distribute the material evenly and ensure thorough filling. 2. Syringe Delivery: Pre-mixed pastes like Vitapex or Metapex can be delivered using syringes. This method ensures accurate placement and minimizes voids. 3. Hand Instrumentation: Materials can be placed using endodontic hand files or pluggers. This technique can be used in combination with the lentulo spiral to ensure a good fill. 4. Pressure Syringe:	3. **Iodoform-based Pastes**: Endoflas, which includes iodoform, is used for its antibacterial effects and easy application. Studies indicate it as effective with a high success rate for infected primary teeth (Gandhi et al., 2017). 4. **Mineral Trioxide Aggregate (MTA)**: Recently introduced for primary teeth, MTA promotes regeneration and shows favorable outcomes for pulpal and periapical health. However, it is expensive and can be challenging to handle in smaller root canals (Manchanda & Sardana, 2020). 5. **Vitapex (Calcium Hydroxide and Iodoform)**: This material combines the benefits of both iodoform and calcium hydroxide, facilitating resorption with the tooth and ease of application. Vitapex has shown high clinical success and ease in placement (Vashista et al., 2015). **Techniques for Obturation** 1. **Lentulospiral Technique**: A popular method using a lentulo spiral instrument to deliver paste materials like ZOE deep into the canal system, offering uniform distribution (Vashista et al., 2015). 2. **Pressure Syringe Technique**: This technique allows for controlled material delivery with less extrusion risk, suitable for paste-like materials like Endoflas (Bhandari & Prajapati, 2012). 3. **Disposable Injection Technique**: Developed for primary teeth, this method facilitates precise delivery of obturating materials and has shown success in clinical trials for ease and effectiveness (Bhandari & Prajapati, 2012). 4. **Rotary vs. Manual Instrumentation**: Rotary instrumentation in obturation has been compared with manual techniques, with rotary approaches

Appendix continued on the next page.

	Used to deliver calcium hydroxide or ZOE into the canal under controlled pressure.Ensures that the material reaches the apex and fills all canal irregularities.Considerations:The choice of material and technique depends on the tooth's condition, the extent of infection, and the dentist's preference.The material should be biocompatible, resorbable at a rate similar to the primary tooth, and have good sealing and antimicrobial properties.It is essential to avoid overfilling to prevent damage to the underlying permanent tooth. These materials and techniques aim to provide a reliable and biocompatible seal, promoting the healing of periapical tissues and ensuring the integrity of the primary tooth until its natural exfoliation.	showing reduced procedure time and improved obturation quality, particularly in curved canals (Ochoa-Romero et al., 2011). 5. **Thermoplasticized Techniques**: Although more commonly used in permanent teeth, adapted versions of thermoplasticized techniques have been attempted in primary teeth for their uniform filling and compact seal, though they require specialized equipment and expertise (Kulkarni, 2017). **Emerging Perspectives** 1. **Polymer-Based Prototypes**: Studies on polymer-based obturation materials aim to combine durability with ease of application in primary teeth, though these are still under investigation for broader use (Aragão & Pintor, 2020). 2. **Sealing Materials**: New sealing techniques focus on reducing microleakage and enhancing root canal filling quality. Studies underscore that proper sealing significantly impacts the success rate, with MTA and other bio-ceramic materials emerging as promising candidates for primary teeth (De-Deus et al., 2014). **Further Reading and Access to Studies** 1. Clinical Assessment of Obturating Techniques - Gandhi et al., 2017 2. Root Canal Obturation Methods - Bawazir & Salama, 2006 3. Comparative Evaluation of Obturation Techniques - Vashista et al., 2015 4. Review of Root Canal Materials - Aragão & Pintor, 2020 5. Evaluation Using CBCT - Singh et al., 2015

		These studies offer insights into the ongoing evolution in materials and techniques for primary tooth obturation, focusing on safety, efficacy, and alignment with the natural exfoliation process of primary teeth.
27- What are the materials used in primary tooth pulpotomy?	In primary tooth pulpotomy, several materials can be used to achieve successful outcomes. These materials can be broadly categorized into medicaments used for vital pulpotomy and those used for non-vital pulpotomy. Here are some commonly used materials: Medicaments for Vital Pulpotomy: 1. Formocresol: Historically the most commonly used material. It is a mixture of formaldehyde and cresol in a water-glycerin base. Effective but has concerns regarding toxicity and potential carcinogenicity. 2. Ferric Sulfate: Acts as a hemostatic agent. Less toxic than formocresol. Can be used as a medicament in vital pulpotomy. 3. Mineral Trioxide Aggregate (MTA): Biocompatible material with excellent sealing properties. Promotes healing and regeneration of the pulp tissue. Higher cost but preferred for its superior outcomes. 4. Calcium Hydroxide: Promotes the formation of a dentinal bridge. Has antimicrobial properties. However, it can cause internal resorption if not used correctly. 5. Sodium Hypochlorite:	sider.ai ile konuşuldu Primary tooth pulpotomy, a common dental procedure for preserving the vitality of young teeth affected by decay or trauma, involves the use of various materials, each with specific biological properties to enhance healing and protect the pulp. Research highlights a range of materials for pulpotomy in primary teeth, categorized broadly by their antimicrobial properties, bioactivity, biocompatibility, and success rates in clinical settings. **Key Materials Used in Primary Tooth Pulpotomy** 1. **Formocresol (FC)**: Traditionally popular due to its antimicrobial properties and fixation capability, FC has been widely used in pulpotomy. However, concerns regarding its potential toxicity and systemic effects have led to a decline in its preference. o *Simancas-Pallares et al., 2010* provide an overview, suggesting a need for less toxic alternatives while acknowledging FC's historical success in primary teeth treatments (Medicina Oral, Patología Oral y Cirugía Bucal). 2. **Mineral Trioxide Aggregate (MTA)**: MTA is known for excellent sealing ability and biocompatibility, making it a reliable choice for primary teeth pulpotomies. MTA encourages tissue regeneration, promoting success rates similar or superior to formocresol.

	Used for its antimicrobial properties. Can be used as an irrigant during the procedure. Medicaments for Non-Vital Pulpotomy: 1. Zinc Oxide Eugenol (ZOE): Commonly used as a temporary filling material. Provides good sealing but may cause some irritation to the pulp tissue. 2. Iodoform-based Pastes: Such as KRI paste or Vitapex.Used for their antimicrobial properties and ease of use. Promote healing and are resorbable. 3. Antibiotic-Corticosteroid Pastes: Such as Ledermix paste. Used to reduce inflammation and infection. Other Materials: 1. Biodentine: Similar to MTA but with easier handling properties. Promotes dentin regeneration and has excellent biocompatibility. 2. Laser Treatment: Diode lasers can be used for pulpotomy procedures. They provide disinfection and hemostasis. 3. Electrosurgery: Can be used for tissue removal and hemostasis during pulpotomy.	○ *Fuks et al., 2006* discuss MTA's success rates and highlight its biocompatibility as a vital benefit for pulp therapy (SpringerLink). 3. **Ferric Sulfate**: Used for its hemostatic properties, ferric sulfate acts by coagulating blood proteins, which provides a favorable environment for healing. Studies show ferric sulfate is comparable to formocresol but lacks toxicity concerns. ○ *Junqueira et al., 2018* demonstrate its effectiveness as an alternative to FC, especially when paired with compatible restoration materials (SciELO). 4. **Biodentine**: A bioactive dentin substitute with properties akin to MTA, Biodentine exhibits high success in pulpotomy procedures. Its biocompatibility and ability to induce hard tissue formation make it favorable for pulpotomy in primary molars. ○ *Shafaee et al., 2019* compare the effectiveness of Biodentine with other materials, underscoring its potential as a substitute for MTA (Elsevier). 5. **Calcium Hydroxide (CH)**: Often used as a pulp-capping agent, CH is biocompatible and induces calcific barrier formation. However, its tendency to disintegrate over time has led to less frequent use in favor of MTA or Biodentine. ○ *Oliveira et al., 2013* evaluate CH's efficacy, citing its limited durability compared to newer alternatives like MTA (ResearchGate). 6. **Zinc Oxide Eugenol (ZOE)**: Frequently paired with other agents, ZOE provides excellent sealing but has shown variable success rates depending on the case and type of restorative procedure. ○ *Çelik et al., 2019* describe ZOE's performance as a pulpotomy agent in
	These materials are chosen based on the clinical situation, the health of the remaining pulp tissue, the operator's preference, and the evidence supporting their efficacy and safety.	combination with other materials (SpringerLink). 7. **Sodium Hypochlorite (NaOCl)**: Sodium hypochlorite is used as an irrigant in pulpotomy to achieve pulp disinfection. Though effective, it's often used in controlled concentrations due to its potential to irritate tissues. ○ *Ranly, 1994* highlights sodium hypochlorite's antiseptic properties, emphasizing careful application to avoid complications (AAPD). 8. **Laser-Assisted Pulpotomy Materials**: Emerging studies suggest laser techniques combined with biocompatible materials like MTA or Biodentine may enhance success rates by reducing bacterial load and promoting hemostasis. ○ *Sonmez et al., 2008* discuss the adjunctive role of laser in improving pulpotomy outcomes in combination with bioactive materials (Elsevier). These materials illustrate the evolving approach in primary tooth pulpotomy, where biocompatibility, regenerative capacity, and reduced toxicity are prioritized for optimal outcomes. The trend towards bioactive materials like MTA and Biodentine reflects a shift from traditional agents, aiming for both safety and long-term success in young patients.
28- What are the indications for regenerative endodontic treatment?	Regenerative endodontic treatment (RET) is an innovative approach aimed at regenerating the damaged pulp-dentin complex. The indications for RET are specific and typically include: Immature Permanent Teeth with Necrotic Pulps: This is the primary indication. RET is often considered for young patients with immature teeth where conventional root	Regenerative endodontic treatment (RET) has gained traction as a biological approach to treat immature teeth with necrotic pulp, allowing continued root development and healing of periapical tissues. RET primarily aims to promote apexogenesis and restore the vitality of dental tissues in cases where traditional root canal treatment may not be ideal. Indications for RET typically focus on immature teeth, but certain factors and case specifics also

Appendix continued on the next page.

	canal treatment might not be feasible or desirable due to the risk of weakening the tooth structure. Apexogenesis in Teeth with Open Apices: RET can promote continued root development and apical closure, which is beneficial in cases where the root formation is incomplete.Teeth with Thin Root Walls: Teeth that have thin root walls are prone to fractures. RET helps to thicken these walls through continued root development and dentin formation.Necrotic Pulp with or without Symptoms: RET is indicated for teeth with necrotic pulp, whether symptomatic or asymptomatic, especially if traditional endodontic treatment options are likely to result in a compromised structural integrity of the tooth.Teeth with Periapical Pathosis: RET can be considered in cases where there is an apical periodontitis or periapical abscess, provided the tooth meets the other criteria for regenerative treatment.Patient's Age: Typically, younger patients are better candidates for RET because their stem cells are more active, and their healing capacity is greater compared to older individuals.Potential for Stem Cell Activity: The tooth must have the potential for the activity of residual stem cells in the apical papilla, which can contribute to the regenerative process. RET is usually not recommended for teeth with mature apices, heavily calcified canals, or in cases where there is significant periodontal involvement that compromises the overall prognosis of the tooth. Each case must be carefully evaluated to determine if RET is the best treatment option.	influence the choice of RET. Below are the primary indications for RET: **1. Immature Permanent Teeth with Necrotic Pulp and/or Apical Periodontitis** • RET is especially beneficial for immature teeth with open apices, where traditional endodontic procedures are challenging due to incomplete root development and thin dentinal walls. • The regenerative approach encourages continued root development and thickening of the dentinal walls, improving long-term tooth integrity. **2. Teeth with Periapical Lesions** • For teeth showing apical periodontitis or periapical radiolucency due to pulp necrosis, RET can help resolve infection and stimulate periapical tissue healing, which is often preferable over conventional treatments in immature teeth. **3. Teeth with Thin Root Walls or High Risk of Fracture** • Immature teeth with thin dentin walls are prone to fractures if treated with traditional endodontics. RET allows for the strengthening of root structure through continued deposition of hard tissue, reducing fracture risk. **4. Cases Requiring Apexogenesis or Continued Root Development** • RET is indicated for teeth that still require apexogenesis (apical root end development). By
		facilitating tissue regeneration, RET can stimulate continued growth and closure of the apex. **5. Young Patients with Favorable Health and Compliance** • RET is often more successful in younger patients who generally have higher healing potential. This includes children and adolescents with underdeveloped roots and open apexes. • The patient's overall health and immune response significantly impact treatment outcomes. Compliance is essential since RET typically involves multiple appointments and requires follow-up. **6. Absence of Severe Canal Calcifications or Obstacles** • Teeth with minimal calcifications or other structural barriers in the canal may be better candidates for RET, as these conditions can hinder the placement and efficacy of regenerative materials. **7. Absence of Large, Severe Root Resorptive Defects** • RET may be less effective if the root has significant external resorption, as extensive structural damage can impair tissue regeneration. **8. Teeth with Restorable Crowns** • Teeth with crowns that can be restored effectively are preferred for RET, as the regenerative process depends on a stable environment. A

		restorable crown prevents bacterial ingress, improving success rates. **Key Contraindications and Limitations to Consider:** While RET offers promising results for immature necrotic teeth, it's generally not recommended for: • **Mature teeth** with closed apices, as the regenerative potential is limited. • Teeth with **severe fractures or non-restorable crowns**, which compromise success. • Cases with significant **comorbid conditions** affecting healing potential (e.g., uncontrolled diabetes or immune deficiencies). • Patients with **poor compliance** for necessary follow-ups and meticulous oral hygiene. **Clinical Evidence**: Studies show high success rates in RET for immature teeth, with documented cases of apexogenesis, root lengthening, and increased dentin thickness in treated teeth. The regenerative approach has helped maintain tooth vitality and strength, reducing fracture risks over time.
29- What is lesion sterilization tissue repair?	Lesion Sterilization Tissue Repair (LSTR) is a treatment concept used in endodontics, particularly for treating primary teeth with pulp infections. This approach focuses on sterilizing the lesion and promoting tissue repair rather than conventional root canal treatment. Here are the key components of LSTR: Sterilization: The primary goal is to eliminate or significantly reduce the microbial load in the infected pulp tissue. This is typically achieved using a combination of antibiotics and disinfectants directly applied to the infected	Lesion Sterilization and Tissue Repair (LSTR) therapy is a dental treatment technique focused on managing infected root canals in a minimally invasive way, especially in pediatric dentistry. It aims to eliminate infection within the root canal system and stimulate natural tissue repair without requiring extensive root canal procedures. This method is particularly beneficial for treating tooth decay and pulpitis (inflammation of dental pulp) in primary (baby) teeth and, in some cases, immature permanent teeth.
	area. Tissue Repair: Once the lesion is sterilized, the focus shifts to promoting natural healing and repair of the affected tissues. This involves creating a favorable environment for the tissue to regenerate and heal. Minimally Invasive: LSTR is considered a minimally invasive procedure compared to traditional root canal therapy. It aims to preserve as much of the natural tooth structure as possible. Antibiotic Mixture: A commonly used mixture in LSTR includes a combination of metronidazole, ciprofloxacin, and minocycline, known as the "3Mix-MP" antibiotic paste. These antibiotics are effective against a wide range of bacteria found in infected dental tissues. Application: The antibiotic mixture is applied directly into the pulp chamber and left in place for a period, usually covered with a temporary filling material. The duration and number of applications can vary depending on the severity of the infection. Indications: LSTR is particularly useful in cases where conventional root canal treatment might be challenging, such as in primary teeth or in patients who are not suitable candidates for more invasive procedures.Outcomes: The success of LSTR depends on thorough sterilization of the lesion and the body's ability to heal and regenerate the tissue. Follow-up appointments are crucial to monitor the healing process and ensure the infection does not recur. LSTR offers a less invasive alternative to traditional endodontic treatments, aiming to preserve natural tooth structure and promote healing in infected dental tissues.	Here's an outline of how LSTR works, its components, and its benefits: **1. Methodology and Approach:** • LSTR utilizes a mixture of specific antibacterial medications applied directly into the infected root canal. These drugs work together to sterilize the lesion and reduce the bacterial load without the need for mechanical instrumentation of the canal. • The treatment involves applying an antibacterial paste containing a combination of antibiotics—usually a "triple antibiotic paste" of metronidazole, ciprofloxacin, and minocycline. These antibiotics target a broad spectrum of bacteria within the root canal, helping to sterilize the tissue effectively. **2. Purpose and Application:** • This approach is used to treat teeth with irreversible pulpitis, necrotic pulp, and chronic apical periodontitis (infection at the root tip). It's especially effective for children and in cases where traditional root canal treatment might be challenging or less ideal due to the patient's age, tooth structure, or other factors. • In LSTR, the goal is to reduce infection sufficiently to allow the tooth's own repair mechanisms to restore the tissue. This minimizes the need for extensive root canal treatment, which can be difficult and costly for young patients. **3. Advantages:** • **Minimally Invasive**: Traditional root canal procedures often require extensive drilling and removal of pulp tissue. In contrast, LSTR involves

Appendix continued on the next page.

		minimal removal of tissue, focusing instead on sterilizing the infected area. • **Effective in Pediatric Dentistry**: Since children may struggle with the discomfort and length of root canal treatment, LSTR provides a viable alternative that can be quicker and less painful. • **Promotes Natural Healing**: By sterilizing the tissue, LSTR enables the body's natural healing processes to repair the affected area, potentially allowing the root and tooth structure to continue developing in young patients. **4. Challenges and Considerations:** • Although LSTR can be effective, there are some concerns about the discoloration of teeth due to the minocycline component. Alternative antibiotic combinations or additives are sometimes used to counteract this issue. • Additionally, LSTR may not be suitable for all cases, especially in adults or in severely damaged teeth that might require more comprehensive treatment. **Clinical Outcomes and Research:** Research on LSTR therapy has demonstrated success in reducing bacterial infection and promoting healing, though the technique is generally more common in Japan and certain Asian countries. Studies continue to explore its efficacy, long-term success rates, and potential as an alternative to conventional root canal therapy. In summary, Lesion Sterilization and Tissue Repair is a promising approach, particularly for pediatric dental care, focusing on minimally invasive infection control and enabling natural tissue repair in infected root canals.
30- In what cases is Cvek pulpotomy applied?	Cvek pulpotomy, also known as partial pulpotomy, is a dental procedure used primarily in the following cases: Traumatic Pulp Exposure: When a tooth has suffered trauma resulting in pulp exposure, particularly in young permanent teeth with incomplete root formation. The aim is to preserve pulp vitality and allow continued root development (apexogenesis). Inflamed Coronal Pulp: In cases where the coronal pulp is inflamed but the inflammation has not extended to the radicular pulp. This is often identified through clinical and radiographic examination.Reversible Pulpitis: When the tooth exhibits symptoms of reversible pulpitis, such as sensitivity to temperature changes, without spontaneous pain or signs of irreversible pulpitis.Vital Pulp Therapy: For teeth that require vital pulp therapy due to carious or traumatic exposure, provided there is a favorable prognosis for maintaining pulp vitality.Young Permanent Teeth: Particularly useful in young permanent teeth with immature apices, as it helps in the preservation of vital pulp tissue and allows for the continued development of the root. The procedure involves removing the inflamed pulp tissue just beneath the exposure site and covering the remaining healthy pulp with a suitable material to promote healing and repair. Common materials used include calcium hydroxide, mineral trioxide aggregate (MTA), and biodentine. The tooth is then restored with a suitable permanent restoration.	Cvek pulpotomy, a type of partial pulpotomy, is primarily applied in cases of traumatic dental injuries in young permanent teeth, particularly when the tooth's pulp is exposed but not infected or necrotic. This procedure is valuable for preserving the vitality of the dental pulp, allowing for continued root development in immature teeth. Here are some specific cases where Cvek pulpotomy is typically applied: 1. **Traumatic Pulp Exposure**: This is the most common indication. If a tooth sustains a fracture that exposes the pulp, a Cvek pulpotomy can be performed to remove the inflamed pulp tissue in the crown and protect the remaining healthy pulp tissue in the root. 2. **Pulp Exposure in Young Permanent Teeth**: In children and adolescents with incompletely developed roots, Cvek pulpotomy allows continued root growth and apical closure (apexogenesis), which is critical for the long-term retention of the tooth. 3. **Minimally Infected Pulp**: When pulp exposure has occurred, but only a small portion of the pulp tissue is inflamed or infected, a Cvek pulpotomy can help in maintaining the vitality of the remaining healthy pulp. 4. **Enamel-Dentin Fracture**: In cases where a tooth has fractured and exposed the pulp but has minimal inflammation or bacterial contamination, Cvek pulpotomy is often preferred over full pulpotomy or root canal treatment to retain as much of the healthy pulp as possible. 5. **Favorable Prognosis with Pulp Exposure**: Cvek pulpotomy is also indicated when the injury

		occurred recently, typically within a few days, and the prognosis for preserving the pulp tissue is high. The technique is less successful if the pulp has been exposed for a prolonged period without intervention. 6. **Permanent Teeth with Immature Roots**: The procedure is particularly beneficial in permanent teeth with immature roots, where pulpal vitality is needed for continued root development. In mature teeth with a closed apex, full root canal treatment may be more appropriate if the pulp is compromised. **Procedure Summary** During a Cvek pulpotomy, the dentist removes only the superficial portion of the exposed pulp, followed by placement of a biocompatible material such as calcium hydroxide or mineral trioxide aggregate (MTA) to protect the remaining pulp tissue. This limited approach aims to maintain pulpal health while allowing natural root growth and apex formation in younger patients. **Advantages** Cvek pulpotomy has several advantages: • Preserves tooth vitality • Allows continued root formation and strengthening in immature teeth • Minimally invasive compared to root canal therapy • High success rates, especially when used in the right cases In summary, Cvek pulpotomy is primarily applied in cases of recent, minor pulp exposure from trauma in young permanent teeth where preserving the pulp's vitality is essential for ongoing development.