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Evaluating the content of AI-generated (ChatGPT) responses on clear retainers

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Abstract

Objective: To evaluate the correctness of ChatGPT's answers pertaining to clear retainers in orthodontics.
Materials and Methods: This study conducted a cross-sectional analysis of content of responses by ChatGPT for a set of questions about clear retainers. A total of 58 questions were created by an orthodontist, based on particular domains and within them, particular subdomains. The content generated by AI were independently assessed for accuracy by two orthodontists. A pre-piloted four-point scale was used to rate the answers. Descriptive statistical assessment was carried out on the data.
Results: The cumulative mean score reflecting the accuracy of the full dataset was (1.70 ± 0.53). Approximately 67% of the AI-produced responses were assigned a rating of objectively true, 29% consisted of selected facts, while 4% fell under the category of minimal facts. Inaccurate information provided by ChatGPT was about patient-reported adverse effects (2.25 ± 0.5), microbiological composition (3 ± 0), knowledge, information, and satisfaction (2 ± 0.64), and patient-clinician relationship (2.25 ± 0.95).
Conclusion: ChatGPT's responses to clear retainer-related questions were frequently inaccurate and lacked citations to reliable sources. The AI also had limitations in providing current and precise information. Because of this, clinicians and patients should approach its answers with caution, as they may contain errors or omit crucial details.

Keywords: Artificial Intelligence, Orthodontics, AI, ChatGPT, Retainers, Clear Retainers, Retention

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1. Introduction

ChatGPT, developed by OpenAI and launched in November 2022, the Artificial intelligence (AI) has seen significant advancement. The AI, as a large language model (LLM), it generates responses that mimic human conversation. ChatGPT uses a generative pre-trained transformer (GPT) structure, processing natural language through neural networks to provide context-sensitive answers.[1] Its strength lies in delivering accurate, highly detailed responses, drawing from an extensive database of information from the internet.[2]

The versatility of ChatGPT is evident in its ability to respond in various languages and writing styles while understanding the context of each query. This makes it highly efficient at automating conversations and answering questions, offering both time and resource savings.[2]

Due to its training on large datasets, ChatGPT often provides more accurate answers than manual responses, surpassing other natural language processing (NLP) systems.[2] However, there are certain limitations, such as security concerns related to potential adversarial attacks, which could distort the quality of its outputs. Additionally, ChatGPT lacks the ability to access real-time data, limiting its ability to provide current or highly specific answers to complex inquiries.[2]

As technology advances, both healthcare providers and patients increasingly turn to Artificial intelligence-based bots and web search tools for healthcare and dental knowledge.[3] Due to their conversational approach and seemingly precise answers, many individuals have come to depend more heavily on these tools for healthcare information, sometimes instead of consulting trusted professionals for reliable information.[3] The risks tied to this growing trend have been well-documented in healthcare literature, emphasizing the importance of caution and the need for clear warnings.[4]

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Clear retainers, which are increasingly popular for their aesthetic appeal, are one such topic of interest. Patients frequently use ChatGPT to learn about clear retainers, Despite this, the accurateness, dependability, and validity of the information offered on this subject have not been extensively assessed. This study aims to examine how well ChatGPT provides information about clear retainers, with the hypothesis that its responses will be accurate and dependable. This research hypothesized that ChatGPT's replies concerning clear retainers would exhibit consistent accuracy and reliability.

2. Materials and Methods

The study involved a cross-sectional analysis of responses produced by ChatGPT addressing questions about clear retainers. In this cross-sectional study, few questions were to be asked to ChatGPT and their responses were to be measured. For the purpose of this analysis, the ChatGPT-4o model was used. The dataset initially consisted of 58 questions, which were formulated by one author and subsequently was finalized after collaborative discussions with 4 orthodontists.

These questions were organized into 12 primary treatment outcome domains and 28 related subdomains outlined by Tsichlaki et al., who employed a standardized framework incorporating outcomes relevant to both patients and clinicians.[5]

To maintain consistency, a single author collected all AI-generated responses to the 58 questions. Data were systematically entered, organized, and assessed using an Excel spreadsheet. Four orthodontists independently evaluated the accuracy of the collected responses. Each evaluator reviewed the answers in the context of the most current and reliable orthodontic evidence, including clinical guidelines, peer-reviewed literature, and accepted standards of care. This evaluation aimed to determine how closely the AI's answers aligned with scientifically validated information and clinical relevance. The evaluation process was based on the most reliable evidence available, and the responses were rated using a modified four-point scale:

1. Objectively true;
2. Selected facts;
3. Minimal Facts;
4. False[6]

This scoring framework allowed the researchers to systematically evaluate the fidelity of ChatGPT's responses in the context of clear retainer-related queries, ensuring both objectivity and clinical relevance in the assessment process. To ensure consistency in scoring, a discussion was held in advance to clarify the rating guidelines for all evaluators.

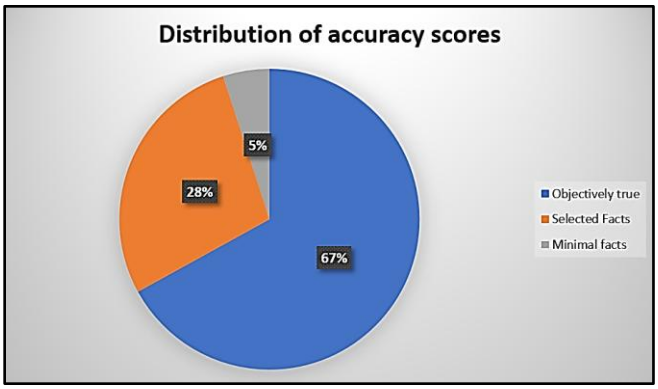
Fleiss'-kappa test was done between the raters to assess the level of agreement beyond chance. Flesch-Kinciad test was done to assess readability of the test.

2.1. Statistical analysis

The data was summarized using basic, simple descriptive statistics. Mean accuracy scores along with their standard deviations were presented for each question individually, as well as for each domain, subdomain, and the overall dataset.

3. Result

Out of the 58 questions across the full set, the average accuracy score was (1.70 ± 0.53). Around 67% of the answers that were provided by the AI were in the objectively true category, 28% of answers fell into the selected facts category, and 5% fit in the minimal facts category (**Graph 1**).



Graph 1: Distribution of accuracy scores

Table 1: Mean scores calculated for each domain, subdomain, and individual question within the domain

Domain	Subdomain	Questions	Mean score/Question		Mean score/Subdomain		Mean score/Domain	
			Mean	SD	Mean	SD	Mean	SD
1) Harm	a. Pain	1. Are clear retainers associated with more or less pain compared to fixed retainers?	1	0	2	0.9	1.64	0.34
		2. Do clear retainers cause more discomfort/irritation as compared to fixed lingual retainers?	2	0.81				
	b. Halitosis	1. Do clear retainers adversely affect the breath?	1.5	0.57	1.75	0.57		
		2. What causes bad breath more, clear retainers or fixed retainers?	2	0				
	c. Mucosal Irritation	1. Are clear retainers associated with irritation to lips and cheeks?	1.75	0.5	1.67	0.5		
		2. Are clear retainers associated with mucosal ulceration?	1.75	0.5				

		3. Are clear retainers associated with gingival irritation?	1.5	0.5				
2)Patient Reported Adverse Events		1. What are the most common reported adverse events with clear retainers?	2.25	0.5			2.25	0.5
3) Function	a. Speech	1. Is there any effect of the clear retainers on speech?	1.5	0.57	1.5	0.57	1.67	0.11
	b. Other (Function)	2. Do clear retainers have an effect on chewing efficacy?	2	0.81	2	0.81		
	c. Habits	3. Does clear retainer wear reduce tendency of clenching and bruxism for TMD subjects?	2	0.81	2	0.81		
4)Periodontal Outcome	a. Periodontial Health	1. Are clear retainers associated with more gingival recession as compared to fixed lingual retainers?	1.5	0.57	1.5	0.57	1.5	0.57
		2. Do clear retainers cause gingival inflammation?	1.5	0.57				
		3. Are clear retainers associated with more gingival inflammation as compared to fixed lingual retainer?	1.5	0.57				
5)Microbiological/ Physiological	a. Microbiological Composition	1. Do clear retainers alter the microbial composition of the oral cavity?	1.5	0.57			2.5	0.86
		2. Do clear retainers promote more plaque formation as compared to fixed lingual retainers?	3	0				
	b. Salivary pH	3. Do clear retainers alter salivary pH?	3	0	3	0		
6)Knowledge, Information, and Satisfaction	a. Information Comprehension	1. Are patient instructions regarding wear of clear retainers easy to comprehend for patients?	1.75	0.5	1.75	0.5	2	0.64
	b. Satisfaction	2. Are patients more satisfied with clear retainers as compared to fixed lingual retainers?	1.25	0.5	1.25	0.5		
	c. Self-esteem and Confidence	3. Does clear retainer result in more confidence in patients as compared to fixed lingual retainer?	3	0	2.87	0.5		
		4. Does clear retainer result in better self-esteem in patients as compared to fixed lingual retainer?	2.75	0.5				
	d. Retainer Impact	5. Do clear retainers affect eating?	1.5	0.57	1.75	0.13		
		6. Do clear retainers affect sleeping?	1.75	0.5				
		7. Is oral health-related quality of life better in the clear retainers when compared to fixed retainers?	2	0.81				
7) Compliance	a. Retainer Breakage	1. How frequently reported are the clear retainer breakages?	1.5	1	1.37	0.25	1.46	0.28
		2. What will happen if I lose my retainer?	1.25	0.5				
	b. Oral and Retainer Hygiene	3. What are the methods of disinfecting and cleaning of clear retainers?	1.25	0.5	1.41	0		
		4. How easy is it to clean clear retainers?	1.25	0.5				
		5. Do patients with clear retainers have oral hygiene which is superior compared to those with fixed lingual retainer?	1.75	0.5				
		6. What are the methods used for measuring the compliance of the patients wearing clear retainers?	1.25	0.5				
	c. Duration of Retainer Wear	7. What is common duration of retainer wear with clear retainers?	1.5	0.57				
	d. Attendance	8. How frequently do I have to visit the orthodontist when I am wearing clear retainers?	2	0				
8)Cost and Effectiveness	a. Cost	1. Are clear retainers more expensive as compared to fixed lingual retainer?	2	0.81	2	0	1.83	0.28
		2. Is alignment more stable with clear retainers?	2	0.81				
	b. Effectiveness	1. Are clear retainers just as effective in retention as compared to fixed lingual retainers?	1.5	0.57	1.5	0.57		

9) Material	a. Materials Used	1. What are clear retainers made up of?	1	0	1.6	0.2	1.53	0.41
		2. What is the most used material for making clear retainers?	1.25	0.5				
		4. Are clear retainers made up of same material as clear retainers?	2.25	0.5				
		5. Are there environmental concerns with polymer used w clear retainer therapy? Are they environmentally friendly?	1.75	0.5				
		6. Which clear retainer material is best for retention after orthodontic treatment?	1.75	0.5				
	b. Stiffness and Wear Resistance	7. What clear retainer material has more stiffness?	1.5	0.57	1.37	0.07		
		8. Which clear retainer material in terms of wear resistance is the best?	1.25	0.5				
10)Patient-Clinician Relationship		1. How can the orthodontist know if I am wearing my retainers?	2.25	0.95			2.25	0.95
11) Clear Retainer vs Fixed Lingual Retainer		1. In which way is fixed retainer better than clear retainer?	1.5	0.57			1.67	0.20
		2. In which ways are clear retainers better than fixed lingual retainers?	2.25	0.5				
		3. Are clear retainers better for treating periodontally compromised patients compared to fixed lingual retainer?	2	0				
		4. Is stability of the treatment better with clear retainers when compared to fixed lingual retainer?	1.5	0.57				
		5. Are clear retainers an effective alternative to fixed lingual retainer?	1.5	0.57				
		6. Can you have both clear and fixed retainers?	1.25	0.5				
12) Others	a. Orthognathic Surgery	1. Can clear retainers be used after orthognathic surgery?	1.75	0.95	1.75	0.95	1.58	0.30
	b. Extraction	2. Can clear retainers be used in patients who have undergone extraction therapy for orthodontics?	1.25	0.5	1.25	0.5		
	c. Other Uses	3. Can clear retainers be used as nightguards?	2	0.81	1.91	0.41		
		4. Can clear retainers be used as sports mouthguard?	1.75	0.5				
		5. Can I use clear retainers as a bleaching tray?	2	0.81				
	d. Myths	6. What are the myths about clear retainers?	1.25	0.5	1.25	0.5		
	e. Retention	7. What are the most common retainers used with clear aligners?	1.5	0.57	1.5	0.57		
	f. Social Media	8. Is the content present on platforms of social media about clear retainers accurate in terms of reliability of the information?	1.5	0.57	1.5	0.57		
	g. Evidence	9. Are there RCTs to prove the effectiveness of clear retainers?	1.25	0.5	1.25	0.5		

3.1. Inaccurate information

The average accuracy for patient-reported adverse effects was (2.25 ± 0.5). Inaccurate information was provided by the AI (ChatGPT) regarding microbiological composition (3 ± 0) domain. For example, with respect to patient-related adverse effects, ChatGPT provides answers of the results of normal wear and tear of the retainer, rather than what the patient reports.

Along with this, the information regarding knowledge (2 ± 0.64) and patient-clinician relationship was also inaccurate (2.25 ± 0.95) domain. In the domain of knowledge, Chat GPT suggests that patients with clear retainers have greater self-confidence as compared to patients with fixed lingual retainers.

The patient-clinician relationship domain as well, Chat GPT suggests the consequences of not wearing retainers, rather than the orthodontist knowing about retainer wear.

3.2. Accurate information

Responses concerning harm (1.64 ± 0.34) were considered accurate. Also, responses in regard to function (1.83 ± 0.28) and periodontal health (1.5 ± 0) domains were also found to be accurate.(

Table 1)

For harm, ChatGPT provided accurate responses with respect to how clear retainers can cause harm because of sharp edges or untrimmed borders. Similarly for function and periodontal health, ChatGPT provided accurate information, for e.g ChatGPT suggested that there is effect on speech while wearing clear retainers but it is only short-lived. For

Table 1) Compliance domain as well had accurate response with the AI suggesting various studies on reported breakages of retainers. In the cost and material domain, the AI gave accurate responses, providing information regarding

Table 1)

The comparison between fixed and clear retainers as well, was accurate, with ChatGPT giving accurate answers for questions, for e.g it provided correct answers on whether clear retainers can be used in place of fixed retainers and if both clear and fixed retainer can be used together.

The Fleiss'-kappa test had a score of 0.61–0.80 which indicates substantial level of agreement between the raters.

3.3. Flesch-kinciad

Had a grade level of 13.29, which means the text is written at approximately a college freshman reading level.

4. Discussion

This cross-sectional study's results supported rejecting the null hypothesis. The answers pertaining to clear retainers were not fully reliable, and the ability to generate evidence-based responses about clear retainers was inferior, as only 67% of the responses were factually correct.

Most of the inaccurate statements referred to the supposed patient-related adverse effects of clear retainers, as well as other more subjective aspects, including knowledge, information, satisfaction, and the patient-clinician relationship. For example, in the domain of patient-related adverse effects, ChatGPT provided more of a generalized answer related to normal wear and tear of the retainer.

Another domain of knowledge as well, the AI-generated responses claimed that patients have more self-esteem and confidence when wearing clear retainers, as they are invisible. However, the claim that patients experience greater confidence and self-esteem with clear retainers compared to fixed lingual retainers because they are invisible is somewhat misleading. While clear retainers are indeed transparent and often preferred by patients who want a discreet option,[11] fixed lingual retainers also remain invisible because they are bonded to the backs of the teeth. Therefore, both types of retainers contribute to improved confidence and self-esteem by offering a subtle appearance.

periodontal health, ChatGPT had accurate responses on how prolonged use without cleaning of clear retainers can cause gingival inflammation.

ChatGPT also provided accurate responses regarding compliance (1.46 ± 0.28), cost (1.83 ± 0.28), and material (1.53 ± 0.41).(

various materials used for making retainers and their cost as well.

Accurate information was noted for comparison between fixed and clear retainers (1.67 ± 0.37) and others (1.58 ± 0.30) in the domain.(

Regarding the domain of patient-clinician relationship, AI more or less shows consequences of not wearing retainers. For example, for the question "How can the orthodontist know if I am wearing my retainers?" the answer provided by ChatGPT was "teeth will begin to shift of there will be relapse if retainers are not worn"

Accurate information was also provided for few of the domains. For example, responses related to harm were accurate, where the AI was asked questions like "Are clear retainers associated with more or less pain compared to fixed retainers?" to which, the response was detailed and accurate which comprising of initial discomfort and how the discomfort is often decreases over time. Related to function, questions like "Is there any effect of clear retainers on speech?" were asked.[16] The AI response was once again accurate and detailed, showing how there is initial discomfort in speech which is usually "short-lived" and it reduces over time.[16] Accurate responses were also noticed with respect to compliance, cost and material domain, where ChatGPT was asked regarding costs and various materials used for making clear retainers. The AI provided seemingly correct information here as well, listing down cost for clear and fixed retainers as well as various materials like Polyvinyl Chloride (PVC), Polyethylene Terephthalate Glycol (PET-G), etc which are used for making clear retainers, which is correct according to a study done by SP Neoh et al.[17]

With regards to com clear retainer vs fixed lingual retainer domain, inaccuracy was found with one question- "Is stability of treatment better with clear retainers when compared to fixed lingual retainer?"

ChatGPT suggested that stability is more with fixed lingual retainers, however, one review study reported that clear as well as fixed lingual retainer perform similarly in ensuring stability of the treatment.[7]

With respect to "Others" domain as well, there were more or less accurate responses provided by the AI for questions like "Can clear retainers be used after orthognathic surgery? " or "Can clear retainers be used in patients who have undergone extraction therapy for orthodontics?" or "What are the common retainers used with clear aligners?"

Here ChatGPT suggested that clear retainers can be used after orthognathic surgery and also in patients who have undergone extraction therapy, which is supported by various studies.[18]

Thereby, the usefulness of ChatGPT in its current form is questionable, as is its potential use in academic and research settings. Many of the responses by AI demonstrated insufficient expert knowledge and limited evidence-based support, and the language was straightforward in answers. The responses were typically extensive and mentioned relevant trials and reviews, yet they omitted in-text referencing.

Nevertheless, certain responses by ChatGPT to the queries regarding clear aligners were correct, such as harmful (1.64 ± 0.34), compliance (1.46 ± 0.28), cost (1.83 ± 0.28), material (1.53 ± 0.41), comparison between fixed and clear retainer (1.67 ± 0.37), and others (1.58 ± 0.30).

ChatGPT indicated that fixed lingual retainers cause persistent irritation as compared to clear retainers. However, a study has shown that fixed lingual retainers cause pain only initially, which later diminishes.[10]

Although large language models generally perform well on knowledge tests, they thend to underperform when addressing medical and dental topics.[12] AI language models rely heavily on the quality of their training data; however, since the datasets they learn from contain biases, this may lead to inaccurate answers in this particular research field.[12]

In addition, the sources (references) were not provided by ChatGPT for its responses. More algorithmic training is required, as it currently exists, to incorporate more up-to-date dental and orthodontic information, principles, and concepts to be applied to clinical scenarios for this AI-driven large language model. In this study, ChatGPT proved to be inadequate for addressing scientific inquiries. The tool lacked the necessary expertise and comprehensive knowledge to provide accurate explanations, both for basic and more advanced concepts in orthodontics.

Another concern raised was that ChatGPT, when evaluated at different time timepoints, provided inconsistent answers to the same questions. This can lead to a lot of inconsistencies and variability in obtaining reliable information, hence creating ethical issues. While it is probable that repeated requests would yield more accurate answers, as machine learning in ChatGPT suggests,[13] the response pattern shows this system still needs more training with high-quality published journal articles in order to improve both its accuracy and ability to present evidence-based answers. With all these limitations, one would not like to recommend depending fully on the present version of ChatGPT in search of valid and reliable information on clear retainers, as there are risks of spreading wrong information both to the profession and the patients.

While on the flip side, satisfactory levels of accuracy were seen for responses to questions regarding function, periodontal health, comparison, and cost-effectiveness.

With time and repeated improvement of the model's underlying algorithm, not to mention continued refinement by human feedback,[14] ChatGPT might become very helpful for any orthodontic patient. The technology may offer an interactive platform whereby one would be able to learn more about clear retainers and other such facets of orthodontic treatment. It is, however, at this stage not yet reliable enough to replace the traditional methods of communication that are still needed in providing patients with exact and complete information on their treatment choices.

4.1. Limitations

Additionally, Bias could have arisen from the subjective judgments of the four orthodontists who assessed and ranked the AI-generated responses. However, this limitation was minimized by doing he Fleiss'-kappa test. Another limitation is that this validation study was conducted specifically on ChatGPT, and these findings may not fully translate to other AI models, as their respective performances may differ. Furthermore, ethical and privacy issues arise with respect to the accuracy and reliability of information from ChatGPT,[15] these are very important to consider when putting the system into practice. These limitations can be mitigated by comparing the answers with different AI models (e.g Gemini) and manually searching for already present literature for verification of the claims made by the AI.

5. Conclusion

The cross-sectional analysis of content in this study showed that responses or answers provided by ChatGPT to the questions about orthodontic clear retainers demonstrated moderate overall accuracy, with 67% of the answers rated as objectively true. However, significant inaccuracies were noted in domains related to patient-reported adverse effects, patient knowledge and satisfaction, and the patient-clinician relationship.

While the AI provided accurate information in areas such as harm, compliance, periodontal health, cost, and material composition, its inability to cite reliable sources and occasional generation of outdated or misleading content underscores its limitations.

Clinicians and patients should therefore exercise caution when using ChatGPT for clinical guidance on clear retainers. Although it may be used supplementally for general information, it cannot replace evidence-based clinical expertise. Future improvements in AI models—particularly those incorporating real-time data access and source citation—are essential for safer and more reliable integration into clinical orthodontic settings.

6. Source of Funding

None.

7. Conflict of Interest

None.

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