

The Thrills and Chills of ChatGPT: Implications for Assessments of Undergraduate Dental Students

Kamran Ali*, Noha Barhom**, Faleh Tamimi Marino***, Monty Duggal****

* Qatar University, College of Dental Medicine QU Health Doha Qatar .

** Qatar University, College of Dental Medicine QU Health Doha Qatar.

*** Qatar University, College of Dental Medicine QU Health Doha Qatar.

**** Qatar University, College of Dental Medicine QU Health Doha Qatar.

* Correspondence: ali.kamran@qu.edu.qa

Abstract: *Background and Purpose:* Open-source generative Artificial intelligence (AI) applications are fast transforming access to information and allow students to prepare assignments and offer quite accurate responses to a wide range of exam questions which are routinely used in assessments of students across the board including undergraduate dental students. This study aims to evaluate the performance of ChatGPT, a generative AI-based application, on a wide range of dental assessments and discusses the implications for undergraduate dental education. *Methods:* This was an exploratory study investigating the accuracy of ChatGPT to attempt a range of recognized assessments in undergraduate dental curricula. ChatGPT was used to attempt ten items based on each of the five commonly used question formats including single-best answer (SBA) multiple-choice questions (MCQs); short answer questions (SAQs); short essay questions (SEQs); True/False questions and fill in the blanks items. In addition, ChatGPT was used to generate reflective reports based on multi-source feedback (MSF); research methodology; critical appraisal of the literature. *Results:* ChatGPT application provided accurate responses to majority of knowledge-based assessments based on MCQs, SAQs, SEQs, True/False and fill in the blanks items. However, it was only able to answer text-based questions and did not allow processing of questions based on images. Responses generated to written assignments were also satisfactory apart from those for critical appraisal of literature. Word count was the key limitation observed in outputs by ChatGPT as it was only able to produce reports limited to approximately 650 words. *Conclusion:* Notwithstanding their current limitations, generative AI-based applications have the potential to revolutionize virtual learning. Instead of treating it as a threat, dental educators need to adapt teaching and assessments in dental education to the benefits of the learners whilst mitigating against dishonest use of AI-based applications.

Keywords: ChatGPT; artificial intelligence; chatbot; education technology; machine learning; dental education; natural language processing

Introduction

AI is a transdisciplinary field, which involves the use of computer algorithms model intelligent behaviour with minimal human intervention and is informed by logic, statistics, cognitive psychology, linguistics, decision theory, neuroscience, cybernetics, and computer engineering¹. AI applications are primarily based on machine learning and utilise information retrieval, image and speech recognition, sensor technologies, robotic devices, and cognitive decision support systems. AI is already creating a global impact and is fast transforming all spheres of modern life including industry, social media, healthcare, space technology, as well as a wide range of functions at the level of governments.²⁻⁴ The ultimate aim of AI is to create machines which are capable to perform intellectual tasks like humans.⁵

Chat Generative Pre-trained Transformer (ChatGPT) is an open-source artificial intelligence-based application freely available on the internet (<https://chat.openai.com/>). Presently it is one of the most advanced natural language processing (NLP) model based on 175 billion parameters and is trained on Azure's AI supercomputer.⁶ ChatGPT is a generative AI which is capable of generating new content

during real-time conversations.⁷ ChatGPT uses various AI models trained on massive amount of text data from before Q4 2021 to respond to user queries.⁸ It offers conversational responses to user queries. It has the ability to remember the user input into the conversation thread and its own response and builds on its previous outputs with subsequent queries.

Since its launch in November 2022 by open AI, chatGPT has generated incredible excitement globally and continues to dominate tech media headlines due to its remarkable abilities.⁹ Powered with a conversational interface, chatGPT allows users to perform numerous text-based tasks such as, answering questions on an unprecedented scale, generating codes, translations, and generating bespoke content. Like all sectors, inevitably, ChatGPT will affect academia in many ways and healthcare education is no exception. One of the main concerns about ChatGPT in healthcare education is related to its ability to generate content and answer questions, which may potentially encourage dishonesty in academic work and assessments.

The aims of this study were to investigate how ChatGPT performs on dental students' assessments and evaluate the implications of this technology on the authenticity, validity and reliability of assessment methods commonly used in undergraduate dental education.

Methods

This was a web-based exploratory study investigating the accuracy of ChatGPT to attempt a range of recognised assessments in undergraduate dental curricula. ChatGPT Feb 9 free version was used in this study.

ChatGPT application was used to attempt ten items based on each of the five commonly used question formats including single-best answer (SBA) multiple-choice questions (MCQs); short answer questions (SAQs); short essay questions (SEQs); True/False questions and fill in the blanks items.

A total of 50 items were created de novo for knowledge-based assessments by the research team. Most items (over 80%) were based on clinical vignettes with a focus on the application of knowledge rather than mere factual recall. The items used for knowledge-based assessments were based on core clinical topic areas in restorative dentistry, periodontics, fixed prosthodontics, removable prosthodontics, endodontics, pedodontics, orthodontics, preventive dentistry, oral surgery, and oral medicine. One assessment item was created for each of ten aforementioned clinical subjects, using five different formats.

Assessments on reflective reports based on multisource feedback (MSF) portfolio assignments, research methodology, and critical appraisal of the literature were also prepared.

All assessment items were blueprinted against the learning outcomes for undergraduate dental students, as identified by the General Dental Council (UK), and benchmarked against the knowledge level expected from newly qualified dental graduates to ensure the items were within the scope of undergraduate dental education.¹⁰ The assessment items and answer keys/assessment rubrics were reviewed by two blinded external reviewers to evaluate their face validity, accuracy, and suitability for undergraduate dental students.

A user account was created on ChatGPT website and the bot was asked to provide response to each item in turn. A log of every query regarding individual assessment items and response(s) generated by ChatGPT was automatically recorded on the account dashboard. All items and responses by ChatGPT were exported from the website for assessment.

Assessment of ChatGPT responses to MCQs, SAQs, SEQs, True/False and Fill in the blank items was done by the research team using the answer keys for individual items. Responses to written assignments i.e., MSF reflective reports, research methodology, and critical appraisal of literature were evaluated by blinded assessors using a predefined rubric for each type of assignment. A separate assessor was used for each of the three different types of written assignments.

Results

ChatGPT performed above satisfactory level on all types dental assessments included in this study except critical appraisal of literature. Exemplars of each type of assessment items and responses by ChatGPT are included in the appendix. For knowledge-based assessments, the mean score of ChatGPT was in the range of 70% to 100%. The highest score was recorded for True/False items (100%) while the lowest mean score of 70% was observed for short essay questions. The performance of ChatGPT on other assessment items i.e., MCQs, SEQs and Fill in the blank items yielded a mean score of 90%. The performance of ChatGPT on knowledge-based assessments and the number of items in each assessment category are summarised in Table 1.

Table 1. ChatGPT Performance on Knowledge-based Assessments.

Assessment	Number of Assessment items (N)	Mean Percentage Score ChatGPT (%)
1. Multiple choice questions (MCQs)	10	90
2. Fill in the blanks items	10	90
3. Short answer questions (SAQs)	10	90
4. True/False questions	10	100
5. Short essay questions (SEQs)	10	70%

The main limitation observed for ChatGPT performance on these items was that it is only able to answer text-based questions and did not allow processing of questions based on images. The main limitation in responses to SEQs was limited details of clinical interventions and follow up visits which resulted in low scores in comparison to other question formats. Nevertheless, no factually inaccurate information was identified in the responses to any of the SEQ items.

Performance of ChatGPT on MSF assignments, research methodology and critical appraisal of literature is summarised in Table 2 and exemplars are provided in the appendix.

Table 2. ChatGPT Performance on Knowledge-based Assessments.

Assignments	Number of Assessment items (N)	Average ChatGPT Grade
1. Reflective portfolio report	5	Excellent
2. Research methodology	5	Satisfactory
3. Critical Appraisal of Literature	5	Borderline

ChatGPT was able to generate good quality reflective reports on MSF and all five reports received an excellent grade. ChatGPT was also able to generate satisfactory research methodology for five different RCTs. However, deficiencies details of sample size calculations, blinding, and assessment of outcome measures were noted consistently for all five attempts. Finally, the lowest grade of performance was observed for critical appraisal of literature. The key limitations observed consistently for all attempts by the ChatGPT included a low word count (upper limit of 650 words), most references cited by ChatGPT were more than five years old, and it missed some key studies based on RCTs. However, some improvements in the quality of critical appraisal and references could be achieved through a conversation with the ChatGPT

Discussion

This study is a first in investigating the impact of generative AI represented by ChatGPT on commonly used assessments in dental education. Our results demonstrate the capabilities of ChatGPT to attempt dental assessments and achieve acceptable grades. Our results corroborate with few recent studies which showed that ChatGPT was able to perform at or near the passing threshold of all three parts of on **United States Medical Licensing Examination® (USMLE®)** without any additional training or reinforcement.^{11,12} The findings underscore the need for dental education providers to recognize the impact of rapid technological advances on dental education. It warrants strategies to mitigate against inappropriate use of technology whilst ensuring that students and faculty are able to benefit from the technology. This is not the first time that education providers are confronted by the challenges posed by innovative technologies. The current generation of academics has already witnessed the internet revolution. Access to information has been transformed by powerful search engines such as Google, and web-based applications like YouTube, as well as use of digital flashcards.¹³ Unlike the pre-millennium era, teachers and textbooks are no longer the exclusive sources of information for students.

One of the main strengths of ChatGPT over traditional web search engines is that ChatGPT offers a conversation style interactive platform for the users and provides a direct response to queries instead of signposting the user to numerous websites. Also, the users are able to engage with ChatGPT to dissect the information and question its authenticity, and sources etc. The utility of ChatGPT is akin to a virtual tutor, which may be accessed round the clock free of cost and it is likely there will be increased use of this tool in higher education including medical and science education.^{12,14,15} ChatGPT offers an intelligent learning platform allowing scaffolding students learning with the ability to adapt and personalise learning content. Use of ChatGPT as a learning platform appears to be a suitable option and does not raise any concerns. Inaccurate information is always a risk with any web-search and is also applicable to ChatGPT warranting the user to cross check information when in doubt. ChatGPT, and similar platforms which may be rolled out in the future, are likely to evolve further with further human input from technical experts as well as users. In any case

Assessments are a critical part of dental education and inform decisions regarding student progression during successive stages of a dental programme.¹⁶ Quality assurance of assessments is essential for institutional reputation and public confidence. Education providers need to ensure that the assessment content is maintained securely and student submissions represent original work. The main limitation of the reflective portfolio reports generated by ChatGPT was that there was little reference to specific learning activities or events. However, it may be argued that if a student is prepared to use ChatGPT to prepare their assignment works, the output can be tweaked to address such limitations. Similarly, ChatGPT may be able to provide a solid foundation for other assignments such as research methodology and critical appraisal and students may be able to refine their assignments to address any limitations with or without further help from ChatGPT.

For academic assignments submitted by the students, an increasing number of institutions carry out plagiarism checks using appropriate software applications such as iThenticate (Turnitin LLC).¹⁷ However, plagiarism-check software is primarily aimed at quantifying the similarity index with published works available online and identifying the source. Given that, ChatGPT is capable of generating new text, routine software applications used for checking plagiarism may not be reliable for identifying outputs by ChatGPT.

Detecting text generated by AI is an active research area in the field of AI. One approach involves using machine learning models to differentiate between AI-written and human-written text.¹⁸ A number of AI-based tools have recently been developed to address this problem such as AI Text Classifier by OpenAI, such as, DetectGPT and GPTZero.¹⁹ However, these tools are not always accurate and misclassification can happen. For instance, the outputs generated by ChatGPT were subjected to scrutiny using these tools, but the results were inconclusive. Some of the outputs generated by ChatGPT

were subjected to scrutiny using ChatGPT-detector software but the results were inconclusive. Moreover, with further expansion and sophistication of language processing, such detection may become even more difficult in the future.²⁰ Therefore, further research is required to enhance the precision of these tools.

Knowledge-based assessments are a core component of undergraduate dental curricula and provide a way to demonstrate that dental graduates have the underpinning scientific knowledge to inform their clinical practice.²¹⁻²³ Historically, knowledge-based assessments in dental education have been delivered face-to-face in university settings using pen and paper. Although this mode of assessment delivery remains the most common, web-based digital assessment platforms are gaining popularity and allow assessments to be administered online as well as offline. Digital assessment platforms allow secure storage of assessment content in addition to designing, blueprinting, audit and psychometric analyses of assessments. Following the COVID-19 pandemic, many healthcare institutions have utilised remote proctoring to deliver online assessments.¹³ Although face-to-face assessments have returned, remote assessments offer some advantages to dental institutions especially if there are resource constraints to provide space and IT equipment for large groups of students sitting an assessment.

ChatGPT does not pose any threats to knowledge-based assessments delivered face-to-face on university campus under direct invigilation. During COVID-19, remote online delivery of assessments were undertaken on a large scale by dental institutions.^{13,24} However, only few institutions had the resources to use commercially available platforms designed to proctor students appropriately.²⁵ Most dental institutions, particularly in developing countries, use open-source online platforms such as Zoom and Web ex to deliver assessments remotely which allowed students to be observed on camera during the assessments. However, these platforms did not permit restricting internet access to assessment content for candidates during assessments. This was mitigated, in part, by creating “non-searchable” questions so that students could not get a quick answer by searching the internet. However, with the availability of bots like ChatGPT, this approach may not work if remote assessments are reintroduced without appropriate proctoring.

The educational value of ChatGPT is promising and there its use in dental education can provide a personalised learning experience to support the varying learning needs of dental students. Face to face invigilated assessments are unlikely to be impacted directly by ChatGPT and do not warrant any modification at this stage. However, there is a risk of dishonesty in academic assignments which are completed by students off-campus and dental educators need to develop appropriate policies to mitigate against such risks.

Open access to ChatGPT is a recent phenomenon and represents a learning curve for dental educators. A quick-fix approach is unlikely to be the correct way forward and dental educators need to deliberate, identify and implement measures to address challenges posed by ChatGPT. Direct invigilation of assignments by moving remote assessment to campus appears to be a possible solution. However, it may not be realistic or appropriate to complete some of these assignments within a timed session. Another option may be to change the format of written assignments to oral presentations followed by questions from assessors.²⁶ However, it would be vital to factor in the resources and faculty time required to assess large number of students. Inevitably, dental education will adapt to new technology as it has done in the past and it is important to avoid knee jerk reactions. Engagement with all stakeholders in dental education including the students to find sustainable solutions is the way forward. It is imperative that dental educators share their institutional approaches and experiences with colleagues to identify best practices which can be adopted more widely.

Conclusion

ChatGPT is a double-edged sword and while it can be helpful for both students and teachers alike, it can be used to generate assignments and answer assessment questions, which raises concerns regarding potential cheating and dishonesty in academic works. Notwithstanding their current limitations, generative AI applications have the potential

to revolutionize virtual learning. Instead of treating it as a threat, dental educators need to adapt teaching and assessments in dental education to the benefits of the learners whilst mitigating against dishonest use of generative AI applications.

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Appendix: Exemplars of author queries and verbatim outputs by GPT

Exemplar 1 Multiple Choice Question (MCQ) - Single-best answer

DR

A 23-year-old female presents with a two-month history of a painless swelling on the lower lip. On examination the swelling is soft and shows a bluish hue. The patient reports recurrent change in the size of the swelling.

Which one of the following is the most likely provisional diagnosis?

- A. Fibroma
- B. Lipoma
- C. Mucocele
- D. Papilloma
- E. Ranula



The most likely provisional diagnosis for the 23-year-old female with a painless swelling on the lower lip that is soft and shows a bluish hue, and reports recurrent change in the size of the swelling is a mucocele. Therefore, the correct answer is C. Mucocele. 👍 🗨️

A mucocele is a common benign lesion that occurs in the oral cavity, often in the lower lip. It results from the accumulation of mucin due to the rupture or obstruction of a minor salivary gland duct. Mucoceles typically present as a painless, bluish, soft swelling that can vary in size and may have a fluctuating nature due to the accumulation and release of mucin. The swelling may also be present for several months or even years.

Fibroma, lipoma, papilloma, and ranula are other possible differential diagnoses for a soft tissue swelling in the oral cavity. Fibromas are benign tumors of fibrous connective tissue, lipomas are benign tumors of adipose tissue, papillomas are benign tumors of squamous epithelium, and ranulas are cystic lesions that occur in the floor of the mouth due to obstruction of the salivary gland ducts. However, based on the clinical presentation described in the question, mucocele is the most likely provisional diagnosis.

Exemplar 2 Fill in the blanks

DR

----- is the most vulnerable site of dental caries



The most vulnerable site of dental caries is the pit and fissure surface of teeth. Pit and fissures are natural grooves on the chewing surfaces of teeth, which can be difficult to clean with brushing and flossing alone. These areas can trap food particles and bacteria, creating an environment that is conducive to the development of dental caries. As a result, pit and fissure surfaces are more susceptible to decay compared to other tooth surfaces, such as smooth surfaces. Dental sealants can be used to protect these vulnerable areas from decay by sealing the pits and fissures with a plastic resin material. 👍 🗨️

Exemplar 3 Short answer question (SAQ)

DR Enumerate five risk factors for oral candidiasis



Oral candidiasis, also known as thrush, is a fungal infection of the mouth caused by an overgrowth of the Candida fungus. Some of the risk factors for oral candidiasis include:



1. Weakened immune system: Individuals with weakened immune systems, such as those with HIV/AIDS or cancer, are at increased risk of developing oral candidiasis.
2. Use of antibiotics: Antibiotics can kill off the beneficial bacteria in the mouth, allowing the Candida fungus to grow and cause an infection.
3. Use of corticosteroids: Corticosteroids, which are often used to treat conditions such as asthma and allergies, can weaken the immune system and increase the risk of developing oral candidiasis.
4. Poor oral hygiene: Poor oral hygiene can lead to an overgrowth of bacteria and yeast in the mouth, increasing the risk of developing oral candidiasis.
5. Diabetes: People with poorly controlled diabetes are more susceptible to oral candidiasis because high blood sugar levels can promote the growth of yeast in the mouth.

Exemplar 4 True/False

DR Necrotizing ulcerative periodontal disease is most commonly caused by fusobacteria and spirochaetes True or False



True. Necrotizing ulcerative periodontal disease (NUPD) is an infectious disease of the periodontium (the tissues that surround and support the teeth) that is characterized by the rapid destruction of gum tissue, periodontal ligament, and alveolar bone. The disease is most commonly caused by the interaction of multiple bacteria, including *Fusobacterium* spp. and spirochetes, which are considered the major pathogens involved in the development of NUPD. Other bacteria, such as *Prevotella intermedia* and *Porphyromonas gingivalis*, have also been implicated in the disease.

*Exemplar 5 Short Essay Question (SEQ)*

DR A 45-year-old smoker develops severe pain after difficult extraction of his lower right third molar tooth under local anaesthesia. He returns to the dental practice after 2two days, complaining of sharp pain, and foul smell from the extraction socket. Discuss the possible diagnosis and management of this patient.



The clinical presentation of severe pain, foul odor, and delayed healing after a dental extraction is suggestive of a postoperative infection, most commonly a dry socket. In this scenario, the dry socket is likely due to the patient's history of smoking, which is a known risk factor for postoperative complications. The management of this patient will require a combination of local and systemic measures.

The first step in managing a dry socket is to irrigate the socket with saline solution and remove any debris or necrotic tissue. The clinician may then place a medicated dressing such as eugenol or zinc oxide eugenol into the socket to promote healing and alleviate pain. The dressing should be changed regularly until the socket is fully healed.

In addition to local measures, systemic antibiotics may be prescribed if the infection is severe or if there is evidence of systemic involvement. The clinician should also advise the patient to stop smoking, as tobacco use can impair wound healing and increase the risk of complications. Pain management may require the use of analgesics such as nonsteroidal anti-inflammatory drugs (NSAIDs) or opioids, depending on the severity of the pain.

It is important to note that in rare cases, severe pain and delayed healing after a dental extraction can be due to other complications such as a fractured mandible or a retained root fragment. Therefore, a thorough clinical examination and radiographic evaluation should be performed to rule out these possibilities.

In summary, the management of a dry socket in a smoker requires a combination of local and systemic measures. The clinician should irrigate the socket, remove debris, and place a medicated dressing to promote healing and alleviate pain. Antibiotics may be prescribed if the infection is severe, and the patient should be advised to stop smoking. Pain management may require the use of analgesics, and a thorough examination should be performed to rule out other possible complications.

Exemplar 6 Short Essay Question (SEQ) with Citations

DR

Discuss caries prevention measures for a 11-year-old child with high sugar consumption, poor oral hygiene and multiple carious teeth (500 words). Generate the response with citations.



Preventing dental caries is essential for maintaining optimal oral health in children. In a child with high sugar consumption, poor oral hygiene, and multiple carious teeth, preventive measures need to be implemented to prevent further decay and improve oral hygiene. Here are some preventive measures that can be taken for an 11-year-old child:

1. **Dietary modification:** One of the most crucial preventive measures for caries prevention is a reduction in sugar consumption. Parents should be advised to limit sugary foods and drinks in their child's diet. Sugar intake should be limited to no more than 10% of the total daily calorie intake (1). Snacking on sugary foods and drinks should also be avoided. Instead, healthy snacks such as fruits, vegetables, and nuts should be encouraged.
2. **Oral hygiene:** Adequate oral hygiene is essential for caries prevention. The child should be taught proper brushing and flossing techniques. Brushing twice a day with fluoride toothpaste and flossing daily can help remove plaque and prevent caries (2). Parents should supervise their child's oral hygiene routine and ensure that the child brushes and flosses correctly.
3. **Fluoride:** Fluoride is an effective measure for caries prevention. Fluoride strengthens tooth enamel and makes it more resistant to decay (3). Fluoride toothpaste and mouth rinses can be recommended for daily use. Professional fluoride treatments can also be provided by a dentist.
4. **Sealants:** Dental sealants are a protective coating applied to the chewing surfaces of the back teeth. They help prevent decay by sealing the grooves and pits of the teeth, making them easier to clean (4). Sealants can be recommended for the child's permanent molars, which are more susceptible to decay.
5. **Regular dental check-ups:** Regular dental check-ups are essential for caries prevention. The dentist can detect early signs of decay and provide preventive treatments such as fluoride application and dental sealants. The child should visit the dentist every six months for a routine check-up (5).

In conclusion, preventing dental caries in an 11-year-old child with high sugar consumption, poor oral hygiene, and multiple carious teeth requires a multi-faceted approach. Dietary modification, proper oral hygiene, fluoride, sealants, and regular dental check-ups are all essential measures for caries prevention. By implementing these preventive measures, parents can help their child maintain optimal oral health.

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Exemplar 7 Reflective Report on Multisource Feedback

DR

Generate a self-reflection report on multi-source feedback for an undergraduate dental student based on self-ratings and ratings by a peer and tutor (rating scores ranging from 0-3: 0= Unsatisfactory 1= Borderline 2= Satisfactory 3= Excellent).

Areas to be considered include the following:

1. Ability to deal with academic commitments
2. Development of technical skills (appropriate to stage)
3. Commitment to own learning
4. Ability to deal with stress
5. Personal organization and time management
- 6 Ability to communicate with colleagues.
7. Safe and effective clinical care to patients
8. Ability to communicate with patients and their attendants
9. Take personal responsibility of own learning
10. Ability to recognise and value the contribution of others
11. Team working skills
12. Ability to give feedback (honest, private and supportive)



As an undergraduate dental student, I recently received multi-source feedback from a peer a tutor, as well as my own self-ratings, in regards to my performance in various areas related to my dental education. Upon reflection, I have identified areas where I have excelled, areas where I need improvement, and areas where I was surprised by my ratings.

One area where I have excelled is my ability to deal with academic commitments. Both my peer and tutor rated me as excellent in this area, and I also gave myself a rating of 3. I believe this is due to my strong work ethic and dedication to my studies, as well as my ability to prioritize and manage my time effectively. In terms of development of technical skills appropriate to my stage, I received satisfactory ratings from both my peer and tutor, but I gave myself a rating of 2. I acknowledge that I still have much to learn and practice in terms of technical skills, but I am proud of the progress I have made thus far. Commitment to my own learning is another area where I excelled, with all three ratings being excellent. I take pride in my ability to seek out new information and actively engage in my education.

One area where I need improvement is in my ability to deal with stress. Both my peer and tutor rated me as borderline in this area, while I gave myself a rating of 1. I recognize that I can become overwhelmed and anxious when facing high-pressure situations, and I need to develop more effective coping strategies to manage my stress levels. Personal organization and time management is another area where I need to improve. My peer rated me as borderline, my tutor rated me as satisfactory, and I gave myself a rating of 2. I recognize that I can struggle with procrastination and can benefit from setting more specific and achievable goals to improve my organizational skills.

In terms of communication, I received mixed ratings. My peer rated me as excellent in my ability to communicate with colleagues, while my tutor rated me as satisfactory. I gave myself a rating of 2, acknowledging that while I feel comfortable communicating with my peers, there is always room for im-

provement. In terms of communicating with patients and their attendants, all three ratings were satisfactory. I recognize the importance of effective communication in the dental profession, and I will continue to work on improving my skills in this area.

Safe and effective clinical care to patients is an area where I received excellent ratings from both my peer and tutor, as well as a rating of 3 from myself. I believe that providing safe and effective care to patients should always be a top priority for dental professionals, and I am proud of the ratings I received in this area.

Recognizing and valuing the contribution of others is an area where I received mixed ratings. My peer rated me as excellent, my tutor rated me as borderline, and I gave myself a rating of 2. I believe that it is important to acknowledge and appreciate the contributions of others, and I will continue to work on improving in this area. Team working skills and the ability to give feedback were two areas where I received borderline ratings from my peer and tutor. I recognize that these skills are essential in the dental profession, and I will work on improving my ability to work effectively with others and provide honest and supportive feedback.

In conclusion, receiving multi-source feedback has provided me with valuable insight into my strengths and areas for improvement as an undergraduate dental student. While I am proud of the areas where I have excelled, I recognize that there is always room for improvement, and I will work on developing new strategies to improve in areas where I need to grow. Overall, I am grateful for the feedback I received and look forward to continuing to learn and grow as a dental professional.

Exemplar 8 Research Proposal

DR

Generate a research methodology proposal for a randomised controlled clinical trial to compare the efficacy of a 1.1% fluoride toothpaste (intervention) compared to a non-fluoridated toothpaste in adult patients with a high caries risk. The primary outcome measure is caries activity assessed at 6 months, 1 year, 3 years and 5 years.



Introduction: Dental caries is a significant public health problem worldwide, particularly among adults with high caries risk. Fluoride toothpaste is considered one of the most effective preventive measures for dental caries. This study aims to compare the efficacy of a 1.1% fluoride toothpaste with a non-fluoridated toothpaste in reducing caries activity among adults with high caries risk.

Research question: Is the use of a 1.1% fluoride toothpaste more effective in reducing caries activity compared to a non-fluoridated toothpaste in adult patients with high caries risk?

Study design: A randomized controlled clinical trial will be conducted with two parallel groups, namely the intervention group (1.1% fluoride toothpaste) and the control group (non-fluoridated toothpaste). Participants will be randomly assigned to either group in a 1:1 ratio. The study will be conducted over a period of 5 years, and the primary outcome measure will be caries activity assessed at 6 months, 1 year, 3 years, and 5 years.

Participants: The study will recruit adult patients aged 18 to 60 years with high caries risk. Participants will be recruited from dental clinics in the local area.

Sample size calculation: Based on previous studies, we estimate that the mean caries activity score in the non-fluoridated toothpaste group will be 1.0, with a standard deviation of 0.5. To detect a minimum difference of 0.3 in mean caries activity score between the two groups with a power of 80% and a type I error rate of 5%, we will require a sample size of 120 participants (60 per group).

Intervention: Participants in the intervention group will be instructed to brush their teeth twice daily using a 1.1% fluoride toothpaste. Participants in the control group will be instructed to brush their teeth twice daily using a non-fluoridated toothpaste.

Outcome measures: The primary outcome measure will be caries activity assessed using the International Caries Detection and Assessment System (ICDAS). Secondary outcome measures will include the number of new carious lesions, changes in plaque index and gingival index, and participants' satisfaction with the toothpaste.

Data analysis: Data will be analyzed using the intention-to-treat principle. Descriptive statistics will be used to summarize the demographic characteristics of the participants. The mean difference in caries activity score between the two groups will be compared using a two-sample t-test. The incidence rate of new carious lesions will be compared using a Poisson regression model. The changes in plaque index and gingival index will be analyzed using a repeated measures analysis of variance.

Ethical considerations: The study protocol will be approved by the local ethics committee. Informed consent will be obtained from all participants, and their confidentiality will be maintained throughout the study.

Conclusion: This randomized controlled clinical trial will provide valuable evidence on the efficacy of a 1.1% fluoride toothpaste compared to a non-fluoridated toothpaste in reducing caries activity among adults with high caries risk.

Exemplar 9 Critical Appraisal of Literature

DR

Write a critical appraisal of literature on the most appropriate material for repair of a root canal perforation during endodontics. Include citations in the response.



Root canal perforations are a common complication encountered during endodontic treatment. These perforations can lead to communication between the root canal system and the surrounding tissues, compromising the success of the treatment. The repair of root canal perforations is critical to the long-term success of endodontic treatment. The selection of an appropriate material for repair is essential to achieving a successful outcome. In this critical appraisal, we will evaluate the literature on the most appropriate material for the repair of root canal perforations during endodontics.

Several materials have been used for the repair of root canal perforations, including amalgam, resin composite, mineral trioxide aggregate (MTA), and bioceramics. Amalgam has been used for many years in the repair of root canal perforations due to its mechanical strength and ease of placement. However, its use has been limited due to concerns about its biocompatibility, corrosion, and esthetics (1).

Resin composites have also been used for the repair of root canal perforations. These materials have good mechanical properties, excellent adhesion to tooth structure, and are esthetically pleasing. However, they have limited biocompatibility and may shrink during the curing process, leading to microleakage (2).

MTA is a biocompatible material that has gained popularity in recent years for the repair of root canal perforations. MTA has excellent sealing ability and promotes tissue regeneration, making it an ideal material for the repair of root canal perforations. A systematic review by Abarajithan et al. (2016) found that MTA had a higher success rate in the repair of root canal perforations compared to other materials (3). MTA has also been shown to have a lower incidence of microleakage compared to other materials (4).

Bioceramics are another type of material that has been used for the repair of root canal perforations. Bioceramics have excellent biocompatibility and sealing ability and are capable of promoting tissue regeneration. A study by Kaup et al. (2015) found that bioceramics had a higher success rate in the repair of root canal perforations compared to MTA (5).

In conclusion, the literature suggests that MTA and bioceramics are the most appropriate materials for the repair of root canal perforations during endodontics. Both materials have excellent biocompatibility, sealing ability, and are capable of promoting tissue regeneration. While amalgam and resin composites have been used in the past, their use is limited due to concerns about biocompatibility, esthetics, and microleakage. Clinicians should consider using MTA or bioceramics for the repair of root canal perforations to achieve the best possible outcome for their patients.

References:

1. Shokouhinejad N, Sharifian M, Aligholi M, et al. Comparison of sealing ability of four materials in repair of furcal perforation: an ex vivo study. *J Dent Res Dent Clin Dent Prospects*. 2011;5(2):51-56.
2. Sipert CR, Hussne RP, Nishiyama CK, Torres SA. In vitro evaluation of marginal microleakage of four materials used for the repair of furcal perforation. *J Endod*. 2005;31(2):117-119.
3. Abarajithan M, Velmurugan N, Kandaswamy D. Management of iatrogenic root perforation with mineral trioxide aggregate: a systematic review. *J Conserv Dent*. 2016;19(6):501-506.
4. Torabinejad M, Hong CU, McDonald F, Pitt Ford TR. Physical and chemical properties

of a new root

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reference 5 is missing.



I apologize for the error. The correct reference for the study by Kaup et al. (2015) is:

5. Kaup M, Schäfer E, Dammaschke T. An in vitro study of different material properties of Biodentine compared to ProRoot MTA. *Head Face Med*. 2015;11:16.
doi:10.1186/s13005-015-0070-7

Thank you for bringing this to my attention.

