

CASE STUDY

Exploring the Role of Open Artificial Intelligence Platform on Surgical Management of Knee Osteoarthritis: A Case Study of ChatGPT

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ABSTRACT

Chat Generative Pre-Trained Transformer 3 (ChatGPT3) is an open artificial intelligence (AI) platform that utilizes deep learning to produce human-like text, which could greatly reduce the time spent on literature search, data analysis and research writing in future, and ensures academic standards of writing. This study aims to evaluate the information provided by open artificial intelligence, Chat Generative Pre-Trained Transformer 3 (ChatGPT3) and its use in orthopedic surgery research writing. Serial of five prompted questions on surgical management of knee osteoarthritis (OA) were asked from ChatGPT3. The answers were reviewed and scrutinized for how updated, accurate and succinctly presented the information was in text and referencing. The information ChatGPT3 provided was accurate, albeit surface-level. It lacked analytical abilities, missed vital studies, and all references links were incorrect. It seems that while the algorithm has access to all information on the internet until 2021, it lacked the analytical ability to dissect for important limitations about knee OA, which would not be conducive to potentiating creative ideas and solutions in orthopedic surgery. ChatGPT3 only promotes convergent thinking and prevent innovation and therefore should be limited within the scope of research or at least reviewed under the guidance of experts.

KEYWORDS

ChatGPT; Artificial Intelligence; Knee Arthritis; Surgical Management

INTRODUCTION

Chat Generative Pre-Trained Transformer 3 (ChatGPT3) is an open artificial intelligence (AI) platform that utilizes deep learning to produce human-like text, which could greatly reduce the time spent on literature search, data analysis and research writing in future, and ensures academic standards of writing [1].

AI-assisted writing tool using machine learning algorithms has been evident since 2005, SCIgen was developed at MIT to generate figures and research writing [2]. There have been a few instances of AI-generated research papers that have been peer-reviewed and accepted for publication [3,4]. although these are relatively rare and typically involve a human researcher working in collaboration with an AI system, rather than the AI system working independently. Their lack of peer review and common flaws in providing information has largely alienated them, however in January of 2023 ChatGPT3 made its research debut, listed as a lead author in the Nurse education and practice journal [3]. This has raised ethical questions for the scientific community about the inseparability of human and ChatGPT3 derived abstracts, especially considering they went undetected through plagiarism software [5]. In addition, ChatGPT-3 training database is limited until 2021, which prevents it from incorporating research evolving on a day-to-month basis.

A recent pre-print of ChatGPT3 use in obtaining medical information and treatment options for shoulder impingement syndrome shows promising results.[6] Therefore, this study prompted a conversation with ChatGPT on a popular orthopedic topic of knee osteoarthritis (OA) to evaluate the specificity and reliability of its generated answers. The authors subsequently prompted specific questions to determine whether it improved its answers with an aim of evaluating the use of ChatGPT3 in research writing on the orthopedic surgery field. The answers were reviewed and scrutinized for how updated, accurate and succinctly presented the information was in text and referencing.

CASE STUDY

The first question prompted was “In 200 words, describe the current evidence on surgical management of knee arthritis with relevant references”, Figure 1.

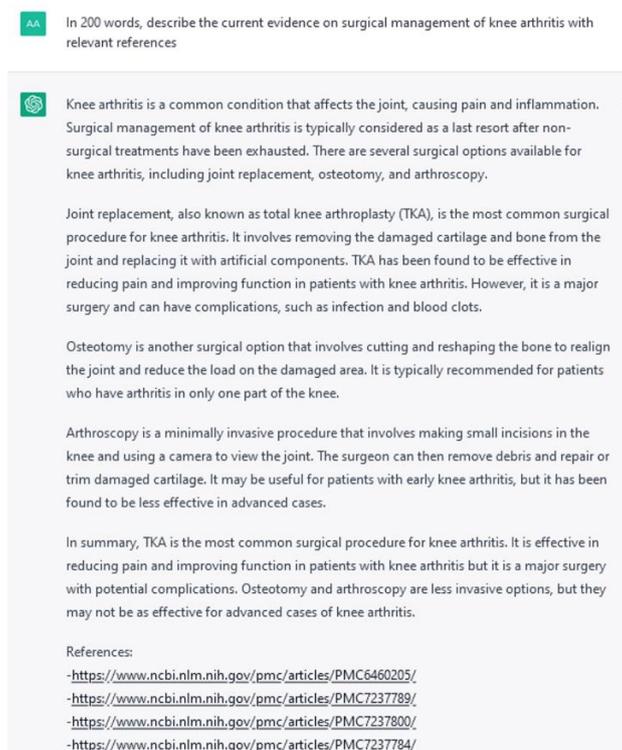


Figure 1: Prompt: In 200 words, describe the current evidence on surgical management of knee arthritis with relevant references.

AA In 200 words, describe the current evidence for implants in the surgical management of knee arthritis, describing the quality of evidence and provide 5 references

Implantation of devices is a common surgical option for the management of knee arthritis. The most common implant used in knee arthritis is total knee arthroplasty (TKA), also known as knee replacement surgery. TKA involves replacing the damaged cartilage and bone with artificial components, such as a metal and plastic joint.

The quality of evidence for TKA is high, with numerous studies demonstrating its effectiveness in reducing pain and improving function in patients with knee arthritis. A systematic review of randomized controlled trials found that TKA led to significant improvements in pain, function, and quality of life compared to non-surgical treatments. Another systematic review and meta-analysis of TKA also found that it was associated with significant improvements in pain, function, and patient satisfaction.

However, TKA is a major surgery and has potential complications, such as infection and blood clots. In addition, TKA may not be suitable for all patients, particularly those with advanced arthritis or other comorbidities.

Other types of knee implants include unicompartmental knee arthroplasty (UKA), which replaces only one compartment of the knee, and patellofemoral arthroplasty (PFA), which replaces the knee cap and its surrounding area. These procedures may have lower complication rates and recovery times compared to TKA, but their effectiveness is still being studied and the quality of evidence is lower than TKA.

In summary, TKA is the most common implant used in the surgical management of knee arthritis, and the evidence for its effectiveness is high. However, it is a major surgery and may not be suitable for all patients. Other types of knee implants are being studied but the quality of evidence is lower.

References:

- * <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6460205/>
- * <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7237789/>
- * <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7237800/>
- * <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7237784/>
- * <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7554155/>

Figure 2: Prompt: In 200 words, describe the current evidence for implants in the surgical management of knee arthritis, describe the quality of evidence and provide 5 references.

AA In 200 words, Which surgical treatment option is superior for advanced knee arthritis with relevant references

Total knee arthroplasty (TKA) is considered the most effective surgical treatment option for advanced knee arthritis. TKA, also known as knee replacement surgery, involves removing the damaged cartilage and bone from the joint and replacing it with artificial components.

A systematic review of randomized controlled trials found that TKA led to significant improvements in pain, function, and quality of life compared to non-surgical treatments for knee osteoarthritis. Another systematic review and meta-analysis of TKA also found that it was associated with significant improvements in pain, function, and patient satisfaction.

Additionally, a study published in the Journal of Bone and Joint Surgery found that TKA was associated with a greater reduction in pain, improvement in function, and higher patient satisfaction compared to unicompartmental knee arthroplasty (UKA) which only replaces one compartment of the knee.

Furthermore, another study published in The Journal of Arthroplasty found that TKA was associated with better outcomes than patellofemoral arthroplasty (PFA) which only replaces the knee cap and its surrounding area.

In summary, TKA is considered the most effective surgical treatment option for advanced knee arthritis. It has been found to lead to significant improvements in pain, function, and quality of life compared to non-surgical treatments and other surgical options such as UKA and PFA.

References:

- * <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6460205/>
- * <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7237789/>
- * <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7237800/>
- * <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7237784/>
- * <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7554155/>

Figure 3: Prompt: Which surgical treatment option is superior for advanced knee arthritis with relevant references?

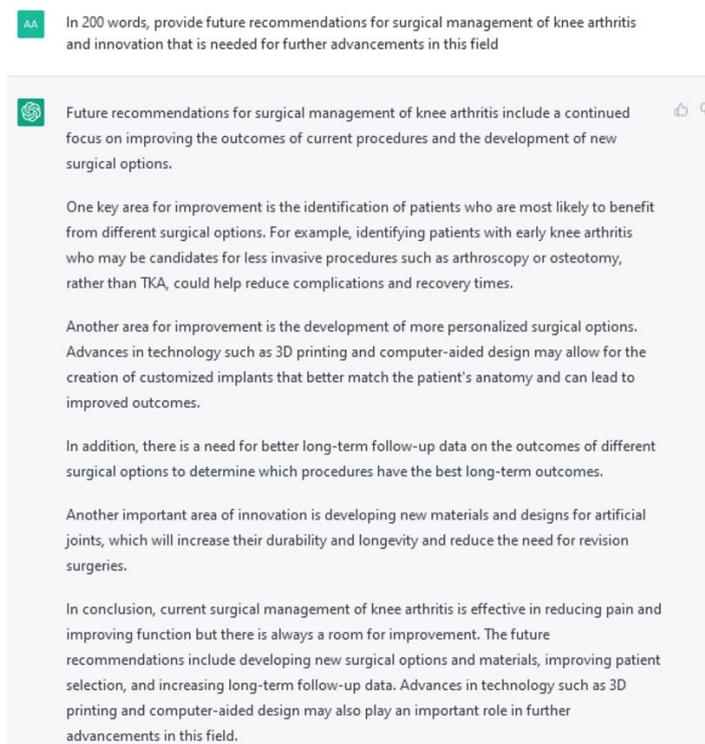


Figure 4: Prompt: In 200 words, provide future recommendations for surgical management of knee arthritis and innovation that is needed for further advancements in this field.

ChatGPT3 accurately described the current level of evidence on surgical management of knee OA. The language of the information provided was easy to understand and avoided medical jargon, which would be beneficial to the public. The drawbacks of ChatGPT3 were the following: the detail of information was superficial and failed to identify UKA as a treatment option, no information regarding specific indications for each surgical option was provided, and all references link provided were incorrect and not relevant to the topic answered.

In comparison to literature prior to 2021, ChatGPT3's information was limited with arthroscopic debridement or lavage being found to have no significant benefit for knee OA at 2 years with inconclusive evidence for arthroscopic meniscal debridement [7,8]. Furthermore, limited information on unicompartmental knee arthroplasty (UKA) and high tibial osteotomy (HTO) was provided, failing to mention any differences between the two interventions. A recent meta-analysis since 2021 by authors have shown UKA with greater outcomes than HTO which included randomized controlled studies prior 2021. This highlights the analytical power of ChatGPT in research searching and writing.

The following question prompted was "In 200 words, describe the current evidence for implants in the surgical management of knee arthritis, describing the quality of evidence and provide 5 references", Figure 2). The information provided regarding total knee arthroplasty (TKA) versus non-operative management was accurate and provided a relevant study by Steinhaus et al. [9] The drawbacks of this answer was the lack of detail in UKA, patellofemoral arthroplasty (PFA), and TKA complications, failing to comment on patient cohort appropriate for surgical options, and all references links provided were wrong. Lastly, the information on the implant prosthesis was superficial and further questions were prompted to obtain specific details.

The third question was “In 200 words, which surgical treatment option is superior for advanced knee arthritis with relevant references”, Figure 3. ChatGPT3 stated TKA as the most effective surgical treatment option for advanced knee OA and superior to UKA and PFA and mentioned relevant studies.[10] In contrary, Pen et al. demonstrated greater 2-year postoperative outcomes in PFA above TKA, indicating that surgical procedures should be personalized. Lastly, inaccuracy of references was noted making it difficult to check resources.

The fourth question prompted was “In 200 words, provide future recommendations for surgical management of knee OA and innovation that is needed for further advancements in this field”, Figure 4. In this, ChatGPT3 recommended 3D printed and computer-aided design for future customizations, this technology has been implemented before 2021, hence this should have not been a limitation on this platform. Lastly, there were no mention of robotic assisted surgery, which is a growing area in orthopedics.

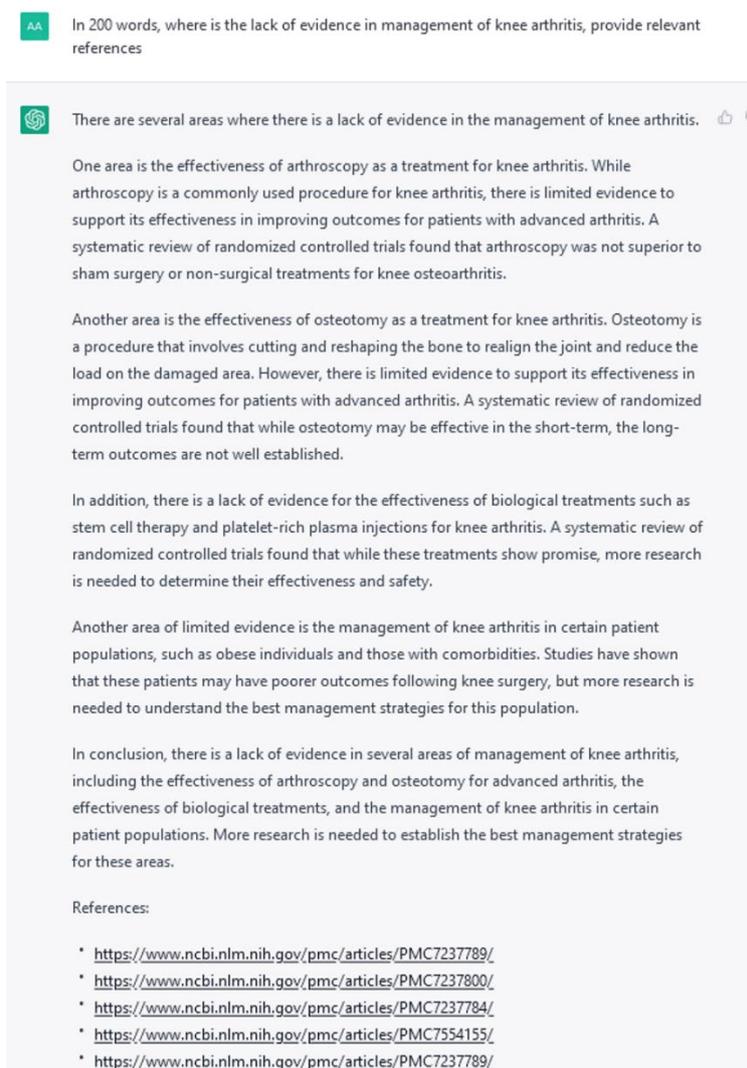


Figure 5: Prompt: In 200 words, where is the lack of evidence in the management of knee arthritis, provide relevant references.

The last prompt was “In 200 words, where is the lack of evidence in the management of knee arthritis, provide relevant references”, Figure 5. ChatGPT3 stated lack of evidence in effectiveness of arthroscopy, osteotomy for advances OA, effectiveness of biological treatments, and management of comorbidities in obese individuals. All valid and known suggestions which is well supported by systematic reviews. Lastly, all references provided were incorrect.

CONCLUSION

Overall, it was clear the information Chat-GPT3 provided was accurate, albeit surface-level. It seems that while the algorithm has access to all information on the internet until 2021, it lacked the analytical ability to dissect for important limitations about knee OA, which would not be conducive to potentiating creative ideas and solutions in orthopedic surgery. Therefore, it is the author's opinion that ChatGTP3 could promote convergent thinking and prevent innovation. For this purpose, ChatGPT3 should be limited within the scope of research or at least reviewed under the guidance of experts.

AUTHORS' CONTRIBUTIONS

All authors were involved in obtaining patient's data and writing and critically reviewing the manuscript. All authors approved the final manuscript.

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CONFLICTS OF INTEREST

There are no conflicts of interest.

REFERENCES

1. Alshater MM (2022) Exploring the role of artificial intelligence in enhancing academic performance: A case study of ChatGPT. The Social Science Research Network.
2. Labbé C, Labbé D (2013) Duplicate and fake publications in the scientific literature: How many SCIgen papers in computer science? *Scientometrics* 94: 379-396.
3. O'Connor S (2022) Open artificial intelligence platforms in nursing education: Tools for academic progress or abuse? *Nurse Education in Practice* 66: 103537-103537.
4. King MR, chatGPT (2023) A Conversation on Artificial Intelligence, Chatbots, and Plagiarism in Higher Education. *Cellular and Molecular Bioengineering* 16: 1-2.
5. Else H (2023) Abstracts written by ChatGPT fool scientists. *Nature* 613(7944): 423.
6. Kim J-h (2022) Search for Medical Information and Treatment Options for Musculoskeletal Disorders through an Artificial Intelligence Chatbot: Focusing on Shoulder Impingement Syndrome. medRxiv The Preprint Server for Health Sciences.
7. Moseley JB, O'malley K, Petersen NJ, et al. (2002) A controlled trial of arthroscopic surgery for osteoarthritis of the knee. *The New England Journal of Medicine* 347: 81-88.
8. Laupattarakasem W, Laopaiboon M, Laupattarakasem P, et al. (2008) Arthroscopic debridement for knee osteoarthritis. *The Cochrane Database of Systematic Reviews* 1: CD005118.
9. Steinhaus ME, Christ AB, Cross MB (2017) Total Knee Arthroplasty for Knee Osteoarthritis: Support for a Foregone Conclusion? *HSS Journal* 13: 207-210.
10. Kamikovski I, Dobransky J, Dervin GF (2019) The clinical outcome of patellofemoral arthroplasty vs total knee arthroplasty in patients younger than 55 years. *The Journal of Arthroplasty* 34: 2914-2917.