Utility of ChatGPT-4 in Musculoskeletal Imaging: A Narrative Review

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Abstract

Background: With its impressive natural language processing and comprehension skills, ChatGPT-4 (Chat Generative Pre-Trained Transformer) is a technology that shows great promise for use in a number of medical fields. This article provides a thorough description of the possible uses of OpenAI's state-of-the-art language model, ChatGPT-4, in musculoskeletal imaging.

Purpose for Review: MSK Radiologists need to evolve about their knowledge and understanding of the roles of ChatGPT and its implications in daily practice. We aim to emphasize the advantages of ChatGPT-4 on the musculoskeletal imaging field and its potential to enhance radiologist working checklist review items, and the overall productivity of radiology reports.

Recent Findings: The fact of that specialists in radiology, rheumatology, orthopedic surgery, and other fields have an idea about ChatGPT. Furthermore, opinions are generally well, despite the fact that many people have reservations about the new technology, which is still developing [1]. In context of the radiology, compared to the radiologists the GPT-4 based ChatGPT showed noticeably better diagnostic accuracy. Although ChatGPT, which is based on GPT-4, performed diagnostically on par with radiology residents, however, it demonstrated lower performance than a musculoskeletal radiologist [2].

Keywords: Musculoskeletal radiology, Artificial intelligence, ChatGPT.

Introduction

Artificial intelligence (AI) is expanding quickly in many fields, including medicine, and does so without requiring human intellect. Diagnostics, such as tumor and fracture identification, are useful uses in orthopedic surgery. Clinicians should be aware of AI's limits, though, as preventing biases and avoidable errors requires the creation of strong reporting and validation systems [3].

There are various methods and application were assumed to be as artificial intelligence tools, some of them are ChatGPT and Bard could help in radiology knowledge, which showed while selecting the best chatbot, it's crucial to take into account its presumptions and the reliability of its responses [4]. In other hand, considering all the variables, including the residents' limited time, inexperience, and lack of understanding, using the Internet has been quite beneficial for on-call tasks.

The most popular resource was "Radiopaedia", which the inhabitants selected because to its free availability, ease of use, lack of additional registration requirements, and attractive mobile viewing layout. Because ChatGPT currently lacks images that are essential for aspiring radiologists and because it lacks references or proof for the information it offers, its value as an artificial intelligence-assisted radiology educational resource is debatable [5]. Furthermore, while ChatGPT-3 answered questions from radiologists' daily clinical routine properly, only 37.9% of "true," recognizable references gave sufficient background information for 37.5% of the questions that were answered correctly.

These findings serve as a clear reminder of ChatGPT-3's limitations [6]. Conversely, ChatGPT-4 may prove to be an invaluable interactive anatomy resource. By offering accurate guidance on anatomical terminology and thorough and well-organized descriptions of anatomy. It also aids in understanding therapeutic

importance of a structure and its link. It's crucial to remember that it does acknowledge that AI should play an assistant role [7]. Generally, in a few of minutes or seconds, the AI technology can assist in identifying knowledge gaps, which can make a time significancy [8]. On the other hand, orthopedic evaluation assessments, the residents outperformed ChatGPT-3.5 and GPT-4 in several experimental studies by providing more accurate answers to questions. When it comes to providing answers to orthopedic resident evaluation examination queries, GPT-4 outperforms ChatGPT-3.5. In comparison to questions containing graphics, ChatGPT-3.5 and GPT-4 both fared better on text-only questions [9].

To our knowledge there was no study assessed the implementation of the artificial intelligence tools through the musculoskeletal radiology field. Thus far, we aimed to evolve the musculoskeletal Radiologists of understanding of the roles of ChatGPT and its implications in daily practice, as well as to emphasize the advantages of ChatGPT on the musculoskeletal imaging field and its potential to enhance radiologist working, and the overall productivity of radiology reports.

Methods

In December 2023, we performed a thorough search of many databases, such as PubMed and Google Scholar, for this narrative review. We focused our search by using keywords like "radiology," "musculoskeletal imaging," "artificial intelligence," "machine learning," and "ChatGPT-4." The publications that addressed the goals of the study have been chosen. We assessed the article titles and abstracts before retrieving the whole contents. We have limited our evaluation to studies that discuss ChatGPT-4's use in reporting or analyzing radiological images, particularly in the musculoskeletal field.

After the authors' careful review, we identified 55 papers that addressed the goals of the study. We got the complete texts of these publications after analyzing their abstracts and titles. Only publications pertaining to ChatGPT-4's use in orthopedics and radiology were included in our review, which also took into account our personal experiences with ChatGPT-4 in these domains. We restricted the scope of our search to English-language publications and human studies.

The articles encompass various aspects of ChatGPT-4's application in radiology, such as imaging acquisitions, analysis, and use of it as an assistant tool in daily practice. We retrieved the images from the PACS (Picture Archiving Communicating System)

thereafter, we addressed the questions and explored the responses that were created by this application in relation to each modality, such as X-ray, CT, and MRI. Figure 1 provides a comprehensive list of prompts used for MRI protocoling, with providing of the most suitable imaging sequences. Figure 2 and figure 3 demonstrating that the ChatGPT-4 acting as a virtual radiology report template generator; simulating detection of the abnormal findings and providing the correct impression. In context of trauma cases showed in figure 4 and figure 6, prompts response were shown, considering of this language model designed to focus specifically on radiology and were fed into the ChatGPT-4 as inputs to produce the required ingredients.

Role of ChatGPT-4 in Musculoskeletal Imaging

ChatGPT and other AI-based language models have shown outstanding capabilities, it remains unclear how well these models will function in real-world circumstances, especially in professions like medicine where sophisticated and high-level thinking is required. Furthermore, there are significant ethical issues that need to be addressed even though using ChatGPT to write scientific articles and other scientific outputs may have certain advantages [10]. Additionally, the application of artificial intelligence for activities like board exam preparation and differential diagnosis has been investigated in the medical industry, using models such as ChatGPT [11].

The application of ChatGPT-4 has the potential to revolutionize the field by offering insightful information, supporting decision-making processes, and enhancing diagnostic accuracy. Imaging studies can be predicted using large language models with better performance suggests that more medical-text training is beneficial. This demonstrates how large language models can be used in radiologic decision-making [12]. More recently, Although ChatGPT4 offers encouraging opportunities for quick figure production, their existing capabilities are unable to meet the exacting requirements set by research on musculoskeletal radiography [13].

Clinical Applications of ChatGPT-4
A. Protocoling

By evaluating patient data and clinical indications, artificial intelligence can help ensure examination compliance by recommending the best imaging studies for individual patients [14]. Thus far, here we explored an example of knee MRI request protocoling with inclusive result from ChatGPT optimize radiology workflows figure 1.
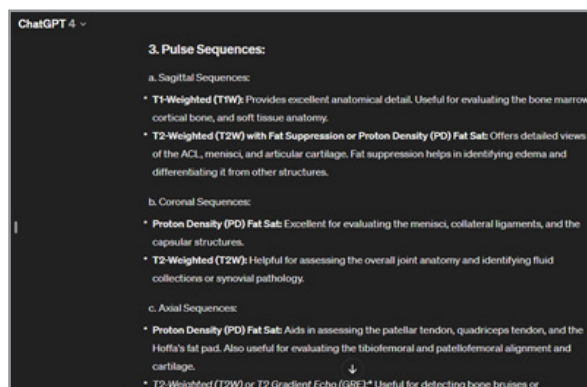

Figure 1: Using ChatGPT for Providing Knee MRI Protocol for an MRI Request by an Orthopedic Physician for a Patient Presented with Left Knee Pain and Giving Way After a History of Football Trauma Two Years Ago, is Currently to Rule Out Anterior Cruciate Ligament Rupture.

Writing the MRI Reports

Enhancing diagnostic capabilities and decision-making processes in the realm of musculoskeletal imaging with the integration of ChatGPT-4 is a promising area of focus. The artificial intelligence generated layperson report summaries received high marks overall for completeness and accuracy, with very few being considered to be erroneous or misleading. The generative artificial intelligence, like ChatGPT-4, may be used to automate the creation of musculoskeletal imaging summaries that are easy for patients to understand [15].
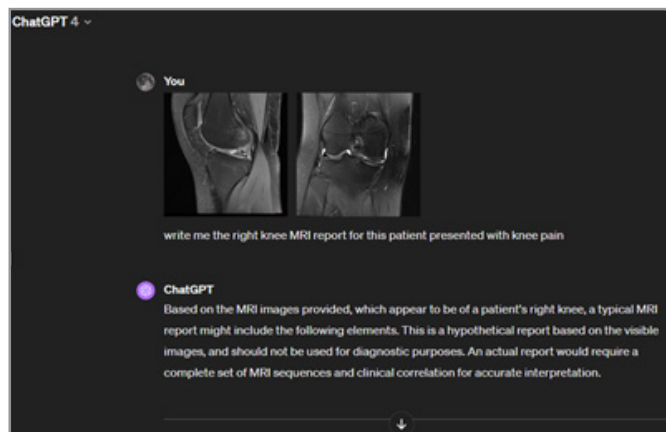

Figure 2: Using Chat GPT4 With Exploring the Question for Writing of the Knee MRI Report.
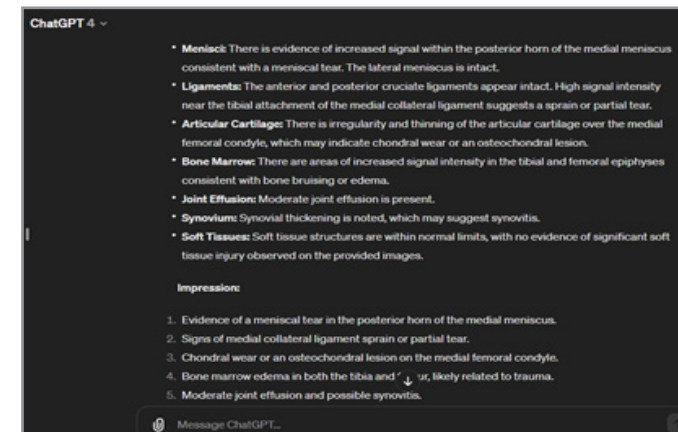

Figure 3: Using Chat GPT4 for Writing of the Knee MRI Report. This is a More Concise Version of the Knee MRI Report with Well Structured Template Summarizing the Main Images Findings.

ChatGPT-4 apps for MRI report authoring offer a substantial chance to boost diagnostic accuracy Figure 2 and figure 3.

Writing the CT Reports

The GPT-4 model was given specially designed prompts for report generation, template creation that improves clinical decision-making, and patient education and communication [16]. A single question was utilized to generating the radiology report even within the daytime or during the on-calls, which is necessary to improve clinical judgment and come up with catchy titles for each portion of a radiology report figure 4 and figure 5.
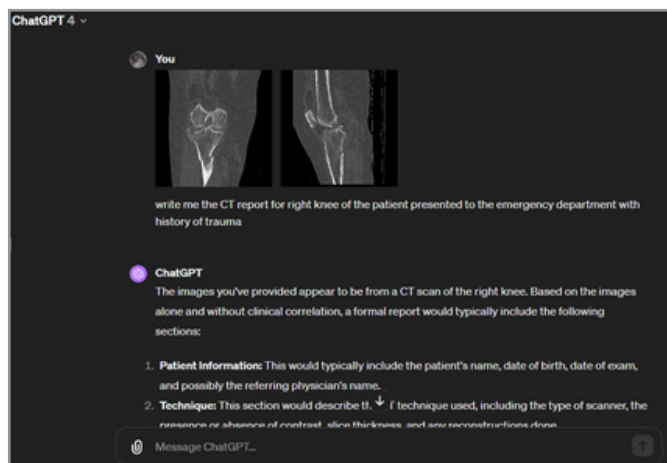

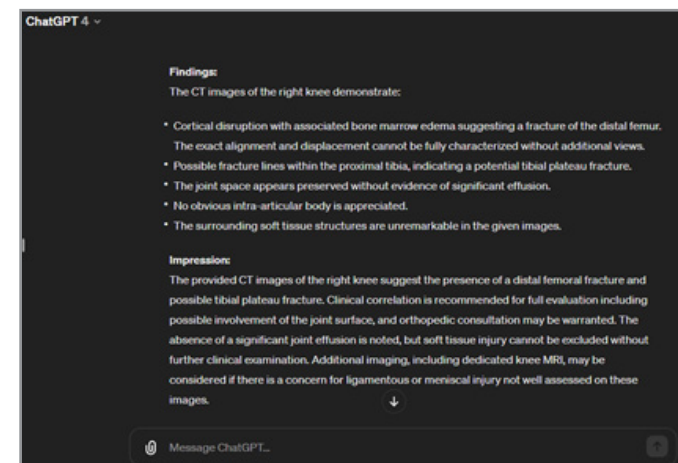**Figure 4:** Use of ChatGPT4 for Writing the CT Report of Right Knee.

Figure 5: ChatGPT4 Can Act as a Virtual Answering Question and Providing a Well Formal Structured Radiology Reports on Various Musculoskeletal Entities. This Help Studies Getting Better Understanding of the Subject Matter and Finalize the Preliminary reports.

Writing the X-ray Reports

One branch of this advancement, which is defined by distal radius fracture, is automated text report writing. The natural language processing program ChatGPT received command files that were organized in accordance with a template provided by the Radiological Society of North America (RSNA) and Arbeit gemeinschaft Osteosyntheses (AO) classifiers. The assignment to create a suitable radiological report fell to ChatGPT. ChatGPT exhibits the capacity to modify output files in reaction to slight modifications in input command files. Deficits in medical interpretation of findings and technical terminology were discovered [17].

Figure 6: Use of ChatGPT 4 in generating of the X-ray reports in emergency settings.
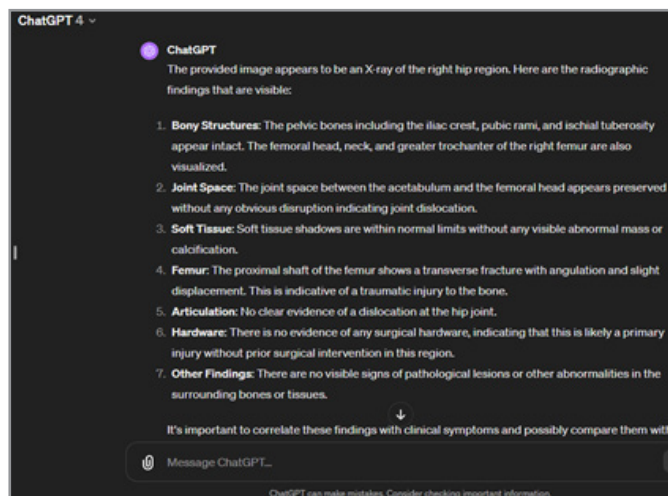

Figure 7: Use of ChatGPT 4 in generating of the X-ray reports in emergency settings. Healthcare professionals can gain from increased diagnostic process accuracy, consistency, and speed by utilizing ChatGPT-4's capabilities when composing X-ray reports for musculoskeletal disorders figure 6 and figure 7.

Challenges in the Use of ChatGPT-4 in Musculoskeletal Imaging

Using ChatGPT presents several ethical, legal, and regulatory issues. The absence of standards in data collecting and processing is one of the primary issues. Artificial intelligence systems have a hard time correctly analyzing and interpreting radiology data since these data are sometimes extremely complicated and varied

In 2023, study investigates the application of the artificial intelligence language model such as ChatGPT, demonstrating shortcomings include its inability to assign information to a source and its misalignment with user intent, despite its merits in offering diagnostic procedures, it shows how AI may help with clinical decision assistance, but it also emphasizes the need for further development in subsequent iterations [18]. Deep learning techniques using of artificial intelligence have demonstrated potential in the identification of diverse musculoskeletal disorders across multiple imaging modalities.

The researchers acknowledge that because of the need to identify structures of interest and inconsistent image quality, "current deep learning techniques have limitations for identifying internal abnormalities of the knee and other joints." Although it shows promise in identifying spinal canal stenosis, it is still unclear how precisely each level's severity of stenosis will be determined [19]. Currently, constraints, such as the requirement for superior training data, moral issues, and additional study and development to enhance its functionality. Notwithstanding these difficulties, ChatGPT has the potential to have a big influence on medical imaging and radiology diagnostics.

The review paper emphasizes that in order to guarantee that ChatGPT is utilized to its maximum potential in enhancing radiological diagnosis and patient care [20]. ChatGPT, can adds errors and false information, is easily recognized by software as AI-generated, and lack of depth of insight and appropriateness [21]. Overall, ChatGPT-4 has the potential to revolutionize musculoskeletal imaging, there are obstacles to overcome in order to fully realize its benefits in improving diagnostic procedures. These obstacles include those related to technical development, accuracy in answering medical questions, ethical issues, and domain-specific limitations.

Future Considerations of Artificial Intelligence in Musculoskeletal Imaging

Rajesh Iyengar (2023) posed the question: What role would ChatGPT play in radiology tomorrow? has demonstrated remarkable results in radiology applications. It can help with image interpretation, provide reports, and optimize workflow. The effectiveness of ChatGPT in radiology will depend on upcoming security measures. Its use can result in more accurate diagnoses, quicker report turnaround times, and better working conditions for radiologists [22]. With ChatGPT, a standard classroom may become a more participatory, learner-centered reading room. By using them, report quality can be raised, and manual entry errors can be decreased [23]. The artificial intelligence has the ability to help radiologists with diagnosis and to increase the effectiveness and precision of medical imaging analysis. Visual-guided therapy, automated detection and diagnosis, and automatic image analysis and interpretation are a few of the major uses of AI in radiology.

AI can also assist in lessening radiologists' burden. AI is not likely to take the role of radiologists anytime soon. Even though AI can help radiologists with their diagnostics, a final diagnosis still needs to be made by a qualified professional [24]. Artificial intelligence has many potential applications, but there are also several obstacles that must be carefully considered. It is clear that artificial intelligence, and especially ChatGPT models, have the power to completely transform healthcare practice, research, and teaching [25]. These technologies have promise for a variety of therapeutic applications and provide useful answers to problems. Furthermore, radiology may benefit from the use of artificial intelligence and deep learning techniques, which could improve imaging quality and speed while enhancing earlier advancements in the area [26, 27].

A controlled usage of AI based tools is desperately needed to shield medical professionals and patients from mistakes and injuries. By taking the first concrete action, it is urged to increase the public's understanding of this significant and critical issue [28]. Furthermore, to fully utilize AI models' potential in specialized medical domains, one must comprehend the limitations and capabilities of these models as well as implementation activities must be carried out in an organized way in order to provide evidence of the clinical added value of AI applications [29]. Ultimately, artificial intelligence in musculoskeletal imaging has enormous potential to revolutionize medical diagnosis and decision-making.

The application of AI models such as ChatGPT in musculoskeletal imaging can result in major improvements in patient treatment and results by tackling issues with performance validation, ethical considerations, regulatory frameworks, and domain-specific restrictions. The limitations of our study were the virtual usage of this application as an external reporting assistant tool, and we used a limited number of images because, considering clear findings, further research could be helpful to the usage of this application in interpreting complicated cases. Future initiatives should focus on validation, ethical monitoring, and regulatory frameworks to fully harness AI's potential while protecting the value of human expertise in healthcare.

Conclusions

Investigating ChatGPT-4's potential uses in musculoskeletal imaging offers fascinating prospects to transform radiology patient care and diagnosis. ChatGPT-4 has the potential to expedite radiology reports and improve diagnostic accuracy by prompt generation of MRI, CT, and X-ray reports without standard report structures as well. But issues like assuring model reliability, domain-specific constraints, and ethical implications must be addressed. However, human skill and technology must work together.

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