



# ChatGPT-4 Generates More Accurate and Complete Responses to Common Patient Questions About Anterior Cruciate Ligament Reconstruction Than Google's Search Engine

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**Purpose:** To replicate a patient's internet search to evaluate ChatGPT's appropriateness in answering common patient questions about anterior cruciate ligament reconstruction compared with a Google web search. **Methods:** A Google web search was performed by searching the term "anterior cruciate ligament reconstruction." The top 20 frequently asked questions and responses were recorded. The prompt "What are the 20 most popular patient questions related to 'anterior cruciate ligament reconstruction?'" was input into ChatGPT and questions and responses were recorded. Questions were classified based on the Rothwell system and responses assessed via Flesch-Kincaid Grade Level, correctness, and completeness were for both Google web search and ChatGPT. **Results:** Three of 20 (15%) questions were similar between Google web search and ChatGPT. The most common question types among the Google web search were value (8/20, 40%), fact (7/20, 35%), and policy (5/20, 25%). The most common question types amongst the ChatGPT search were fact (12/20, 60%), policy (6/20, 30%), and value (2/20, 10%). Mean Flesch-Kincaid Grade Level for Google web search responses was significantly lower ( $11.8 \pm 3.8$  vs  $14.3 \pm 2.2$ ;  $P = .003$ ) than for ChatGPT responses. The mean correctness for Google web search question answers was  $1.47 \pm 0.5$ , and mean completeness was  $1.36 \pm 0.5$ . Mean correctness for ChatGPT answers was  $1.8 \pm 0.4$  and mean completeness was  $1.9 \pm 0.3$ , which were both significantly greater than Google web search answers ( $P = .03$  and  $P = .0003$ ). **Conclusions:** ChatGPT-4 generated more accurate and complete responses to common patient questions about anterior cruciate ligament reconstruction than Google's search engine. **Clinical Relevance:** The use of artificial intelligence such as ChatGPT is expanding. It is important to understand the quality of information as well as how the results of ChatGPT queries compare with those from Google web searches

In the rapidly evolving landscape of medical practice, the integration of advanced technologies, such as artificial intelligence (AI) and machine learning, has the potential to reshape various domains, including

orthopaedic surgery. One example is ChatGPT, a sophisticated language model developed by OpenAI. ChatGPT is a publicly available computer program designed to comprehend and generate human-like text, making it a powerful tool for communication, information dissemination, and problem-solving across a wide range of topics, including health care. ChatGPT can offer insights, assistance, and collaboration on a multitude of topics and can be readily accessed by both providers and patients.

As ChatGPT has become more popular, it has begun to be used among the medical community, including orthopaedic surgery.<sup>1-4</sup> Recent studies have explored ChatGPT's accuracy in providing medical information and have compared the appropriateness of ChatGPT with a Google web search in answering patient questions.<sup>5,6</sup> Internet search engines, such as Google, use machine learning to identify search

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query data patterns and predict subsequent queries based on the initial search, including frequently asked questions (FAQs).<sup>7,8</sup> Despite patients commonly using search engines for health information before going to a doctor, studies have shown the quality of information and readability of information provided can be suspect and misleading.<sup>9,10</sup> Given the issues search engines, the integration of ChatGPT as an additional patient resource for knowledge dissemination raises pertinent ethical considerations and challenges.

Anterior cruciate ligament reconstruction (ACLR) is one of the most common orthopaedic surgeries performed, with 80,000 and 120,000 cases in the United States per year.<sup>11-13</sup> When providers are counseling patients undergoing ACLR, patients often discuss internet search results with them.<sup>14,15</sup> Internet search engines, such as Google, have been formally assessed to determine the most FAQs and quality of responses available to patient questions for ACLR.<sup>16</sup> The purpose of this study was to replicate a patient's internet search to evaluate ChatGPT's appropriateness in answering common patient questions about ACLR compared with Google web search. We hypothesized that ChatGPT would provide similar information to a Google web search.

## Methods

The following term was inputted into an internet search engine ([www.google.com](http://www.google.com)) using a clean-installed Google Chrome incognito browser window, "anterior cruciate ligament reconstruction." A clean-installed browser was one that was cleared of browsing history, cookies, and data cache and was used to minimize the impact of individualized search algorithms. A list of the first 20 FAQs was recorded from the search (February 2, 2024), and their associated answers and websites were recorded on Microsoft Excel. A list of the first 10 consecutive questions necessitating a numerical response were recorded separately. The questions were categorized according to the Rothwell classification system, as previously reported in the literature.<sup>6,17,18</sup> Questions were classified into fact, policy, or value categories and further classified into 10 subcategories relevant to ACLR, including specific activities, timeline of recovery, restrictions, technical details, cost, indications/management, risks/complications, pain, longevity, and evaluation of surgery. Full classification is available in [Table 1](#). Websites were classified into the following groups: commercial, academic, medical practice, single-surgeon practice, government, or social media sites. Two reviewers (M.G. and B.P.) categorized the questions and websites, and

**Table 1.** Rothwell's Classification of Questions, Question Classification by Topic, and Website Categorization

Rothwell's classification	Description
Fact	Asks whether something is true and to what extent, objective information
Policy	Asks whether a specific course of action should be taken to solve a problem
Value	Asks for evaluation of an idea, object, or event
Question classification subcategory	Description
Fact	Ability to perform a specific activity or action after meniscectomy or any restrictions to activity or lifestyle during recovery or indefinitely
Activities/restrictions	Specific questions regarding length of time for recovery milestones
Timeline of recovery	Surgical procedure, includes specific questions about implants
Technical details	Cost of surgery and/or rehabilitation postoperatively
Cost	Specific questions regarding the structure and function of the meniscus
Anatomy/function	Questions regarding how one knows they have a meniscal injury
Diagnosis	Surgical indications and timing of surgery
Policy	Management of risks/complications during and after surgery
Indications/management	Pertains to duration, severity, and management of pain
Risks/complications	Specific questions regarding longevity of a meniscal repair
Value	Evaluation of the successfulness or invasiveness of a meniscal repair/knee arthroscopy
Pain	Comparison between meniscal and other injuries in regard to severity, etc.
Longevity	
Evaluation of surgery	
Injury comparison	
Website categorization	Description
Academic	Institution with a clear academic mandate, including universities, academic medical centers, academic societies
Commercial	Commercial organization that positions itself as a source of health information, includes medical device and pharmaceutical companies
Government	Websites ending in.gov or maintained by a national government
Medical practice	Local hospital or orthopaedic practice without an academic affiliation
Single-surgeon personal	Website built and maintained by individual surgeon. Excludes biography pages on institutional websites
Social media	Websites maintained by nonmedical organizations primarily designed for information sharing between internet users. Includes health blogs, internet forums, and support groups

**Table 2.** Top 10 Frequently Asked Questions per Search Engine

	Google	ChatGPT
1	Is an ACL reconstruction a major surgery? ( <b>evaluation of surgery</b> )	How long does it take to recover fully from ACL reconstruction surgery? ( <b>timeline of recovery</b> )
2	What is the recovery time for anterior cruciate ligament reconstruction? ( <b>timeline of recovery</b> )	What are the potential complications or risks associated with ACL reconstruction? ( <b>risks/complications</b> )
3	What is the difference between ACL repair and ACL reconstruction? ( <b>technical details</b> )	Will I be able to return to sports or physical activities after ACL reconstruction surgery? ( <b>specific activities</b> )
4	How painful is post ACL reconstruction? ( <b>pain</b> )	What type of anesthesia is used during ACL reconstruction surgery? ( <b>technical details</b> )
5	Will my knee ever be the same after ACL reconstruction? ( <b>evaluation of surgery</b> )	How soon after ACL reconstruction surgery can I start physical therapy? ( <b>timeline of recovery</b> )
6	Is ACL reconstruction worth it? ( <b>evaluation of surgery</b> )	Will I need to use crutches after ACL reconstruction surgery? ( <b>indications/management</b> )
7	Do you lose speed after ACL surgery? ( <b>risks/complications</b> )	How long do I need to wear a knee brace after ACL reconstruction surgery? ( <b>timeline of recovery</b> )
8	What does an ACL surgery scar look like? ( <b>indications/management</b> )	What are the chances of re-injury to the ACL after reconstruction surgery? ( <b>risks/complications</b> )
9	Why is ACL surgery recovery so painful? ( <b>pain</b> )	How soon after ACL reconstruction surgery can I drive? ( <b>specific activities</b> )
10	Is ACL graft stronger than original? ( <b>technical details</b> )	What restrictions or precautions should I follow after ACL reconstruction surgery? ( <b>restrictions</b> )

NOTE. Bold indicates Rothwell question subcategory. ACL, anterior cruciate ligament.

discrepancies were resolved by a third reviewer (J.C.). To assess interobserver reliability, Cohen’s kappa coefficient was calculated for classifications which was 0.83 indicating near-perfect agreement.

The language model AI chatbot ChatGPT 4.0 (Open AI; <https://chat.openai.com/>) was used for development of FAQs and answers (February 2, 2024). The prompt “What are the 20 most popular patient questions related to ‘anterior cruciate ligament reconstruction?’” was inputted to generate the list of questions, which were recorded. In a separate query, the prompt “Please answer the following questions as if you’re providing up-to-date information to a patient considering knee ligament surgery in 2 to 3 sentences ideally” was used. The previously recorded FAQs were inputted and corresponding answers from ChatGPT were recorded with no clarification or follow-up. ChatGPT was unable to provide specific sources for its information and stated it provided information based on general medical knowledge.

Questions were classified into categories and subcategories via the Rothwell classification. Analysis between question categorization was performed. Flesch-Kincaid Grade Level was calculated to assess the readability of answers to FAQs on both Google and ChatGPT. The first 5 FAQs on Google were inputted into ChatGPT, and their answers were recorded and compared with the answers found on Google.

Google web search and ChatGPT question answers were graded for correctness and completeness by 2 orthopaedic surgery resident reviewers (M.G. and J.C.), and discrepancies were resolved by a third reviewer (T.L.). The correctness was graded as 0 = incorrect, 1 =

partially correct, and 2 = correct, and completeness was graded as 0 = incomplete, 1 = partially complete, and 2 = complete as in a previous study.<sup>19</sup> Descriptive statistics and Student *t*-tests were performed on Excel (Microsoft, Redmond, WA) for Flesch-Kincaid Grade Level and question grading. This project was exempt from institutional review board approval.

## Results

Among the questions assessed, 3 of 20 (15%) questions were similar between the Google web search and ChatGPT search for “anterior cruciate ligament reconstruction.” These questions were “What is the recovery time for ACLR?”, “How painful is post ACLR?”, and “What is the success of ACL surgery?” The most common question types among the Google web search were value (8/20, 40%), fact (7/20, 35%), and policy (5/20, 25%). The most common question subcategories were evaluation of surgery (5/20, 25%), pain (3/20, 15%), risks/complications (3/20, 15%), indications/management (3/20, 15%), technical details (3/20, 15%), restrictions (2/20, 10%), and timeline of recovery (1/20, 5%). The most common sources were medical practice (6/20, 30%), single-surgeon practice (4/20, 20%), social media (4/20, 20%), academic (3/20, 15%), government (2/20, 10%), and commercial (1/20, 5%).

The most common question types among the ChatGPT search were fact (12/20, 60%), policy (6/20, 30%), and value (2/20, 10%). The most common question subcategories were indications/management (4/20, 20%), technical details (4/20, 20%), timeline of recovery (4/20, 20%), specific activities (3/20, 15%), risks/complications (2/20, 10%), restrictions (1/20,

**Table 3.** Comparison of Responses for Top 5 Frequently Asked Questions by Search Engine

Question	Google	ChatGPT
1. Is an ACL reconstruction a major surgery?	Minimally invasive surgeries use smaller incisions than open surgeries and generally offer faster recovery, with fewer health risks. However, because ACL surgery involves a complex reconstruction or replacement of a major tendon, it can be considered a major surgery.	ACL reconstruction is considered a major surgery, primarily because it involves significant changes to the knee's anatomy, typically requiring general anesthesia, and a substantial recovery and rehabilitation period. However, it is commonly performed arthroscopically, which is less invasive than open surgery. This means smaller incisions, potentially less pain, and a quicker recovery time compared with traditional open knee surgeries. The surgery aims to restore stability to the knee, allowing individuals to return to their previous levels of activity, including sports.
2. <b>What is the recovery time for anterior cruciate ligament reconstruction?</b>	2-6 weeks: beginning to walk normally without pain relief or crutches. 6-14 weeks: full range of motion restored – able to climb up and down stairs. 3-5 months: able to do activities such as running without pain (but still avoiding sports) 6-12 months: return to sport.	The recovery time after ACL reconstruction can vary, but it generally takes about 6 to 9 months for most patients to return to their preinjury level of activity. This timeline can depend on factors like the type of graft used, the patient's adherence to rehabilitation, overall health, and the specific demands of their regular activities or sports. The recovery process involves several stages, including reducing swelling, regaining knee motion, and progressively increasing exercise intensity to restore strength and function. For personalized recovery plans and advice, it's recommended to consult with a health care provider.
3. What is the difference between ACL repair and ACL reconstruction?	ACL reconstruction has been around for decades and has been the go-to procedure for torn ligaments. Reconstruction has a high success rate but can take 6-12 months for a full recovery. ACL repair seeks to keep the patient's ligament in place to promote self-healing. The ligament may also require stem cells.	ACL repair and ACL reconstruction are 2 different surgical approaches for treating ACL injuries. ACL repair involves reattaching the torn ligament back to the bone, which is less common and usually only possible when the ligament has cleanly torn off from the bone. ACL reconstruction, in contrast, involves replacing the torn ligament with a graft, either from the patient's own body (autograft) or from a donor (allograft). Reconstruction is more common and is generally preferred because of greater success rates in restoring long-term knee stability, especially for active individuals or athletes.

(continued)

**Table 3.** Continued

Question	Google	ChatGPT
4. How painful is post-CL reconstruction?	Most people have some surgery-related pain and discomfort for the first week or so. Not surprisingly, pain from knee surgery decreases with time. By the end of a week or two at the most, you should have very little discomfort. Swelling and bruising are also relatively common, and like discomfort, they're temporary.	Post-ACL reconstruction pain varies among individuals, but it is generally manageable with proper care and medication. In the first few days after surgery, patients often experience moderate to significant pain, which can be controlled with prescribed pain medication. As the knee begins to heal and rehabilitation progresses, the pain typically decreases. The initial discomfort is part of the healing process, and adherence to prescribed pain management strategies, including ice, elevation, and physical therapy, is crucial for a smoother recovery. For personalized pain management advice, it's best to consult with your health care provider.
5. Will my knee ever be the same after ACL reconstruction?	ACL surgery fully restores the functioning of the knee in more than 80% of cases. However, your knee may not be exactly like it was before the injury, and you may still have some pain and swelling.	After ACL reconstruction, the knee may not feel exactly the same as it did before the injury, but the goal of the surgery is to restore its stability and function to a level that allows a return to most activities and sports. Some individuals might experience changes in sensation, slight differences in movement, or require ongoing attention to knee strength and health. The success of the surgery and rehabilitation can lead to a knee that functions well for most activities, although some adjustments or ongoing care might be necessary. For detailed and personalized information, it's important to consult with a health care provider.

NOTE. Bold font indicates similar question between Google and ChatGPT. ACL, anterior cruciate ligament.

5%), pain (1/20, 5%), and evaluation of surgery (1/20, 5%). Mean Flesch-Kincaid Grade level for Google web search responses was significantly lower ( $11.8 \pm 3.8$  vs.  $14.3 \pm 2.2$ ;  $P = .003$ ) than for ChatGPT responses.

The mean correctness for Google web search question answers was  $1.47 \pm 0.5$ , and mean completeness was  $1.36 \pm 0.5$ . Mean correctness for ChatGPT answers was  $1.8 \pm 0.4$  and mean completeness was  $1.9 \pm 0.3$ , which were both significantly greater than Google web search answers ( $P = .03$  and  $P = .0003$ ). A comparison of the first 10 numerical questions is included in Table 2. A comparison of question responses for the top 5 Google web search questions is included in Table 3. A comparison of the top 10 questions with numerical responses is included in Table 4.

### Discussion

Our study found few similar FAQs between Google web search and ChatGPT, with Google web search

questions predominantly asking about value-type questions, whereas ChatGPT questions asked about fact-type questions. The readability of Google web search responses was significantly better compared with ChatGPT; however, mean correctness and completeness were significantly greater for ChatGPT responses compared with Google web search responses.

Interestingly, Google and ChatGPT had few similar questions in their respective top 20 FAQs and had dissimilar Rothwell classifications. Google web search questions were predominantly categorized as value-related aspects, such as evaluation of surgery, pain, and longevity. In contrast, the ChatGPT language model leaned towards fact-based inquiries such as technical details, specific activities, and recovery timelines. In addition, it is worth noting that, in our study, ChatGPT did not generate any questions pertaining to "value." Dubin et al.<sup>6</sup> compared Google with ChatGPT for total hip arthroplasty/total knee arthroplasty

**Table 4.** Top 10 Questions With Numerical Responses by Search Engine

Question	Google	ChatGPT
1. What is the recovery time for anterior cruciate ligament reconstruction?	6-12 months	6-9 months
2. What is the success rate of ACL surgery?	80%-90%	80%-90%
3. What is the average age of ACL tears?	15-45 years old	15-45 years old
4. What is the most painful day after ACL surgery?	First day postoperatively	First few days
5. How long should you take off work after ACL surgery?	If you sit at work, you may be able to go back in 1 to 2 weeks. However, if you are on your feet at work, it may take 4 to 6 weeks. If you are very physically active in your job, it may take 4 to 6 months.	If jobs or school activities that are primarily sedentary, individuals might return within 1 to 2 weeks. For more physically demanding roles or activities, it might take 4 to 6 weeks or longer.
6. How long can you delay ACL surgery?	6 months or longer	Varies based on individual circumstances, but it's generally advisable not to delay it excessively
7. What is the failure rate of ACL surgery?	5%	5%-10%
8. How long after ACL surgery can you drive?	Left knee, you can resume driving when you feel your reaction times are back to normal (typically 1 week). If it is your right knee, usually allow driving 4-6 weeks after surgery	Generally, for surgeries on the left leg (for automatic vehicles), driving can often resume in 1-2 weeks. For the right leg or manual vehicles, the timeframe might be longer
9. How long should I wear a knee brace after ACL surgery?	First 6 weeks	2-6 weeks
10. What percentage of ACL grafts fail?	34.20%	5%-10%

ACL, anterior cruciate ligament.

questions and found both had predominantly “fact” questions and only 25% were similar. Castle et al.<sup>16</sup> reviewed 273 unique questions from multiple key words pertaining to ACLR on Google and found more than 50% of them related to “fact.” Our review of Google web search questions found a large percentage (35%) of “fact” questions; however, most questions were “value”-related, which could be the result of medical practices and surgeon practice webpages being the predominant sources used, which are written to be more patient-focused. ChatGPT did not provide sources; however, it is trained on a wide variety of information and databases and stated its answers were based on “general medical knowledge and guidelines within the field of orthopedic surgery.”<sup>20</sup> In addition, the timing of the query can change top responses on Google; therefore, variability is possible if the study were to be repeated. Few studies have compared a search engine and large language model; however, our study shows a distinct difference in question type.

Examining the readability of responses, Google web search had a significantly lower reading grade level compared with ChatGPT. Karimi et al.<sup>21</sup> conducted a systematic review of patient education materials and found they often exceed the recommended sixth-grade reading level. In our study, both Google web search and ChatGPT responses had higher reading grade levels than the recommended at mean 11th grade and 14th grade, respectively. ChatGPT responses were significantly more complex and longer, despite including prompting to provide 2- to 3-sentence responses

written “to potential patients.” Hurley et al.<sup>5</sup> examined ChatGPT responses for shoulder stabilization and similarly found they were at “college” reading level; however, they did not provide detail regarding if any “prompting” was used. Without prompting, ChatGPT tends to offer longer responses, potentially hindering its adaptability and readability to the general patient population.<sup>19</sup> This underscores the necessity of refining these models for optimal patient interaction, especially in the field of orthopaedic surgery.

We found ChatGPT responses to have significantly greater mean completeness and correctness scores compared with Google web search. Multiple studies on Google web search answers for arthroscopic surgery found poor quality evidence scores, especially for medical practice and single-surgeon practice sources, which were the most represented sources for our study.<sup>16,18</sup> Cassidy et al.<sup>22</sup> performed a review of online orthopaedic information and found most to be generally of poor quality. A recent study assessed whether ChatGPT provided accurate information on ACL surgery for both medical doctors and patients compared with sports medicine-trained orthopaedic surgeons, and they found ChatGPT was 65% correct in providing satisfactory answers and struggled with topics in which a clear answer was not readily available.<sup>19</sup> We likely found ChatGPT to be a better resource because we assessed it solely as a resource for commonly asked patient questions, as more complex and nuanced questions are better reserved for discussion in the clinic with the patient’s surgeon. We also used ChatGPT with

minimal prompting to better simulate realistic usage by patients. Mika et al.<sup>23</sup> presented commonly asked patient questions about TKA to ChatGPT and found it provided mostly evidence-based responses and could act as a patient education adjunct. Hurley et al.<sup>5</sup> also concluded ChatGPT provided high-quality answers to questions about shoulder stabilization surgery. When numerical questions and answers were compared, Google web search and ChatGPT had largely similar answers, indicating similar efficacy and accuracy in answering discrete numerical questions. Aside from the high reading grade level, ChatGPT had more correct and complete responses therefore, given that ChatGPT is widely and freely available, we believe it has promise as a potential patient resource in addition to internet search engines.

The accuracy of information, and the role of AI and large language model as a complementary tool rather than a replacement for medical expertise, warrants careful evaluation. Studies on data quality using search engines such as Google, which uses machine learning for common question generation, have shown varying quality of responses and readability to commonly asked patient questions.<sup>24,25</sup> Given the numerous and varying quality of sources available, the internet can be an illuminating, and sometimes misleading, source of patient information regarding complex topics such as orthopaedic surgery. When directly designed by medical providers, AI models have demonstrated utility in guiding patient decisions.<sup>26</sup> However, AI language models such as ChatGPT do not rely on medical professionals for programming, so there is potential for misinformation. Kaarre et al.<sup>19</sup> found ChatGPT struggled with the more complex and nuanced questions regarding ACL surgery details, and concluded, while promising, an orthopaedic sports surgeon is a superior resource. Also, given the recent surge of machine learning studies in orthopaedic surgery, there is increasing discussion on the limits of machine learning and the need for high-quality data input to ensure high-quality conclusions.<sup>27</sup> Similarly, ChatGPT is limited based on its data input, which is currently not designed by orthopaedic surgeons, thus vigilance is needed when assessing its recommendations. Overall, almost every ChatGPT response we reviewed included a statement deferring to a health care professional for a more in-depth discussion, indicating that the limits of the program were considered by its design team, whereas Google web search answers were pulled from a myriad of sources of differing quality and type.

### Limitations

This study was not without limitations. The methodology to assess the responses was subjective, and variation of answer quality is possible. Although evaluation of answer quality was approached methodologically

and a previously used grading methodology was employed,<sup>19</sup> answer ratings were ultimately subjective. Second, while we used the ChatGPT 4.0, the program can evolve, and answer responses can subsequently change based on new training. Similarly, prompting can change ChatGPT responses and while we did include one, more sophisticated prompts and changing the version, length, and style of questions could alter the chatbot response. With the new updates to ChatGPT, we were unable to verify the individual sources from their answers; therefore, we could not directly compare them to Google web search. Lastly, the sampling of which questions are considered common can change over time, as website sources are updated, and a repeat study could select different questions to include.

### Conclusions

ChatGPT-4 generated more accurate and complete responses to common patient questions about ACLR than Google's search engine.

### Declaration of Generative AI and AI-Assisted Technologies in the Writing Process

During the preparation of this work, the author(s) used ChatGPT in order to provide content for our manuscript. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

### Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: T.S.L. reports board membership, American Orthopedic Society for Sports Medicine, and consultant or advisor for Smith & Nephew. All other authors (M.A.G., J.P.C., M.J.A., B.A.P., M.D.M., and V.M.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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