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Article

Evaluating ChatGPT-4o's Web-Enhanced Responses in Patient Education: Ankle Stabilization Surgery as a Case Study

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Abstract: Background: Artificial intelligence (AI) is increasingly used in healthcare for patient education, clinical decision support, and medical information dissemination. ChatGPT-4o, an advanced large language model (LLM) with web search functionality, claims to improve response accuracy and relevance. However, its reliability and ability to provide comprehensive and evidence-based medical information remain uncertain. This study evaluates the quality, readability, and accuracy of ChatGPT-4o's responses to common patient inquiries regarding ankle stabilization surgery. Methods: On January 30, 2025, ChatGPT-4o was prompted with frequently asked questions about ankle stabilization surgery. The web search function was enabled to enhance response accuracy. Three independent reviewers assessed the AI-generated responses using the DISCERN tool for quality and the Flesch-Kincaid metrics for readability. Inter-rater reliability was calculated to determine rating consistency. Results: The readability analysis revealed that ChatGPT-4o's responses were highly complex (Flesch-Kincaid Reading Ease Score = 23.07, Grade Level = 13.9), requiring a college-level education for comprehension. DISCERN scores ranged from 47 to 58, indicating moderate quality. The inter-rater reliability score of 0.73 demonstrated substantial agreement. Limitations included overly optimistic recovery timelines, lack of authoritative citations, and insufficient discussion of surgical risks. Conclusion: ChatGPT-4o provides structured and accessible medical information but exhibits limitations in accuracy, transparency, and risk disclosure. Future improvements should focus on enhancing source reliability, readability, and personalization to improve AI-assisted patient education.

Keywords: AI-generated health information; Readability assessment; DISCERN score; Spinal surgery education; Patient health literacy

Introduction

Artificial intelligence (AI) is progressively employed in healthcare for patient education, clinical decision support, and medical information dissemination (Gibson et al., 2024). Large language models (LLMs), such as ChatGPT, have demonstrated proficiency in providing structured medical information; yet, concerns remain regarding their accuracy, reliability, and transparency (Haidar et al., 2023). In particular, AI-generated responses often lack authoritative citations and may oversimplify complex medical concepts (Kim et al., 2024).

Existing studies primarily assess ChatGPT's offline responses, neglecting its web search capabilities (Fahy et al., 2024). ChatGPT-4o represents the latest iteration of OpenAI's large language model, designed to provide improved reasoning, contextual understanding, and response coherence compared to previous versions. One of its key advancements is the **integration of a web search functionality**, allowing the AI to access and retrieve real-time information from online sources. This feature theoretically enhances the accuracy, transparency, and up-to-date relevance of AI-generated medical responses. However, the reliability of the retrieved information is uncertain.

Ankle stabilization surgery is a common procedure for patients with chronic ankle instability; nonetheless, patient understanding of surgical indications, recovery expectations, and postoperative risks differs significantly. Inaccurate or incomplete information can impact decision-making and patient satisfaction. Therefore, evaluating AI's capability to generate reliable and patient-friendly content in this domain is critical (Casciato et al., 2024; Parekh et al.).

This study aimed to assess the quality, readability, and accuracy of ChatGPT-4o's responses to frequently asked patient inquiries regarding ankle stabilization surgery, incorporating its web search functionality. By identifying the strengths and limitations of AI-generated medical content, the study provides insights into the current state of **AI-assisted patient education** and highlights areas for future improvement.

Methods

Artificial Intelligence

On January 30, 2025, ChatGPT-4o, an advanced AI software, was employed to address frequently asked patient inquiries regarding ankle stabilization surgery. These inquiries were formulated based on clinical expertise from our research team as well as prior studies investigating patient expectations following the procedure. A comprehensive list of these questions is provided in Table 1. The AI's web search functionality was activated to enhance the relevance and accuracy of its responses. Three independent reviewers—MZ, XS, and YP—systematically evaluated the AI-generated responses. Multiple scoring frameworks were utilized to assess both the readability and informational quality of the content provided. The findings, including a synthesized analysis and summary of the AI-generated responses, are presented in the following sections. The complete, unedited responses can be accessed in Appendix 1.

Quality Analysis

The DISCERN score is used to evaluate the quality of AI-generated responses, two validated tools were employed. The DISCERN score was developed as an instrument for assessing the quality of written patient information related to treatment options (Charnock et al., 1999). It consists of three structured sections: (1) eight questions that evaluate the reliability of the information presented, (2) seven questions that focus on the completeness and accuracy of treatment-related details, and (3) a final overall quality rating. The total possible score is 80, with classifications as follows: a score exceeding 70 is considered "excellent," while a score above 50 is classified as "good."

Readability Analysis

The readability of the responses was assessed using two well-established metrics: the Flesch-Kincaid Reading Ease Score (FRES) and the Flesch-Kincaid Grade Level (FKGL) (Flesch, 1948). The FRES assigns a numerical readability score ranging from 0 to 100, where higher scores indicate simpler and more accessible text. A score near 100 suggests that the content is very easy to

understand, while lower scores denote increased complexity. The FKGL is an adaptation of the FRES and estimates the minimum education level required for comprehension. A higher FKGL score corresponds to more complex text, indicating that individuals with lower levels of formal education may find the material difficult to understand. Readability was calculated using the WebFX online readability test (Readability Test, 2025).

Statistical Analysis

A qualitative statistical analysis was conducted using **Microsoft Excel** to evaluate the consistency of ratings among reviewers. Specifically, **inter-rater reliability (IRR)** was calculated for the **DISCERN score** to determine the degree of agreement between evaluators. The IRR was interpreted using a standardized classification system: values between **0.01 and 0.20** indicated little to no agreement, while scores from **0.21 to 0.40** reflected fair agreement. A range of **0.41 to 0.60** was considered moderate, whereas scores from **0.61 to 0.80** indicated substantial agreement. The highest category, **0.81 to 1.00**, represented near-perfect consensus among raters (McHugh, 2012).

Table 1. Questions.

No.	Question
1	Do I need ankle stabilization surgery?
2	Can I avoid ankle stabilization surgery with physical therapy?
3	Who should get ankle stabilization surgery?
4	Can my ankle instability be managed without surgery?
5	What are the different types of ankle stabilization surgery?
6	What should I expect after ankle stabilization surgery?
7	When can I return to daily activities after ankle stabilization surgery?
8	How long until I can return to sport after ankle stabilization surgery?
9	When can I return to work after ankle stabilization surgery?
10	When can I drive after ankle stabilization surgery?
11	Will I get arthritis after ankle stabilization surgery?

Results

Results pertaining to quality and readability are shown in Table 2. The DISCERN score ranges from 47 to 58, suggesting a reasonable quality of the assessed materials. The Flesch-Kincaid Reading Ease Score is 23.072, indicating a highly challenging readability level that typically requires a college education or above for comprehension. The Flesch-Kincaid Grade Level is 13.9, further reinforcing this classification. Additionally, the Intraclass Correlation Coefficient (ICC) score is 0.73, indicating moderate reliability.

Table 2. The results of Quality and Readability Assessment of AI-Generated Responses.

	Judge 1	Judge 2	Flesch-Kincaid Reading Ease Score	Flesch-Kincaid Grade Level
Q1	56	54	13.8	16.1
Q2	58	53	19.4	14
Q3	58	52	1.9	17.1
Q4	57	54	18.9	14.3
Q5	56	53	23.2	13.1
Q6	56	56	35.6	11.4
Q7	48	47	35.2	11.7
Q8	48	48	18.3	14.6
Q9	48	47	19.5	14.6
Q10	49	47	32.7	13.4
Q11	49	47	35.3	12.6
Mea n	53	50.73	23.07	13.9

Questions and answers

The following content presents our critique and reflection on each AI-generated response. The complete responses can be found in Appendix 1.

Q1: Do I need ankle stabilization surgery?

AI provided a balanced response, emphasizing non-surgical options like physical therapy and bracing, while delineating circumstances that may necessitate surgery, such as chronic instability or recurrent sprains. It appropriately recommended consulting a specialist for evaluation. However, the absence of cited sources and specific success rates limits its reliability. The response was clear and informative but could benefit from more detailed evidence.

Q2: Can I avoid ankle stabilization surgery with physical therapy?

AI effectively outlined how physical therapy can improve ankle stability through exercises targeting strength, balance, and flexibility. It acknowledged that therapeutic outcomes fluctuate based on injury severity and the patient's commitment, reflecting a realistic perspective. However, the lack of specific studies or success rates weakens its credibility. The recommendation to seek an expert was appropriate; however, the response could have included more concrete examples of outcomes or timelines. Overall, it was informative but might benefit from greater empirical support.

Q3: Who should get ankle stabilization surgery?

AI may proficiently summarize the indications for ankle stabilization surgery and furnish pertinent medical background information. However, its responses tend to be general. Although it mentions indications such as chronic ankle instability, recurrent sprains, and failure of conservative treatment, it fails to differentiate how patients of varying severity should make surgical decisions. Moreover, it lacks quantitative criteria to assess the necessity of surgery. Additionally, the transparency of information sources is insufficient. Despite the frequent inclusion of citations, no specific references or data are provided, complicating the verification of the response's reliability.

Q4: Can my ankle instability be managed without surgery?

AI provides a comprehensive overview of prevalent non-surgical treatment options for ankle instability, presenting interventions including physical therapy, bracing, activity modification, pharmacological management, and orthotics in a well-structured, point-by-point format. However, while the response recognizes that the effectiveness of non-surgical treatment depends on the severity of the condition, it does not furnish explicit criteria for distinguishing patients appropriate for conservative management from those necessitating further evaluation for surgical intervention. For instance, patients with recurrent sprains or severe ligament injuries tend to have lower success rates with conservative treatment. Additionally, AI merely enumerates treatment modalities without offering comparative data on their relative efficacy. For example, it does not provide evidence regarding the extent to which physical therapy reduces recurrence rates or the efficacy of bracing in reducing the incidence of ankle sprains, rendering the response unsupported by evidence-based medicine. Furthermore, although the response mentions nonsteroidal anti-inflammatory drugs (NSAIDs) and corticosteroid injections, it does not specify their appropriate indications, long-term risks, or alternative options. This omission may mislead patients into believing that these pharmacological treatments are viable long-term management strategies for ankle instability, thus overshadowing the essential significance of rehabilitation exercises. Notably, the response omits a discussion on the potential of treatment failure. Not all patients achieve satisfactory stability through non-surgical interventions, and some may still require surgical management. The response omits to define the circumstances under which conservative treatment is deemed ineffective, nor does it address potential complications associated with delayed surgery, such as joint degeneration or worsening chronic instability.

Q5: What are the different types of ankle stabilization surgery?

The AI-generated response thoroughly covers the major types of ankle stabilization surgeries, encompassing anatomical repair (Broström procedure), non-anatomical reconstruction, tendon transfer, arthroscopic treatment, ankle arthrodesis, and total ankle replacement. It also offers an overview of the indications and key characteristics of each procedure, allowing readers to quickly

grasp their respective roles and clinical applications. Additionally, factors influencing surgical selection—such as the degree of ligament damage, activity level, and presence of arthritis—are briefly mentioned, aligning with clinical decision-making principles.

Q6: What should I expect after ankle stabilization surgery?

AI systematically categorizes the different phases of postoperative recovery—namely the acute phase, early recovery, rehabilitation phase, and long-term recovery—while succinctly outlining key management strategies for each stage, such as immobilization, weight-bearing progression, and rehabilitation exercises. Furthermore, it addresses essential aspects of postoperative care, including swelling management, pain control, and individual variability in recovery duration, in accordance with general clinical recovery protocols, offering patients a clearer comprehension of postoperative expectations.

However, the response does not discuss potential postoperative risks and complications, such as wound infections, nerve injury, joint stiffness, chronic postoperative pain, and recurrent instability, all of which are critical for informed patient decision-making. Moreover, the heterogeneity in rehabilitation protocols is oversimplified; for example, different surgical techniques (e.g., Broström repair vs. ligament reconstruction) may affect weight-bearing progression and overall recovery time, yet the response does not make this distinction. From a scientific rigor perspective, while multiple citations are included, the response is deficient in specific data, such as success rates of rehabilitation or findings from high-impact studies. Additionally, the estimated time for returning to high-impact sports (three months) may be overly optimistic. Some studies suggest that a full return to competitive sports may take 6 to 12 months or longer, contingent on individual rehabilitation progress and postoperative joint stability.

Q7: When can I return to daily activities after ankle stabilization surgery?

AI organizes postoperative recovery into distinct phases, covering early immobilization, weight-bearing progression, rehabilitation exercises, and final recovery, providing patients with a step-by-step reference. Additionally, it underscores key factors for surgical success, such as adhering to medical advice, avoiding excessive weight-bearing, maintaining rehabilitation exercises, and attending regular follow-ups. However, the response does not adequately account for individual variability in recovery. Factors such as surgical technique, patient age, baseline health status, and compliance with rehabilitation protocols can markedly influence the recovery time. For instance, patients undergoing Broström repair may recover faster than those undergoing ligament reconstruction, yet the response does not make this distinction. Moreover, potential postoperative complications are not discussed. Issues such as joint stiffness, persistent swelling, poor ligament healing, or chronic ankle instability might adversely impact recovery progression and long-term functional outcomes.

Q8: How long until I can return to sport after ankle stabilization surgery?

AI divides the recovery process into specific stages, commencing with an initial recovery period of 3–4 months, followed by a more comprehensive recovery duration of 5–6 months. It also highlights key factors influencing recovery, including surgical technique, adherence to rehabilitation protocols, and individual healing rates. In addition, during the rehabilitation process, attention should be paid to important aspects of the rehabilitation process, such as monitoring movement patterns, enhancing proprioceptive training, and incorporating sport-specific exercises, all of which align with evidence-based postoperative management strategies. However, the estimated recovery time may be overly idealized, especially the claim that patients can return to unrestricted physical activity within 5–6 months lacks prudence. Studies indicate that high-intensity activities—such as jumping, rapid directional changes, and cutting movements—may require 6–12 months or longer for safe resumption. This critical aspect is not adequately addressed in the response.

Q9: When can I return to work after ankle stabilization surgery?

The AI response provides a clear timeframe for returning to work based on job type (office work vs. physically demanding labor) and emphasizes key suggestions, including elevating the foot, adhering to rehabilitation exercises, and attending regular follow-ups. Moreover, it acknowledges

individual variability in recovery speed and accounts for cases where recovery may be extended to 3 months, improving adaptability. Nevertheless, similarly, the estimated recovery time remains somewhat optimistic and lacks consideration of potential postoperative risks.

Q10: When can I drive after ankle stabilization surgery?

AI differentiates the impact of left- and right-foot surgeries in terms of driving recovery, emphasizing the critical role of right-foot surgery in controlling the accelerator and brake. It also considers important factors such as vehicle type (automatic vs. manual transmission), postoperative pain management, and necessary functional recovery. Additionally, it advises performing safety practice sessions before officially resuming driving and taking insurance policies into account—practical aspects that are often overlooked in real-world driving recovery. However, the response does not specify objective functional criteria for safe driving resumption. Essential benchmarks, such as sufficient ankle range of motion, pain-free weight-bearing, and adequate reaction speed for emergency braking, are not explicitly addressed.

Q11: Will I get arthritis after ankle stabilization surgery?

AI points out that chronic ankle instability can lead to abnormal joint motion and cartilage wear, thereby increasing the risk of osteoarthritis, and emphasizes that the objective of surgery is to restore stability so as to reduce the likelihood of joint degeneration. Furthermore, the response maintains a balanced perspective by not overstating the benefits of surgery. It appropriately acknowledges that surgical intervention cannot eliminate the risk of osteoarthritis and indicates that the initial injury degree, preoperative cartilage condition, and individual factors will all influence long-term joint health. These considerations align with critical aspects of clinical decision-making.

Discussion

This study evaluates the performance of AI in providing medical information pertinent to ankle stabilization surgery. The results indicate that AI-generated responses can systematically outline surgical indications, postoperative rehabilitation management, and non-surgical treatment options, offering patients structured medical information. However, its predicted recovery time tends to be overly optimistic, potentially leading patients to have unrealistic expectations of the postoperative rehabilitation process. Additionally, AI-generated responses lack the support of authoritative medical literature, with ambiguous information sources that reduce clinical credibility. Simultaneously, AI is one-sided in the discussion of surgical risks and long-term prognosis, failing to fully assess potential issues such as surgical failure, chronic instability, and postoperative osteoarthritis, impeding patients' ability to make informed decisions.

This study has discovered that AI tends to provide overly optimistic recovery time estimates, which may exert potential impacts on patients' postoperative experience and medical decision-making. AI-generated responses often do not fully consider individual differences, postoperative complications, and potential delay factors in the rehabilitation process, but rather tend to provide standardized and idealistic estimates of recovery time. This phenomenon is often observed in existing research. For example, in an evaluation of ChatGPT-generated vascular surgery information, researchers found that AI's predicted postoperative recovery times were generally more optimistic than real-world outcomes (Haidar et al., 2023). Similarly, this trend has been noted in studies on neurosurgical procedures (Shlobin et al., 2024), suggesting that such idealization bias is widespread.

Overly optimistic predictions may influence patients' psychological expectations, leading them to develop unrealistically high hopes for their recovery process. If their actual recovery does not meet these expectations, patients may experience anxiety, dissatisfaction, or a decline in trust in their medical team. Research demonstrates that patients' postoperative experiences are shaped not only by their actual recovery situation but also by the gap between preoperative expectations and real recovery progress (Pan et al., 2023). Therefore, future research should explore more precise and personalized postoperative recovery prediction models to mitigate AI-generated idealization bias and enhance its applicability in clinical practice.

One potential solution lies in the development of **personalized AI agent-based prediction models**. In contrast to general AI models trained on large-scale datasets, AI agents can dynamically adjust recovery time estimates by integrating **individual patient history, surgical type, preoperative health status, and adherence to postoperative rehabilitation plans**. This adaptability helps avoid rigid and overly idealized predictions. Recent studies have begun exploring AI's applications in **personalized medicine**. For instance, some research suggests that AI models incorporating **electronic health records (EHRs) and real-time monitoring data** can significantly improve the accuracy of postoperative recovery predictions (Gibson et al., 2024). Future AI agents could leverage **reinforcement learning (RL)** to refine their predictive capabilities dynamically. By learning from historical clinical data while continuously optimizing predictions, these AI models could integrate **real-time postoperative activity data, pain management status, and rehabilitation progress** to generate more adaptive recovery time forecasts. Moreover, AI agents could incorporate **multimodal medical data**, such as **physiological indicators (e.g., heart rate, oxygen saturation), postoperative imaging data, and patient-reported recovery experiences**, providing more precise recovery trajectories. This approach may help patients form more realistic recovery expectations while enabling **healthcare teams to optimize individualized rehabilitation plans and improve patient adherence** (Pan et al., 2023).

In previous studies, researchers have generally found that AI-generated medical information often lacks appropriate citations and supporting references, which can undermine its credibility, reduce patients' trust in its content, and limit its applicability in medical decision-making (Golan et al., 2023). Addressing this issue, our study builds upon prior research by utilizing the latest version of ChatGPT-4o, incorporating its web search (Search) functionality to enhance the accuracy and transparency of AI-generated responses. Theoretically, this feature allows AI to retrieve up-to-date medical knowledge from the web, potentially improving the quality of its responses.

However, our findings indicate that for questions related to ankle stability surgery, this approach did not yield significant improvements. One major limitation is the inconsistency in the reliability of retrieved sources, with some information exhibiting questionable accuracy. AI-generated responses frequently refrain from citing peer-reviewed academic papers or authoritative medical guidelines, instead relying primarily on open data sources, online articles, or news reports. This mechanism can result in responses lacking rigorous scientific foundations and, in some cases, introducing biased or incomplete medical advice, which may ultimately affect patients' decision-making (Haidar et al., 2023).

Moreover, while the Search function allows AI to access real-time information, AI tends to prioritize older content when citing sources. This may originate from AI's weighting mechanism in web searches, which favors widely disseminated or historically authoritative information over the latest medical advancements. As a result, AI-generated medical responses may fail to reflect the most current research and clinical guidelines, potentially limiting patients' access to cutting-edge medical knowledge and leading them to make decisions based on outdated information (Abreu et al., 2024). Given the constant evolution of treatment protocols, drug recommendations, and surgical techniques, an over-reliance on outdated information may mislead patients and impact their health outcomes. Therefore, AI-generated medical information should be interpreted with caution and must not replace professional medical consultation. Future research and technological advancements should focus on improving AI's ability to filter and prioritize high-quality, up-to-date academic sources to enhance the reliability and utility of AI-generated medical content.

According to the readability assessments, AI-generated responses exhibit poor readability, with medical terminology potentially posing comprehension challenges for the general public. This finding is consonant with previous research, which has also identified readability concerns in AI-generated medical information (Abou-Abdallah et al., 2024; Moons & Van Bulck, 2024). Some studies have attempted to improve readability; however, simplifying medical concepts often results in a loss of precision, impeding patients' knowledge acquisition and decision-making. Existing approaches to enhancing the readability of ChatGPT-generated text frequently oversimplify the content—not only

in terms of language and sentence structure but also by omitting crucial information (Abou-Abdallah et al., 2024; Moons & Van Bulck, 2024). The optimal method for balancing readability and medical accuracy remains uncertain. Future research should further explore AI's potential to improve the readability of medical information while maintaining its integrity, ensuring that both accessibility and informational quality are optimized.

AI-generated medical content faces numerous challenges at both ethical and practical levels. One fundamental issue is that AI cannot perform individualized medical assessments. Consequently, patients may mistakenly perceive AI-generated responses as personalized medical advice, thus leading to inappropriate treatment choices. Recent studies indicate that although AI can provide detailed medical information, its recommendations lack consideration of individual medical history, lab results, or clinical context. This limitation increases the risk of AI-generated treatment suggestions being misaligned with a patient's actual condition (Fahy et al., 2024). Such non-personalized advice may mislead patients into self-diagnosing their conditions inaccurately, potentially delaying proper diagnosis and treatment, and thereby exacerbating health risks.

Moreover, AI-generated medical information presents significant legal uncertainties, making its application in medical decision-making particularly risky. Currently, AI lacks legal personhood and therefore cannot be held accountable for errors or misleading medical information (Rose et al., 2024). If patients rely on AI-generated responses for self-diagnosis or treatment, they may neglect the critical role of professional medical evaluations, which may lead to mismanagement of their condition and even legal disputes. Case studies have revealed that AI-generated medical content often lacks essential warnings, such as omitting information on drug side effects, potential contraindications, or the risks of treatment failure—omissions that could directly endanger patients' health (Dimitsaki et al., 2024; Morreim, 2025).

Additionally, AI-generated medical content may be influenced by biases in the training data, leading to incomplete coverage of all viable treatment options and impacting both patient informed consent and healthcare equity (Hanci et al., 2024). Research has shown that AI-generated medical advice gravitates towards mainstream treatment approaches and neglects the needs of minority groups, low-income populations, or patients with rare diseases. This bias could further exacerbate disparities in healthcare resource distribution. For instance, studies on cancer treatment information have found that AI provides limited details on personalized clinical trials or emerging therapies, which may reduce patients' access to optimal treatment options (Abreu et al., 2024).

Given these concerns, AI-generated medical content must be reviewed in conjunction with professional medical oversight to ensure its safety, accuracy, and ethical compliance. Moving forward, healthcare institutions and regulatory bodies should establish review mechanisms for AI-generated medical information, requiring AI to explicitly indicate the nature of its non-professional advice while providing medical information. Additionally, integrating AI with authoritative medical databases could improve the reliability of its information dissemination. Only through continuous optimization within technological, ethical, and legal frameworks can AI be more safely and effectively applied in the field of medical information dissemination.

Limitations

The primary limitation of this study is that AI technology is still continuously evolving, and its future versions may improve information transparency and clinical applicability. As a result, the conclusions of this study may be time-sensitive. Additionally, this study focuses solely on the domain of ankle stability surgery without further categorizing different surgical types. Future research could extend to other medical fields to evaluate the applicability of AI in a broader range of healthcare scenarios. Furthermore, AI-generated responses were validated based on expert experience rather than clinical trials. Future studies should incorporate the feedback from both physicians and patients to further assess the reliability of AI-generated medical information.

Conclusion

This study evaluated the performance of ChatGPT-4o, with web search functionality enabled, in providing medical information related to ankle stability surgery. The findings indicate that AI demonstrates a certain level of systematicity in discussing surgical indications, postoperative rehabilitation management, and non-surgical treatment options. However, its predictions regarding postoperative recovery time tend to be overly optimistic and lack the support of authoritative medical literature, affecting clinical credibility. Additionally, AI's discussion of surgical risks and long-term prognosis remains somewhat superficial, failing to comprehensively cover potential complications, which may impact patients' informed decision-making. Future research should focus on enhancing the scientific rigor, personalization, and readability of AI-generated medical information while integrating clinical validation to assess its applicability in real-world medical settings, thereby enhancing its reliability and practicality in medical information dissemination.

List of abbreviations

AI – Artificial Intelligence, **FKGL** – Flesch-Kincaid Grade Level, **FKRE** – Flesch-Kincaid Reading Ease, **DISCERN** – A standardized tool for assessing the quality of written consumer health information.

Author Contributions: **MZ** contributed to conceptualization, methodology, software, investigation, data curation, writing – original draft. **QH** contributed to methodology, validation, formal analysis, investigation, and data curation. **XH** contributed to conceptualization, validation, writing–review & editing. **XS** contributed to conceptualization, validation, writing–review & editing, supervision, and project administration. **YZ** contributed to the formal analysis. All the authors have read and approved the final version of the manuscript and agree with the order of presentation of the authors.

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Appendix 1 Response from Chatgpt-4o

Search date: 2025 Jan 30

1. Do I need ankle stabilization surgery?

Determining whether you need ankle stabilization surgery depends on several factors, including the severity and frequency of your ankle instability, your response to non-surgical treatments, and your overall health and activity level.

Here are some considerations:

Non-Surgical Treatments:

- **Physical Therapy:** Strengthening the muscles around the ankle can improve stability.
- **Bracing:** Wearing an ankle brace during activities can provide support.
- **Activity Modification:** Avoiding activities that exacerbate instability can help manage symptoms.

When to Consider Surgery:

- **Chronic Instability:** If you experience persistent ankle instability despite comprehensive non-surgical treatments.
- **Frequent Ankle Sprains:** Recurrent sprains can indicate significant ligament laxity.
- **Impact on Daily Life:** If ankle instability significantly affects your daily activities or athletic performance.

Consultation with a Specialist:

It's essential to consult with an orthopedic surgeon or a foot and ankle specialist. They can assess your condition through physical examinations and imaging studies, such as MRI or stress X-rays, to determine the extent of ligament damage and recommend the most appropriate treatment plan.

Risks and Benefits of Surgery:

Surgical intervention aims to repair or reconstruct damaged ligaments to restore ankle stability. While many patients experience improved stability and function post-surgery, it's important to discuss potential risks, such as infection, nerve injury, or stiffness, with your surgeon.

Conclusion:

Only a qualified healthcare professional can determine if ankle stabilization surgery is appropriate for you. I recommend scheduling an appointment with a specialist to discuss your symptoms, treatment history, and options moving forward.

2. Can I avoid ankle stabilization surgery with physical therapy?

Physical therapy is often an effective alternative to ankle stabilization surgery for many individuals experiencing ankle instability. Engaging in a structured

rehabilitation program can strengthen the muscles around the ankle, improve proprioception (the body's ability to sense movement and position), and enhance overall joint stability.

Key Components of Physical Therapy for Ankle Instability:

1. **Range-of-Motion Exercises:** These exercises help maintain and improve the flexibility of the ankle joint, preventing stiffness.
2. **Strengthening Exercises:** Focusing on the muscles supporting the ankle, particularly the peroneal muscles, can enhance stability.
3. **Proprioceptive and Balance Training:** Activities such as using a wobble board or standing on one foot can improve balance and the body's ability to control the position of the ankle.
4. **Functional Exercises:** Incorporating sport-specific or activity-specific movements prepares the ankle for the demands of daily activities or athletic participation.

Research indicates that exercise therapy can significantly reduce the risk of recurrent ankle sprains. A systematic review found that such interventions are effective in both acute ankle sprains and chronic instability cases.

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However, the success of physical therapy largely depends on factors such as the severity of the ligament damage, adherence to the rehabilitation program, and individual response to therapy. If conservative treatments like physical therapy do not alleviate the instability or if the ankle continues to give way during routine activities, surgical options might be considered.

It's essential to consult with a healthcare professional, such as a physical therapist or orthopedic specialist, to develop a personalized treatment plan based on your specific condition and goals.

3. Who should get ankle stabilization surgery?

Ankle stabilization surgery is typically considered for individuals who experience chronic ankle instability that significantly impacts their daily activities or athletic performance, especially when conservative treatments have not provided sufficient

relief. This condition often arises from repeated ankle sprains leading to stretched or torn ligaments, resulting in an ankle that frequently "gives way."

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Indications for Ankle Stabilization Surgery:

- **Chronic Ankle Instability:** Persistent instability due to loosened or stretched ligaments on the outside of the ankle.
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- **Recurrent Ankle Sprains:** Frequent sprains indicating significant ligament laxity.
- **Failure of Conservative Treatments:** Lack of improvement after physical therapy, bracing, or activity modification.
- **Impact on Quality of Life:** Instability affecting daily activities or sports participation.

Surgical Options:

The primary surgical approach for lateral ankle instability is the Broström procedure, which involves repairing or reconstructing the damaged ligaments to restore stability.

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Consultation with a Specialist:

If you are experiencing these symptoms, it's essential to consult with an orthopedic surgeon or foot and ankle specialist. They can assess your condition through physical examinations and imaging studies to determine the most appropriate treatment plan.

In summary, ankle stabilization surgery is generally recommended for individuals with significant ankle instability that persists despite conservative management and adversely affects their quality of life.

4. Can my ankle instability be managed without surgery?

Yes, ankle instability can often be managed without surgery through various non-surgical treatments. The effectiveness of these approaches depends on the severity

of your condition and your adherence to the treatment plan. Here are some common non-surgical options:

1. Physical Therapy:

Engaging in a structured physical therapy program can strengthen the muscles around the ankle, improve balance, and enhance joint stability. Therapists may employ exercises to increase range of motion, strength, and proprioception (the body's ability to sense movement and position). citeturn0search5

2. Bracing:

Using an ankle brace can provide external support, reducing the risk of the ankle "giving way" during activities. Bracing is particularly beneficial during physical activities or sports. citeturn0search1

3. Activity Modification:

Avoiding activities that exacerbate ankle instability, especially those involving uneven surfaces or high-impact movements, can prevent further injury. Gradually reintroducing activities as stability improves is often recommended.

citeturn0search2

4. Medications:

Over-the-counter nonsteroidal anti-inflammatory drugs (NSAIDs) can help reduce pain and inflammation associated with ankle instability. In some cases, doctors may recommend corticosteroid injections to manage inflammation.

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5. Orthotics:

Custom orthotic devices or arch supports can help distribute pressure more evenly across the foot and provide additional support to the ankle. citeturn0search0

6. Rest, Ice, Compression, Elevation (RICE):

In the initial stages following an ankle injury, applying the RICE method can help manage swelling and pain. This involves resting the ankle, applying ice packs, using compression bandages, and elevating the foot above heart level.

citeturn0search10

It's important to note that while many individuals experience significant improvement with these non-surgical treatments, the success largely depends on the severity of the instability and adherence to the treatment regimen. If conservative measures do not lead to satisfactory improvement, surgical options may be considered. [citeturn0search2](#)

Consulting with a healthcare professional, such as an orthopedic specialist or a podiatrist, is essential to develop a personalized treatment plan tailored to your specific condition and lifestyle.

5. What are the different types of ankle stabilization surgery?

Ankle stabilization surgery encompasses various procedures aimed at restoring stability to the ankle joint, particularly after chronic instability or recurrent sprains. The choice of surgical technique depends on factors such as the severity of ligament damage, patient activity level, and overall health. Here are the primary types of ankle stabilization surgeries:

1. Anatomic Repair (Broström Procedure):

This procedure involves repairing and tightening the existing ligaments, specifically the anterior talofibular ligament (ATFL) and the calcaneofibular ligament (CFL), to restore their normal anatomy and function. The Broström procedure is often preferred due to its effectiveness in restoring stability while preserving the natural range of motion.

[hopkinsmedicine.org](https://www.hopkinsmedicine.org)

2. Non-Anatomic Reconstruction:

In cases where the native ligaments are too damaged for direct repair, surgeons may opt for reconstruction using tendon grafts. This involves replacing the damaged ligaments with a tendon, often harvested from the patient's own peroneus brevis tendon or using an allograft. While this method provides increased stability, it may result in reduced ankle mobility.

[hss.edu](https://www.hss.edu)

3. Tendon Transfer:

This technique involves rerouting a nearby tendon to take over the function of the damaged ligaments. For example, the peroneus brevis tendon can be used to reconstruct the lateral ankle ligaments. This method is typically considered when other reconstructive options are not feasible.

pennmedicine.org

4. Arthroscopic Procedures:

Minimally invasive arthroscopy can be utilized to assess and treat intra-articular issues contributing to instability. While not a primary stabilization technique, arthroscopy can address problems like loose bodies or cartilage damage that may exacerbate instability.

venturaortho.com

5. Ankle Fusion (Arthrodesis):

In severe cases of instability accompanied by arthritis, ankle fusion may be considered. This procedure involves fusing the bones of the ankle joint to eliminate movement, thereby providing stability and pain relief at the cost of joint mobility.

en.wikipedia.org

6. Total Ankle Replacement (Arthroplasty):

For patients with significant joint damage and instability, total ankle replacement involves replacing the damaged joint surfaces with prosthetic components. This aims to maintain joint mobility while providing stability. It's typically recommended for older, less active patients due to the demands placed on the prosthetic joint.

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The selection of the appropriate surgical approach should be made in consultation with an orthopedic surgeon or foot and ankle specialist, who can assess the specific circumstances and recommend the most suitable procedure.

6. What should I expect after ankle stabilization surgery?

Recovery after ankle stabilization surgery is a structured process aimed at restoring function, strength, and stability to your ankle. Here's what you can generally expect:

Immediate Postoperative Period (0–2 Weeks):

- **Immobilization:** Your ankle will be placed in a plaster cast, and you'll need to avoid putting weight on it, using crutches for mobility.

[fortiusclinic.com](https://www.fortiusclinic.com)

- **Pain Management:** It's common to experience pain during this period; your healthcare provider will prescribe medications to help manage it.

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Early Recovery (2–6 Weeks):

- **Transition to Boot:** Around the two-week mark, the initial cast may be replaced with a supportive boot to immobilize your foot.

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- **Partial Weight-Bearing:** Depending on your surgeon's advice, you might begin partial weight-bearing activities during this phase.

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Rehabilitation Phase (6 Weeks – 3 Months):

- **Physical Therapy:** A tailored rehabilitation program will focus on improving balance, mobility, and function.

[svph.org.au](https://www.svph.org.au)

- **Gradual Weight-Bearing:** You'll progressively increase weight-bearing activities as guided by your therapist.

Long-Term Recovery (3 Months – 1 Year):

- **Return to High-Impact Activities:** By around three months, you may resume more demanding activities, but it's essential to consult your doctor about appropriate footwear and any necessary precautions.

[svph.org.au](https://www.svph.org.au)

- **Continued Rehabilitation:** Ongoing exercises will help enhance strength and prevent future instability.

Additional Considerations:

- **Swelling:** It's normal for swelling to persist for several months post-surgery; elevating your ankle can help alleviate this.

svph.org.au

- **Full Recovery:** Achieving complete recovery and returning to all regular activities can take up to a year.

svph.org.au

Keep in mind that individual recovery experiences can vary based on factors like the specific surgical procedure performed, your overall health, and adherence to rehabilitation protocols. Regular follow-ups with your healthcare provider are crucial to monitor progress and address any concerns during your recovery journey.

7. When can I return to daily activities after ankle stabilization surgery?

Resuming daily activities after ankle stabilization surgery is a gradual process that depends on the extent of the surgery, your overall health, and adherence to rehabilitation protocols. Here's a general timeline:

First 2 Weeks Post-Surgery:

- **Immobilization and Elevation:** Your ankle will be in a protective boot or cast. It's crucial to keep your foot elevated to reduce swelling and aid healing.

svph.org.au

- **Non-Weight Bearing:** You'll need to use crutches or a mobility aid to avoid putting weight on the operated foot.

Weeks 3–6:

- **Transition to Weight Bearing:** Depending on your surgeon's advice, you may begin partial weight-bearing activities, gradually progressing to full weight-bearing as tolerated.

davidgordonortho.co.uk

- **Physical Therapy Initiation:** A tailored rehabilitation program will start, focusing on restoring range of motion and strengthening the ankle.

Weeks 6–12:

- **Increased Activity:** As strength and stability improve, you can gradually resume light daily activities, such as household chores and desk work.

- **Continued Rehabilitation:** Ongoing physical therapy will help enhance balance and proprioception.

3 Months and Beyond:

- **Return to Normal Activities:** Many patients can return to most daily activities, including work and moderate exercise.
- **High-Impact Activities:** Activities like running or sports may be reintroduced around 4–6 months post-surgery, depending on your progress and surgeon's guidance.

svph.org.au

Full Recovery:

- Complete recovery, including a return to all pre-surgery activities, can take up to a year.

svph.org.au

Important Considerations:

- **Follow Medical Advice:** Adhere closely to your surgeon's and physical therapist's recommendations.
- **Listen to Your Body:** Progress at a pace that feels comfortable, avoiding activities that cause pain or discomfort.
- **Regular Follow-Ups:** Attend all scheduled appointments to monitor your recovery and adjust your rehabilitation plan as needed.

Remember, individual recovery experiences can vary. Maintaining open communication with your healthcare team is essential to ensure a safe and effective return to your daily activities.

8. How long until I can return to sport after ankle stabilization surgery?

Returning to sports after ankle stabilization surgery is a gradual process that depends on factors such as the specific surgical procedure performed, the severity of the initial injury, and individual healing rates. Typically, patients can anticipate a return to athletic activities within **3 to 6 months** post-surgery.

General Timeline:

- **3 to 4 Months Post-Surgery:** Patients may begin early return-to-sport activities, focusing on strengthening and promoting proper movement patterns.
[massgeneral.org](https://www.massgeneral.org)
- **5 to 6+ Months Post-Surgery:** Unrestricted return to sport is often feasible, with continued strengthening, proprioceptive exercises, and initiation of sport-specific training programs.
[massgeneral.org](https://www.massgeneral.org)

Factors Influencing Return to Sport:

- **Type of Surgery:** Procedures like the Broström repair typically have a recovery period of at least 3 to 6 months.
en.wikipedia.org
- **Rehabilitation Progress:** Adherence to a structured rehabilitation program is crucial for regaining strength, flexibility, and proprioception.
- **Individual Healing Rates:** Personal health factors and the body's response to surgery can affect recovery timelines.

Recommendations:

- **Consult Your Surgeon:** Engage in detailed discussions with your orthopedic surgeon to receive personalized advice tailored to your specific situation.
- **Adhere to Rehabilitation Protocols:** Following prescribed physical therapy and rehabilitation exercises is crucial for a safe and efficient return to sports.
- **Monitor Your Progress:** Regular follow-up appointments will help assess your recovery and readiness to resume athletic activities.

Remember, these timelines are general estimates. Your healthcare provider will offer the most accurate guidance based on your individual circumstances and progress.

9. When can I return to work after ankle stabilization surgery?

The appropriate time to return to work after ankle stabilization surgery varies based on factors such as the nature of your job, the specific surgical procedure performed, and your individual healing process. Here's a general guideline:

Desk-Based Jobs:

- If your role is primarily sedentary, you may be able to resume work approximately **2 to 4 weeks** post-surgery. During this period, it's advisable to keep your foot elevated to minimize swelling.

[windsorfoot.com](https://www.windsorfoot.com)

Physically Demanding Jobs:

- For occupations that involve manual labor, prolonged standing, or walking, a longer recovery period is necessary. Typically, returning to such roles may take between **6 to 10 weeks** after surgery.

[fortiusclinic.com](https://www.fortiusclinic.com)

Individual Recovery Considerations:

- Recovery timelines can vary based on personal factors, including overall health, adherence to rehabilitation protocols, and the body's healing response. Some patients may require up to **3 months** before safely resuming work activities, especially in physically demanding roles.

[orthopaedic-surgery-paris.com](https://www.orthopaedic-surgery-paris.com)

Recommendations:

- **Consult Your Surgeon:** Engage in detailed discussions with your orthopedic surgeon to receive personalized advice tailored to your specific situation.
- **Adhere to Rehabilitation Protocols:** Following prescribed physical therapy and rehabilitation exercises is crucial for a safe and efficient return to work.
- **Monitor Your Progress:** Regular follow-up appointments will help assess your recovery and readiness to resume work-related activities.

Remember, these timelines are general estimates. Your healthcare provider will offer the most accurate guidance based on your individual circumstances and progress.

10. When can I drive after ankle stabilization surgery?

The appropriate time to resume driving after ankle stabilization surgery depends on several factors, including which foot was operated on, the type of vehicle you drive, your recovery progress, and your ability to perform driving tasks safely.

Key Considerations:

- **Right vs. Left Ankle:** If your right ankle underwent surgery, extra caution is necessary since it controls the accelerator and brake pedals. For right ankle surgeries, it's generally recommended to wait until you can bear full weight on the foot and have regained sufficient strength and mobility to operate the pedals safely. This period can vary but often takes several weeks.
southpalmorthopedics.com
- **Vehicle Type:** Driving an automatic transmission vehicle may allow for an earlier return to driving, especially if the surgery was on the left ankle, as the right foot manages the primary controls.
- **Pain Medication:** Avoid driving while taking narcotic pain medications, as they can impair reaction times and judgment.
- **Functional Ability:** Ensure you have the necessary range of motion, strength, and absence of pain to perform emergency braking and other driving maneuvers.

General Guidelines:

- **Right Ankle Surgery:** Patients are often advised to wait until they can bear full weight on the right foot without pain and have discontinued use of immobilization devices. This period typically ranges from 6 to 9 weeks post-surgery.
danieldeanmd.com
- **Left Ankle Surgery:** If you drive an automatic car, you might be able to resume driving sooner, provided you feel comfortable and are not taking medications that impair your abilities.

Recommendations:

- **Consult Your Surgeon:** Always discuss your specific situation with your orthopedic surgeon to receive personalized advice.
- **Practice Safely:** Before returning to regular driving, consider practicing in a safe, controlled environment to assess your comfort and ability.
- **Insurance Considerations:** Be aware that driving against medical advice or before full recovery may affect your insurance coverage in the event of an accident.

Remember, these are general guidelines, and individual recovery times can vary. Prioritizing safety for yourself and others on the road is paramount.

11. Will I get arthritis after ankle stabilization surgery?

Ankle stabilization surgery aims to restore stability to the ankle joint, which can help prevent the development of arthritis. Chronic ankle instability, if left untreated, can lead to abnormal joint movements and increased wear on the cartilage, elevating the risk of osteoarthritis.

pmc.ncbi.nlm.nih.gov

By addressing the instability through surgical repair or reconstruction of the damaged ligaments, the procedure seeks to normalize joint mechanics and reduce the likelihood of arthritis progression. However, it's important to note that while surgery can mitigate this risk, it does not entirely eliminate the possibility of developing arthritis in the future.

Factors such as the extent of the original injury, the presence of cartilage damage at the time of surgery, and individual patient characteristics can influence long-term joint health. Therefore, it's crucial to have a thorough discussion with your orthopedic surgeon about the potential risks and benefits of the procedure, as well as realistic expectations for outcomes and any preventive measures you can take post-surgery to maintain joint health.

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