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Foot and Ankle Surgery

## Diagnosis, treatment, and prevention of ankle sprains: Comparing free chatbot recommendations with clinical guidelines



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#### ARTICLE INFO

Article history: Received 23 September 2024 Accepted 10 December 2024

Keywords: Lateral ankle sprains chatbots artificial intelligence (AI) ChatGPT Claude Perplexity treatment recommendations

#### ABSTRACT

*Background:* Free chatbots powered by large language models offer lateral ankle sprains (LAS) treatment recommendations but lack scientific validation. *Methods:* The chatbots—Claude, Perplexity, and ChatGPT—were evaluated by comparing their responses to a questionnaire and their treatment algorithms against current clinical guidelines. Responses were graded on

questionnaire and their treatment algorithms against current clinical guidelines. Responses were graded on accuracy, conclusiveness, supplementary information, and incompleteness, and evaluated individually and collectively, with a 60% pass threshold. *Results:* The collective analysis of the questionnaire showed Perplexity scored significantly higher than

Claude and ChatGPT (p < 0.001). In the individual analysis, Perplexity provided significantly more supplementary information than the other chatbots (p < 0.001). All chatbots met the pass threshold. In the algorithm evaluation, ChatGPT scored significantly higher than the others (p = 0.023), with Perplexity below the pass threshold.

*Conclusions:* Chatbots' recommendations generally aligned with current guidelines but sometimes missed crucial details. While they offer useful supplementary information, they cannot yet replace professional medical consultation or established guidelines.

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#### 1. Introduction

Lateral ankle sprains (LAS) represent the most prevalent form of ankle sprains and are among the most common musculoskeletal injuries. While approximately 2–7 ankle sprains cases are reported in emergency departments for every 1000 person-years, the overall incidence rate of individuals with ankle sprains, regardless of whether they sought emergency care, is estimated to be between 19.0 and 26.6 cases per 1000 person-years. [4] LAS frequently result in chronic instability, hindering work and sports performance and

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imposing substantial socioeconomic costs. [12] Due to the persistent heterogeneity in treatment strategies worldwide, an international evidence-based clinical guideline was established in 2012 and updated in 2018 to systematically assist practitioners and patients in making informed healthcare decisions for specific clinical situations [5,6,12].

Large language models like Chat generative pre-trained transformers (ChatGPT, OpenAI, San Francisco, CA, USA) are trained on vast guantities of text, using advanced artificial intelligence (AI) algorithms to produce human-comparable responses for tasks such as answering questions, summarizing content, and translating languages. [1] In addition to ChatGPT, numerous other AI-powered chatbots have been introduced, offering a range of capabilities, use cases, difficulty levels, and other characteristics. Most conversational AI systems offer bifurcated deployment models: a base-level, nocost iteration and an enhanced, subscription-based variant. These models exhibit disparities in customization capabilities, user interface sophistication, operational scalability, and ancillary functionalities. Among the most prominent chatbots in the field, in addition to ChatGPT, are Claude (Anthropic, San Francisco, CA, USA) and Perplexity (Perplexity AI, San Francisco, CA, USA), which all offer both free and paid versions.

#### https://doi.org/10.1016/j.fas.2024.12.003

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List of abbreviations: AI, artificial intelligence; ChatGPT, chat generative pretrained transformers; LAS, lateral ankle sprain

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The accessibility of chatbots to the general public and the userfriendliness of their interfaces have prompted questions about their capability and utility in addressing medical questions and in making diagnostic and clinical decisions. While chatbots in spine surgery have shown significant potential for enhancing clinical decisionmaking, both patients and healthcare professionals are urged to exercise caution to safeguard the quality and safety of care. [2,7,10,11] Regarding hip fractures, ChatGPT generated recommendations that diverged from the American Academy of Orthopaedic Surgeons guidelines [8].

In view of the very high incidence of LAS and the number of treatments performed independently by the patient without presentation to the emergency department, the relevance of the reliability of chatbots for the treatment of LAS becomes apparent. This study aimed to compare the recommendations provided by the free versions of Claude, Perplexity, and ChatGPT with the updated consensus statement on clinical guidelines for the diagnosis, treatment, and prevention of ankle sprains.

#### 2. Materials and methods

#### 2.1. Questionaire and algorithm

Institutional Review Board (IRB) approval was deemed unnecessary for this study, as it utilized publicly available free chatbots and did not involve human subjects research. The methodology was adapted from previously established research. [2,7] First, to assess chatbots knowledge of LAS, 19 questions were developed regarding the consensus statement, particularly in light of new evidence:

- 1. What are the predisposing factors for lateral ankle sprains?
- 2. What are the prognostic factors for lateral ankle sprains?
- 3. What historical and physical examination findings are most consistent with the diagnosis of lateral ankle sprain?
- 4. What are the most appropriate diagnostic tests for lateral ankle sprains?
- 5. Is dynamic imaging (such as stress radiographs or ultrasound) helpful in the diagnostic testing of lateral ankle sprains?
- 6. What is the role of pharmacologic treatment in the management of lateral ankle sprains?
- 7. What is the role of immobilization in the treatment of lateral ankle sprains?
- 8. What is the role of exercise in the treatment of lateral ankle sprains?
- 9. What is the role of manual therapy in the treatment of lateral ankle sprains?
- 10. What is the role of modalities such as ultrasound, laser therapy, electrotherapy, and short wave therapy in the treatment of lateral ankle sprains?
- 11. What is the role of injections in the treatment of lateral ankle sprains?
- 12. What is the role of interprofessional communication in the treatment of lateral ankle sprains?
- 13. What is the role of surgical therapy in the treatment of lateral ankle sprains?
- 14. What is the role of functional support in the prevention of lateral ankle sprains?
- 15. What is the role of exercise therapy in the prevention of lateral ankle sprains?
- 16. What is the role of footwear in the prevention of lateral ankle sprains?
- 17. Are there specific recommendations for returning to work after an lateral ankle sprain?
- 18. Are there any recommendations for returning to sports after lateral ankle sprains?

19. What are cost effectiveness tools in the treatment of lateral ankle sprains?

Second, chatbots were asked to create an algorithm for the treatment of lateral ankle sprains: "Create an algorithm for the examination, diagnosis and treatment of lateral ankle sprains".

To ensure unbiased responses, each question was submitted to Claude, Perplexity, and ChatGPT on August 22, 2024, with a new chat initiated for each query. The chatbots were instructed to produce responses without line breaks to optimize data processing.

#### 2.2. Evaluation of answers

In alignment with prior studies, the chatbot-generated responses were evaluated against the consensus statement based on four criteria: accuracy, overconclusiveness, supplementary information, and incompleteness.

The grading criteria, as recently reported, are as follows [2,7].

- 1. Accuracy: Does the chatbot response align with the consensus statement?
  - a. If YES: The chatbot response is consistent with the consensus statement, with no contradictions.
  - b. If NO: The chatbot response contradicts the consensus statement.
- 2. Overconclusiveness: In cases where the consensus statement indicates insufficient evidence to make a recommendation, did the chatbot provide one?
  - a. If YES: The chatbot offered a recommendation despite the consensus statement's lack of one.
  - b. If NO: Either the chatbot refrained from making a recommendation in alignment with the consensus statement, or both the chatbot and the consensus statement provided recommendations.
- 3. Supplementary: Does the chatbot response include additional relevant information not covered by the consensus statement?
  - a. If YES: The chatbot response contains significant additional information, such as references to peer-reviewed literature or further elaborations beyond what is found in the consensus statement.
  - b. If NO: The chatbot response does not introduce additional relevant information beyond what is specified in the consensus statement.
- 4. Incompleteness: If the chatbot response is deemed accurate, does it omit any relevant details included in the consensus statement?
  - a. If YES: The chatbot response lacks relevant information that is present in the consensus statement.
  - b. If NO: The chatbot response captures all the relevant details included in the consensus statement, with no omissions.

The evaluation of chatbot responses was conducted independently by two reviewers to enhance the reliability of the scoring process. In instances of disagreement, a third author was consulted, and the case was thoroughly discussed to reach a consensus. Each criterion—accuracy, overconclusiveness, supplementary content, and incompleteness—was assessed individually, and the criteria were also evaluated collectively. Since Perplexity always provides literature references compared to the other chatbots, the "Supplementary" item was rated positively for Perplexity for each question. In the case of the requested algorithm for the treatment of LAS, the reference was evaluated only once. The bibliographic reference was provided only for the creation of the algorithm (Table 2). In the case of the individual questions, the individual references were omitted for the sake of clarity.

To compare the chatbots' responses with guideline recommendations, a pass threshold of 60% correct answers was

#### Table 1

Questionnaire with questions, chatbot responses, and grading. A: Accurate, O: Overconclusiveness, S: Supplementary, I: Incompleteness.

			Grading			
Question	Chatbot	Answers	A	0	S	I
1. What are the predisposing factors for lateral ankle sprains?	Claude	The predisposing factors for lateral ankle sprains include: previous lateral ankle injuries, poor balance or proprioception, weakness in lateral ankle muscles (particularly the peroneal muscles), anatomical factors such as high arches or overpronation, inadequate warm-up, improper footwear, playing surface conditions, participation in certain sports or activities involving quick directional changes or jumping, overweight or obesity, fatigue, and poor flexibility. A history of lateral ankle sprains increases the risk of future injuries due to weakened ligaments and potential instability. Reduced proprioception and muscle weakness can lead to decreased joint stability. Anatomical factors like high arches or flat feet may alter biomechanics and increase strain on the lateral ankle. Inadequate warm-up, improper footwear, and challenging surface conditions can all contribute to injury risk. Certain sports and activities, excess body weight, fatigue, and poor flexibility in the calf muscles or Achilles tendon can also predispose individuals to lateral ankle sprains.	Yes	Yes	No	Yes
	Perplexity	Several predisposing factors increase the risk of lateral ankle sprains. A previous lateral ankle sprain is one of the most significant risk factors, as it can lead to decreased stability and increased likelihood of reinjury. For male athletes, higher weight and body mass index, poor dynamic balance performance, and lower hip strength are associated with increased lateral ankle sprain risk. In female athletes, lower specific lateral ankle strength, particularly deficient concentric dorsiflexion strength, is identified as a risk factor. Participation in sports involving jumping, cutting, and rapid directional changes, such as basketball, soccer, and tennis, also increases the likelihood of lateral ankle sprains. Anatomical factors like high-arched feet may predispose individuals to lateral ankle sprains. Additionally, factors such as height, limb dominance, and generalized joint laxity have been suggested as potential risk factors, though the literature is divided on their significance. Wearing inappropriate footwear and engaging in activities on uneven surfaces can also contribute to an increased risk of lateral ankle sprains.	Yes	No	No	Νο
	ChatGPT	The predisposing factors for lateral ankle sprains include previous lateral ankle injuries, weak or imbalanced muscles around the lateral ankle, inadequate warm-up before physical activity, poor proprioception or balance, improper footwear, playing sports on uneven surfaces, high body mass index (BMI), and engaging in activities that involve sudden changes in direction or jumping.	Yes	Yes	No	No
2. What are the prognostic factors for lateral ankle sprains?	Claude	Prognostic factors for lateral ankle sprains include the severity of the initial injury, with higher- grade sprains generally having a poorer prognosis and longer recovery time. The number of ligaments involved also affects outcomes, with multiple ligament injuries typically requiring more extensive rehabilitation. A history of previous lateral ankle sprains is associated with a higher risk of recurrence and chronic instability. The timeliness and quality of initial treatment play a crucial role, with early appropriate management leading to better outcomes. Patient compliance with rehabilitation protocols significantly impacts recovery, as does the individual's overall health and fitness level. Age can be a factor, with younger patients often recovering more quickly but also being at higher risk for re-injury due to activity levels. The presence of associated injuries, such as bone bruises or small fractures, can complicate recovery. Biomechanical factors, including foot type and alignment, influence long-term prognosis and the risk of developing chronic lateral ankle instability. The patient's activity level and the demands of their sport or occupation affect both recovery time and the risk of re-injury. Psychosocial factors, such as fear of re-injury or motivation for recovery, can impact rehabilitation outcomes. The quality and extent of rehabilitation, including proprioceptive training and strength building, are crucial for optimal recovery and prevention of future sprains. Lastly, the presence of predisposing factors that are not adequately addressed during treatment can affect long-term prognosis and increase the likelihood of recurrent injuries.	Yes	Yes	No	No
	Perplexity	Based on the search results, several prognostic factors have been identified for lateral ankle sprains. Good prognostic factors associated with better outcomes include: younger age, low- grade sprain, low activity level, good functional status, good neuromuscular function, and isolated injury without associated injuries. Poor prognostic factors that may lead to worse outcomes include: older age, female gender, systemic joint laxity/hypermobility, unfavorable joint geometry, limb/foot malalignment, previous lateral ankle injury, and multi-ligament injury. Additional factors that may influence prognosis include: pain intensity, difficulties bearing weight, restricted joint motion, body mass index (BMI), and injury severity as assessed by ultrasonography. Extrinsic factors like higher level of competition, lack of lateral ankle bracing/taping, and improper landing technique may also negatively impact outcomes. It's important to note that the evidence for many of these factors is still limited or inconsistent, and more research is needed to fully understand their prognostic value. Clinicians should consider these factors when formulating treatment plans and identifying patients at risk of poor outcomes following an lateral ankle sprain.	No	No	No	Yes
	ChatGPT	Prognostic factors for lateral ankle sprains include the severity of the initial injury, the presence of swelling and bruising, the range of motion and strength in the lateral ankle after injury, the time taken to begin treatment, adherence to rehabilitation protocols, the patient's age, physical fitness level, any pre-existing conditions, and the history of previous lateral ankle injuries.	Yes	No	No	No
3. What historical and physical examination findings are most consistent with the diagnosis of lateral ankle sprain?	Claude	Historical and physical examination findings most consistent with the diagnosis of an lateral ankle sprain typically include a history of sudden inversion or eversion injury, often accompanied by an audible "pop" or sensation of tearing. Patients usually report immediate pain, swelling, and difficulty bearing weight on the affected lateral ankle. The mechanism of injury is often described as rolling the lateral ankle during sports activities, stepping on an uneven surface, or landing awkwardly from a jump. On physical examination, visible swelling and bruising around the lateral ankle, particularly over the lateral or medial malleolus, are common. Palpation reveals tenderness over the affected ligaments, most commonly the	Yes	No (contina	No ued on 1	No next page)

			Grading			
Question	Chatbot	Answers	A	0	S	I
		anterior talofibular ligament (ATFL) for lateral sprains. Range of motion testing typically shows pain and limitation, especially with inversion for lateral sprains or eversion for medial sprains. The anterior drawer test and talar tilt test may demonstrate increased laxity compared to the uninjured lateral ankle, indicating ligament damage. However, these tests can be difficult to perform accurately due to pain and swelling in the acute phase. Weight-bearing capability is often reduced, and patients may demonstrate an antalgic gait. The Ottawa Lateral ankle Rules can be applied to assess the need for X-rays to rule out fractures. Neurovascular examination is usually normal, but it's important to check for any sensory or vascular compromise. The absence of bony tenderness over specific areas (as defined by the Ottawa Lateral ankle Rules) and the presence of localized soft tissue swelling and tenderness over ligamentous structures strongly support the diagnosis of an lateral ankle sprain over other conditions like fractures or tendon injuries.				
	Perplexity	The most consistent historical and physical examination findings for diagnosing an lateral ankle sprain include: A history of an inversion-type twist of the foot followed by pain and swelling. The patient can usually walk on the foot, albeit carefully and with pain. The ability to bear weight typically excludes a fracture in patients with normal sensation. On physical exam, there are areas of tenderness and swelling, with the maximal point of tenderness at the anterior talofibular ligament (ATFL) and/or calcaneofibular ligament (CFL) areas for lateral lateral ankle sprains. Ecchymosis may be present. There should be no bony point tenderness. Passive inversion and plantar flexion reproduce symptoms in lateral sprains. The anterior drawer test and talar tilt test can assess ligamentous instability, though these may be limited by pain and swelling in acute injuries. The severity of swelling, ecchymosis, and clinical instability helps grade the sprain as grade 1 (stretch with microscopic tearing), grade 2 (partial tear), or grade 3 (complete rupture). The Ottawa Lateral ankle Rules can guide the need for imaging. Key aspects of the history include the mechanism of injury, weight-bearing status, and any previous lateral ankle trauma. The physical exam should assess the location and severity of swelling, bruising, pain, and range of motion.	Yes	Νο	Yes	No
	ChatGPT	Historical and physical examination findings consistent with the diagnosis of an lateral ankle sprain include a history of trauma or twisting injury to the lateral ankle, immediate pain and swelling, difficulty bearing weight, bruising around the lateral ankle, tenderness over the ligaments, limited range of motion, and positive results on special tests like the anterior drawer test or talar tilt test.	Yes	No	Yes	Yes
4. What are the most appropriate diagnostic tests for lateral ankle sprains?	Claude	The most appropriate diagnostic tests for lateral ankle sprains typically begin with a thorough clinical examination, which is often sufficient for diagnosis in many cases. However, when additional information is needed, imaging studies may be employed. Plain radiographs (X-rays) are usually the first-line imaging test, primarily to rule out fractures or other bony abnormalities. The Ottawa Lateral ankle Rules can guide the decision to obtain X-rays, potentially reducing unnecessary radiation exposure. If X-rays are negative but there's suspicion of an occult fracture or significant soft tissue injury, magnetic resonance imaging (MRI) may be considered. MRI is excellent for visualizing soft tissue structures, including ligaments, tendons, and cartilage, and can provide detailed information about the extent of ligament damage, presence of bone bruises, or associated injuries. Ultrasound is another option that can be useful for evaluating ligament integrity and is particularly valuable for its dynamic assessment capabilities. It's non-invasive, relatively inexpensive, and doesn't involve radiation, but its accuracy is highly operator-dependent. In some cases, particularly for high-level athletes or when surgical intervention is being considered, stress radiographs may be used to assess ligament laxity. Computed tomography (CT) scans are rarely necessary for simple lateral ankle sprains but may be used if there's suspicion of complex fractures not visible on plain radiographs. Arthrography, while less commonly used, can be helpful in identifying specific ligament tears. In most cases of suspected lateral ankle sprains, a combination of clinical examination and plain radiographs is sufficient for diagnosis and treatment planning. More advanced imaging techniques like MRI are typically reserved for cases where there's uncertainty in the diagnosis, suspicion of additional injuries, or when conservative treatment fails to produce the expected improvement.	Yes	No	No	No
	Perplexity	The most appropriate diagnostic tests for lateral ankle sprains typically include a thorough clinical examination and selective use of imaging studies. The clinical examination is the cornerstone of diagnosis and includes taking a detailed history of the injury mechanism and symptoms, followed by a physical examination. Key components of the physical exam include inspection for swelling and bruising, palpation for areas of tenderness, assessment of range of motion, and special tests such as the anterior drawer test and talar tilt test to evaluate ligament integrity. The Ottawa Lateral ankle Rules are widely used to determine the need for radiographs, helping to rule out fractures and reduce unnecessary imaging. If radiographs are indicated based on the Ottawa Lateral ankle Rules, plain X-rays are the initial imaging modality of choice. In cases where there is suspicion of more complex injuries or chronic instability, additional imaging studies may be considered. These can include stress radiographs to assess ligament laxity, ultrasound for real-time visualization of soft tissue structures, magnetic resonance imaging (MRI) for detailed evaluation of ligaments and other soft tissues, and computed tomography (CT) for assessing bony injuries. However, it's important to note that for most acute lateral ankle sprains, a thorough clinical examination is sufficient for diagnosis and management, with imaging reserved for cases where there is suspicion of fracture or other complications.	Yes	No	No	No

(continued on next page)

			Grading			
Question	Chatbot	Answers	Α	0	S	I
	ChatGPT	The most appropriate diagnostic tests for lateral ankle sprains include a physical examination with special tests like the anterior drawer test and talar tilt test, assessment using the Ottawa Lateral ankle Rules to determine the need for imaging, and X-rays to rule out fractures. In some cases an MRI or ultrasound may be used to assess ligament damage or soft tissue injuries	Yes	No	Yes	No
<ul> <li>6. What is the role of pharmacologic treatment in the management of lateral ankle sprains?</li> </ul>	Claude	Dynamic imaging can be helpful in diagnostic testing for lateral ankle sprains, particularly in more severe cases or when chronic instability is suspected. Stress radiographs can reveal excessive talar tilt or anterior drawer, indicating ligament laxity or complete tear. They're most useful for Grade III sprains or in cases where surgical intervention is considered. Dynamic ultrasound allows real-time visualization of ligament integrity during joint movement, helping assess the extent of damage and differentiate partial from complete tears. It's non-invasive and can guide treatment decisions. However, these tests are not routinely necessary for most acute lateral ankle sprains, which are typically diagnosed clinically. They're more valuable in complex cases, for preoperative planning, or when evaluating chronic instability. The added radiation exposure of stress radiographs should be considered. Generally, dynamic imaging is an adjunct tool, used when clinical examination findings are equivocal or additional information is needed for treatment planning.	Yes	No	No	No
	Perplexity	Dynamic imaging, such as stress radiographs and ultrasound, is helpful in the diagnostic testing for lateral ankle sprains. Ultrasound: This imaging modality is non-invasive, safe, and provides real-time dynamic imaging, allowing for detailed visualization of the lateral ankle joint in motion. It is particularly useful for early detection and diagnosis of ligament injuries, such as tears or partial tears, and can help differentiate lateral ankle sprains from other conditions like fractures or tendon tears. Ultrasound is also advantageous due to its low cost and absence of radiation exposure, making it a practical option for assessing lateral ankle sprains and guiding treatment decisions. Stress Radiographs: These can be used to assess lateral ankle stability and are often employed to evaluate the extent of ligamentous injury. Stress radiographs may provide further assessment when standard radiographic imaging is inconclusive. Overall, dynamic imaging techniques enhance the diagnostic capabilities for lateral ankle sprains by providing a comprehensive evaluation of the injury	Yes	No	Yes	No
	ChatGPT	Yes, dynamic imaging, such as stress radiographs and ultrasound, is helpful in the diagnostic testing for lateral ankle sprains. Stress Radiographs: These are particularly useful for assessing ligamentous stability by applying controlled stress to the lateral ankle during imaging, which can reveal joint instability that might not be apparent on standard X-rays. This is especially helpful for diagnosing more severe sprains (Grade II and III) where there may be significant ligament damage. Ultrasound: Dynamic ultrasound imaging allows real-time assessment of ligament integrity and can help detect partial or complete tears, as well as evaluate the lateral ankle's stability during movement. Ultrasound is also beneficial in differentiating between ligament injuries and other soft tissue damage, such as tendon or cartilage injuries. Overall, both stress radiographs and ultrasound can provide valuable information in cases where the	Yes	Yes	Yes	Yes
	Claude	clinical examination is inconclusive or when planning for potential surgical intervention. Pharmacological treatment plays a supportive role in managing lateral ankle sprains, primarily for pain control and reducing inflammation. NSAIDs (non-steroidal anti-inflammatory drugs) like ibuprofen or naproxen are commonly used to alleviate pain and swelling, especially in the acute phase. They can be taken orally or applied topically. Acetaminophen (paracetamol) is an alternative for pain relief without anti-inflammatory effects. For severe pain, short-term use of opioids may be considered, but is generally avoided due to risk of dependence. Topical agents such as diclofenac gel can provide localized pain relief with fewer systemic side effects. Oral enzyme supplements like bromelain may help reduce swelling and bruising. In some cases, corticosteroid injections might be used for persistent pain or inflammation, but are controversial due to potential negative effects on healing. Medications should be used in conjunction with other treatments like RICE (Rest, Ice, Compression, Elevation) and rehabilitation exercises. The choice and duration of pharmacological treatment depend on sprain severity, patient factors, and potential side effects. Medication use should be balanced against potential risks especially in athletes where masking pain could lead to further injury	No	No	No	No
	Perplexity	Pharmacological treatment plays a significant role in the management of lateral ankle sprains, primarily focusing on pain relief and reducing inflammation. Nonsteroidal anti-inflammatory drugs (NSAIDs) are commonly used due to their analgesic and anti-inflammatory properties, which help decrease swelling and pain, potentially speeding up recovery. However, their use is somewhat controversial because they may impair the natural healing process by inhibiting inflammation, which is a critical component of healing. Additionally, NSAIDs can cause side effects such as gastrointestinal bleeding, bronchospasm, or renal failure, although COX-2 selective NSAIDs have reduced gastrointestinal risks at the cost of increased cardiovascular risks. Alternatives to NSAIDs include paracetamol (acetaminophen) and opioids, which are also effective for pain management. Paracetamol is often preferred due to its fewer gastrointestinal side effects, although it lacks anti-inflammatory effects. Opioids can be used for more severe pain but come with risks such as nausea, respiratory depression, and sedation. Overall, the choice of pharmacological treatment should be tailored to the individual patient's needs, considering the severity of the sprain, potential side effects, and personal tolerance to medications.	Yes	No	No	No
	ChatGPT	The role of pharmacological treatment in the management of lateral ankle sprains primarily involves pain relief and reducing inflammation. 1. Nonsteroidal Anti-Inflammatory Drugs (NSAIDs): NSAIDs like ibuprofen or naproxen are commonly used to reduce pain and inflammation in the acute phase of an lateral ankle sprain. They help manage symptoms and allow for more comfortable participation in rehabilitation exercises. 2. Acetaminophen: This can be used as an alternative for pain relief, particularly for patients who cannot tolerate	Yes	Yes	Yes	Yes

			Grading			
Question	Chatbot	Answers	A	0	S	I
		NSAIDs or in cases where inflammation is less of a concern. 3. Topical Analgesics: These may be applied to reduce localized pain, especially in mild to moderate sprains. 4. Muscle Relaxants: In cases where muscle spasms contribute to discomfort, muscle relaxants may be prescribed, although their use is less common. 5. Corticosteroids: Although generally not recommended for acute sprains, corticosteroid injections might be considered in cases of chronic lateral ankle pain or inflammation, particularly if there is no improvement with other treatments. 6. Opioids: Rarely, for severe pain not controlled by other means, short-term use of opioids may be considered, but they are generally avoided due to the risk of dependency and side effects. Overall, pharmacological treatment is aimed at symptom management to facilitate early mobilization and participation in rehabilitation, which is key to recovery.				
7. What is the role of immobilization in the treatment of lateral ankle sprains?	Claude	Ine fole of immobilization in the treatment of lateral ankle sprains has evolved over time, with current evidence supporting a more balanced approach between protection and early mobilization. Immobilization can play a crucial role in the acute phase of injury, typically the first 24–72 hours, to protect the injured ligaments and reduce pain and swelling. However, prolonged immobilization is generally not recommended as it can lead to joint stiffness, muscle atrophy, and delayed return to function. The degree and duration of immobilization depend on the severity of the sprain. For mild (Grade 1) sprains, minimal immobilization with elastic bandages or braces that allow some movement is often sufficient. Moderate (Grade II) sprains may benefit from short-term use of a semi-rigid brace or aircast, which provides more support while still allowing some movement. Severe (Grade III) sprains occasionally require more rigid immobilization, such as a cast or walking boot, for a short period. The goal of immobilization is to prevent further injury and reduce pain and swelling while promoting healing. However, it's important to transition to controlled mobilization as soon as tolerated to prevent the negative effects of prolonged immobilization. This transition typically involves progressing from more restrictive devices to less restrictive ones, and gradually increasing weight-bearing and range of motion exercises. The PRICE principle (Protection, Rest, Ice, Compression, and Elevation) is often employed in conjunction with immobilization during the acute phase. Ultimately, the trend in lateral ankle sprain treatment is towards functional treatment, which combines short- term protection with early, controlled mobilization and rehabilitation exercises. This approach	Yes	ΝΟ	ΝΟ	ΝΟ
	Domiouitu	aims to balance the benefits of protection with the need to maintain flexibility, strength, and proprioception, leading to faster recovery and reduced risk of chronic lateral ankle instability.	Vee	Vee	Na	Vee
	Гегрилиу	evidence. For most lateral ankle sprains, especially mild to moderate (Grade I and II) injuries, functional support is generally preferred over immobilization. Functional support allows for earlier mobilization and has been shown to result in faster return to work, less persistent swelling, and greater range of motion compared to immobilization. However, for severe (Grade III) lateral ankle sprains, a short period of immobilization may be beneficial. Current evidence suggests that a 10-day period of immobilization using a below-knee cast or rigid brace can be advantageous for Grade III sprains, followed by controlled therapeutic exercises. This short period of immobilization helps reduce swelling and pain during the early inflammatory phase of ligament healing. It's important to note that long-term immobilization (4–6 weeks) should be avoided as it can have detrimental effects on muscles, ligaments, and joint surfaces. After the initial short immobilization period for severe sprains, treatment should transition to functional support and progressive exercises. The choice of support and duration of immobilization should be based on the severity of the injury and individual patient factors. Overall, the current approach emphasizes early protected weight-bearing and functional rehabilitation for most lateral ankle sprains, with limited use of immobilization reserved for the most severe cases.				
	ChatGPT	The role of immobilization in the treatment of lateral ankle sprains is to protect the injured ligaments, reduce pain and swelling, and promote healing during the acute phase. Immobilization can involve the use of a brace, splint, or cast and is typically recommended for more severe sprains. It helps to prevent further injury by restricting movement, but prolonged immobilization should be avoided to prevent stiffness and muscle weakness.	Yes	No	No	No
8. What is the role of exercise in the treatment of lateral ankle sprains?	Claude	Exercise plays a crucial role in the treatment of lateral ankle sprains, contributing significantly to recovery, prevention of recurrence, and long-term lateral ankle health. The exercise program typically evolves through different phases of healing. In the acute phase, gentle range of motion exercises can help maintain flexibility and reduce swelling. As healing progresses, exercises focus on restoring full range of motion, improving strength, enhancing proprioception, and regaining balance and coordination. Strength training targets the muscles around the lateral ankle, particularly the peroneals, which are crucial for lateral stability. Exercises may include resistance band work, calf raises, and lateral ankle eversion/inversion movements. Proprioceptive training is essential to improve balance and prevent future sprains. This includes exercises like single-leg stands, wobble board training, and progressing to more dynamic balance activities. Flexibility exercises for the calf muscles and Achilles tendon help maintain proper lateral ankle mechanics. As recovery advances, functional exercises that mimic daily activities or sport-specific movements are introduced. These may include agility drills, plyometrics, and sport-specific skills. Exercise also plays a vital role in preventing chronic lateral ankle instability by addressing any remaining deficits in strength, flexibility, or proprioception. The exercise program should be progressive, starting with basic movements and advancing to more complex, functional activities as the patient improves. It's important to tailor the exercise regimen to the individual's needs, considering factors such as the severity of the sprain, the patient's activity level, and specific goals. Regular exercise not only aids in recovery but also helps reduce the risk of re-injury by improving overall lateral ankle function and stability. Patient education on proper exercise technique and the importance of consistent adherence to the exercise program is crucial for optimal outcomes. I	Yes	Yes	No	No
				(contin	ued on	next page)

			Gradi			
Question	Chatbot	Answers	A	0	S	I
	Perplexity	fundamental component of lateral ankle sprain treatment, facilitating recovery, improving function, and playing a key role in preventing future injuries. Exercise plays a crucial role in the treatment of lateral ankle sprains, serving multiple purposes throughout the rehabilitation process. In the early stages of recovery, gentle range-of-motion exercises help prevent stiffness and maintain flexibility. As healing progresses, strengthening exercises are introduced to target the muscles and tendons supporting the lateral ankle, particularly focusing on the dynamic stabilizers in the front and back of the leg and lateral ankle. Proprioception (balance) training is a key component of rehabilitation, as poor balance often leads to repeat sprains and lateral ankle instability. This typically involves exercises like standing on the affected foot with eyes closed or using balance boards. Once pain-free, endurance and agility exercises are incorporated, such as running in progressively smaller figures-of-8, to improve overall lateral ankle function. Evidence from systematic reviews and meta-analyses supports the effectiveness of exercise-based rehabilitation in reducing the risk of recurrent lateral ankle sprains compared to minimal or usual care. Exercise interventions have been shown to improve various clinical and patient-reported outcomes. The therapeutic quality, content, and volume of exercise programs can influence their effectiveness, with higher training doses potentially leading to better outcomes. Overall, a well-structured, progressive exercise program that addresses range of motion, strength, proprioception, and sport-specific activities is essential for optimal recovery from lateral ankle sprains and prevention of future injuries.	Yes	Yes	No	No
	ChatGPT	The role of exercise in the treatment of lateral ankle sprains is to restore strength, flexibility, and proprioception, prevent stiffness, and reduce the risk of recurrent sprains. Exercise protocols typically include range-of-motion exercises, strengthening exercises for the lateral ankle and surrounding muscles, balance and proprioception training, and gradual return-to- activity exercises to promote full recovery and functional stability.	No	No	No	Yes
9. What is the role of manual therapy in the treatment of lateral ankle sprains?	Claude	Manual therapy plays a significant role in treating lateral ankle sprains, complementing other interventions. Joint mobilization techniques improve arthrokinematics, increase range of motion, and reduce pain by restoring normal joint play. Soft tissue mobilization helps reduce swelling, break down scar tissue, and improve tissue extensibility. Manipulation may be used to address joint restrictions and improve overall lateral ankle function. Myofascial release techniques target trigger points and fascial restrictions, enhancing tissue mobility. Lymphatic drainage massage can help reduce edema, especially in the acute phase. Proprioceptive neuromuscular facilitation (PNF) techniques improve neuromuscular control and flexibility. Instrument-assisted soft tissue mobilization (IASTM) may be employed to address fibrotic tissue and promote healing. Manual therapy can help correct biomechanical imbalances that may have contributed to the sprain. These techniques are typically used in conjunction with exercise therapy and modalities, tailored to the individual's needs and stage of healing. Manual therapy also provides hands-on assessment of tissue quality and joint mobility throughout the rehabilitation process. The specific manual therapy approach depends on the therapist's expertise, patient preferences, and the stage of healing, with gentler techniques used in the acute phase and more aggressive interventions as healing progresses.	Yes	No	No	No
	Perplexity	Manual therapy plays a beneficial role in the treatment of lateral ankle sprains by improving clinical outcomes when combined with therapeutic exercise. It is particularly effective in restoring range of motion, reducing pain, and enhancing functional performance. Studies have shown that manual therapy, when added to exercise programs, significantly improves dorsal and plantar flexion, lower limb function, and reduces pain compared to exercise alone. Techniques used in manual therapy include mobilizations and manipulations, such as talocrural distraction thrust, talocrural AP glide, and hindfoot lateral glide, which help restore normal joint motion and stimulate proprioception. Additionally, manual therapy can aid in breaking fibrous adhesions, reducing local ischemia, and decreasing inflammatory cytokines, leading to improved neural feedback and dynamic stability. Overall, incorporating manual therapy into the rehabilitation process for lateral ankle sprains can maximize treatment efficacy and support a quicker return to activity.	Yes	No	No	No
	ChatGPT	The role of manual therapy in the treatment of lateral ankle sprains is to enhance recovery by improving joint mobility, reducing pain, and preventing long-term complications. 1. Joint Mobilization: Techniques such as posterior and anterior glides of the talus are used to restore normal joint mechanics and improve the range of motion, particularly dorsiflexion, which is often restricted after an lateral ankle sprain. 2. Soft Tissue Mobilization: This involves techniques like massage and myofascial release to reduce muscle tightness, alleviate pain, and improve circulation, thereby aiding the healing process. 3. Proprioceptive Training: Manual therapy can include exercises and manipulations that help restore proprioception (the sense of joint position), which is crucial in preventing recurrent sprains and chronic instability. 4. Pain Reduction: Manual therapy, including gentle mobilization and soft tissue techniques, can help reduce pain and swelling in the acute and subacute phases of an lateral ankle sprain. 5. Scar Tissue Management: Techniques to manage and mobilize scar tissue can prevent excessive adhesion formation and maintain tissue flexibility, aiding in a smoother recovery. Overall, manual therapy plays a complementary role in the rehabilitation of lateral ankle sprains, working alongside exercise therapy and other treatments to restore normal function and prevent future injuries.	Yes	No	Yes	No
10. What is the role of modalities such as ultrasound, laser therapy, electrotherapy, and	Claude	The role of modalities such as ultrasound, laser therapy, electrotherapy, and short wave therapy in the treatment of lateral ankle sprains remains somewhat controversial, with mixed evidence regarding their effectiveness. These modalities are often used as adjuncts to other treatment approaches, aiming to reduce pain, decrease inflammation, and promote healing. Ultrasound therapy uses high-frequency sound waves to generate deep heat in tissues, potentially	Yes	No	Yes	Yes
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short wave therapy in the treatment of lateral ankle sprains?		increasing blood flow and metabolism in the injured area. Some studies suggest it may help reduce pain and swelling in acute lateral ankle sprains, but overall evidence for its effectiveness is limited. Laser therapy, particularly low-level laser therapy (LLLT), is thought to stimulate cellular activity and promote healing. While some research indicates it may help reduce pain and swelling in lateral ankle sprains, conclusive evidence is lacking. Electrotherapy, including transcutaneous electrical nerve stimulation (TENS) and neuromuscular electrical stimulation (NMES), may help with pain management and muscle re-education. TENS can provide pain relief by stimulating nerves, while NMES may help prevent muscle atrophy during the recovery period. Short wave diathermy uses electromagnetic energy to generate heat in deeper tissues, potentially increasing blood flow and reducing pain and stiffness. However, like other modalities, evidence for its effectiveness in lateral ankle sprain treatment is limited. While these modalities are commonly used in clinical practice, their use should be considered as part of a comprehensive treatment approach that includes more established interventions such as PRICE (Protection, Rest, Ice, Compression, Elevation), early mobilization, and exercise therapy. The decision to use these modalities should be based on individual patient factors, the specific characteristics of the injury, and the clinical's judgment. It's important to note that while these modalities may provide short-term symptomatic relief, they should not replace or delay more active forms of treatment that have stronger evidence bases, such as exercise and functional rehabilitation. Future research with high-quality randomized controlled trials is needed to better establish the effectiveness of these modalities in lateral ankle sprain treatment				
	Perplexity	Based on the available evidence, modalities such as ultrasound, laser therapy, electrotherapy, and short wave therapy appear to have limited effectiveness in the treatment of lateral ankle sprains. Specifically for ultrasound therapy, multiple systematic reviews and randomized controlled trials have found little to no benefit compared to placebo or sham treatments for outcomes like pain, swelling, function, and overall recovery in acute lateral ankle sprains. The evidence suggests that any potential benefits of ultrasound are likely small and of limited clinical importance, especially given the typically short recovery period for most lateral ankle sprains. For other modalities like laser therapy, electrotherapy, and short wave diathermy, there is insufficient high-quality evidence to support their use or demonstrate clear benefits. Overall, the current evidence does not strongly support the routine use of these passive modalities in lateral ankle sprain treatment. Instead, the literature emphasizes active treatments like early mobilization, exercise therapy, and functional support as more effective approaches for managing acute lateral ankle sprains and preventing recurrence. However, more research may be needed to definitively rule out any potential benefits of these modalities or identify optimal protocols that could provide clinically meaningful improvements in lateral ankle sprain	Yes	No	No	No
	ChatGPT	The role of modalities such as ultrasound, laser therapy, electrotherapy, and short wave therapy in the treatment of lateral ankle sprains is to reduce pain, inflammation, and swelling, and to promote tissue healing. Ultrasound therapy helps to increase blood flow and improve tissue repair, laser therapy accelerates cellular regeneration and reduces inflammation, electrotherapy provides pain relief and reduces swelling through electrical stimulation, and short wave therapy enhances deep tissue healing by increasing circulation and reducing stiffness. These modalities are typically used as adjuncts to other treatments like exercise therapy and manual therapy	Yes	No	No	No
11. What is the role of injections in the treatment of lateral ankle sprains?	Claude	Injections play a limited and somewhat controversial role in treating lateral ankle sprains. Corticosteroid injections may be used for persistent pain and inflammation, particularly in cases of prolonged recovery or chronic lateral ankle instability. However, they're generally avoided in acute sprains due to potential negative effects on ligament healing and increased risk of re-injury. Platelet-rich plasma (PRP) injections are sometimes used to potentially enhance healing, especially in high-grade sprains or for elite athletes, but evidence for their efficacy is mixed. Prolotherapy, involving irritant injections to stimulate healing, is occasionally used for chronic cases, though its effectiveness is debated. Hyaluronic acid injections might be considered for cases with associated cartilage damage or early osteoarthritis. Local anesthetic injections can be used diagnostically to pinpoint pain sources in complex cases. In some instances, botulinum toxin injections have been explored for managing muscle spasms associated with chronic lateral ankle instability. Generally, injections are not first-line treatments for typical lateral ankle sprains and are reserved for specific scenarios where conservative measures have failed. Their use should be carefully considered, weighing potential benefits against risks such as infection, tissue atrophy, and masking symptoms that could lead to further injury.	Yes	No	Yes	No
	Perplexity	Injections can play a role in the treatment of lateral ankle sprains, primarily for managing pain and inflammation. Corticosteroid Injections: These are commonly used to reduce swelling and inflammation in the lateral ankle joint, providing relief from pain and improving mobility. They are particularly beneficial when conservative treatments like physical therapy and NSAIDs are insufficient in managing symptoms. Hyaluronic Acid Injections: These injections help lubricate the joint, which can improve movement and reduce pain, particularly in cases where there is joint degeneration. Platelet-Rich Plasma (PRP) Injections: PRP injections are used to promote healing by utilizing growth factors from the patient's own blood. They are increasingly popular for treating sports injuries, including lateral ankle sprains, although evidence on their efficacy is still developing. While injections can be effective in managing symptoms, they are typically considered when other conservative measures do not provide adequate relief. It's important to note that the safety and efficacy of these injections can vary, and they should be administered by qualified healthcare professionals after a thorough evaluation.	Yes	No	No	No

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	ChatGPT	The role of injections in the treatment of lateral ankle sprains is generally limited and is typically reserved for specific cases where conservative treatments have not provided sufficient relief or where there are complications. 1. Corticosteroid Injections: These are sometimes used to reduce persistent inflammation and pain in chronic cases, particularly if there is significant swelling or if the patient has not responded well to other treatments. However, corticosteroid injections are not commonly recommended for acute lateral ankle sprains due to the potential risk of weakening ligaments or delaying healing. 2. Platelet-Rich Plasma (PRP) Injections: PRP injections, which are then injected into the injured area. This treatment is considered in cases of chronic ligament injuries or for promoting healing in severe sprains, although evidence of its effectiveness is still evolving. 3. Hyaluronic acid Injections may occasionally be considered in cases of persistent joint pain following an lateral ankle sprain. Prolotherapy is sometimes considered for chronic lateral ankle sprain. So the patient so the ligamentous structures to stimulate healing. Prolotherapy is sometimes considered for chronic lateral ankle instability or ligament laxity following an lateral ankle sprain. So therapy is sometimes considered for chronic lateral ankle sprain or therapeutically to provide temporary pain relief, particularly during rehabilitation exercises.Summary: Injections are not typically first-line treatments for lateral ankle sprain but can be considered in chronic or complicated cases to manage pain, reduce inflammation exercises.Summary: Injections are not typically reserves of pain or therapeutically to converte treatments.	Yes	No	Yes	No
12. What is the role of interprofessional communication in the treatment of lateral ankle sprains?	Claude	Interprofessional communication plays a vital role in the comprehensive treatment of lateral ankle sprains, ensuring optimal patient care and outcomes. Effective collaboration among various healthcare professionals allows for a holistic approach to diagnosis, treatment, and rehabilitation. Primary care physicians, emergency department staff, orthopedic specialists, physical therapists, athletic trainers, and radiologists may all be involved in managing lateral ankle sprains at different stages. Clear communication between these professionals ensures consistent and coordinated care. For instance, the initial treating physician's accurate documentation of the injury mechanism, severity, and initial treatment guides subsequent care by specialists or therapists. Radiologists provide crucial information about any associated bony injuries, which informs treatment decisions. Physical therapists and athletic trainers communicate patients' progress in rehabilitation to physicians, allowing for timely adjustments to treatment plans. In sports settings, communication between medical staff and coaches is essential for making informed decisions about an athlete's return to play. Pharmacists may be consulted regarding pain management strategies, particularly for patients with comorbidities or those on multiple medications. For patients with complex cases or underlying conditions, coordination with other specialists like rheumatologists or endocrinologists may be necessary. Effective interprofessional communication also facilitates seamless transitions of care, whether from acute to rehabilitative settings or between different healthcare providers. It helps in avoiding duplication of tests or treatments and ensures that all aspects of patient care are addressed. Regular team meetings or case conferences can be beneficial for discussing complex cases and developing comprehensive treatment strategies. Additionally, clear communication with the patient and their family is crucial, ensuring they understand the treatment plan, exp	Yes	Yes	Yes	Yes
	Perplexity	Interprofessional communication plays an important role in the effective treatment of lateral ankle sprains, though it is not extensively discussed in the provided search results. Effective communication between different healthcare providers involved in treating lateral ankle sprains is crucial for several reasons: 1) It ensures a comprehensive assessment of the injury, as different professionals may identify different aspects of the injury or associated conditions. 2) It allows for a coordinated treatment plan that addresses all aspects of the injury and rehabilitation. 3) It facilitates the sharing of expertise across disciplines, potentially leading to more effective treatment strategies. 4) It helps ensure continuity of care as the patient progresses through different phases of treatment and rehabilitation. 5) It can improve patient outcomes by ensuring all providers are aligned on treatment goals and approaches. 6) It may help in identifying and addressing any psychosocial factors that could impact recovery. 7) It allows for better monitoring of progress and timely adjustments to the treatment plan if needed. While not explicitly mentioned in the search results, the use of a communication checklist or standardized protocols for information sharing between different healthcare professionals involved in lateral ankle sprain treatment could be beneficial. This could include emergency department staff, primary care physicians, orthopedic specialists, physiotherapists, and athletic trainers, ensuring that all relevant information about the injury, treatment, and rehabilitation is effectively communication in the treatment of lateral ankle sprains is to be the professional communication in the treatment of lateral ankle sprains is to be interprofessional communication in the treatment of lateral ankle sprains is to be the sprains is to be interprofessional communication in the treatment of lateral ankle sprains is to be the sprains is to be there th	No	Νο	No	Νο
	charof I	ensure coordinated care, optimize treatment outcomes, and prevent complications. Effective communication between healthcare providers, such as physicians, physical therapists, and athletic trainers, allows for the sharing of patient progress, the development of tailored	103	110	INU	110

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Question	Chatbot	Answers	Α	0	S	I
Question 13. What is the role of surgical therapy in the treatment of lateral ankle sprains?	Claude e	Answers rehabilitation plans, and timely adjustments to treatment protocols, leading to a more comprehensive and effective recovery process. Surgical therapy plays a limited but important role in the treatment of lateral ankle sprains, primarily reserved for cases that do not respond to conservative management or for patients with specific indications. The vast majority of lateral ankle sprains (approximately 90%) can be successfully treated with non-surgical methods. However, surgery may be considered in cases of chronic lateral ankle instability, severe (Grade III) sprains with complete ligament tears, or when conservative treatment fails to provide adequate stability and function. The main surgical approaches include ligament repair, reconstruction, or augmentation. Acute ligament repair is arely performed, typically only in cases of severe sprains in high-level athletes. More commonly, surgery is considered for chronic lateral ankle instability, usually after a prolonged period of conservative treatment (typically 3–6 months) has failed. Surgical techniques may involve direct repair of the damaged ligaments, reconstruction using autografts or allografts, or augmentation procedures to reinforce existing ligamentous structures. Arthroscopic techniques are increasingly used, allowing for less invasive procedures and potentially faster recovery times. In some cases, additional procedures may be performed during surgery, such as addressing any associated injuries like osteochondral lesions or peroneal tendon problems. The decision to pursue surgical treatment is based on various factors, including the severity of instability, the patient's activity level and goals, and the presence of associated injuries. Surgical intervention aims to restore lateral ankle stability, improve function, and prevent further injury. However, it's important to note that surgery carries risks such as infection, nerve damage, and prolonged recovery time. Post-surgical rehabilitation is crucial and typically involves a period	Yes	0 Yes	<b>S</b> Yes	I Yes
	Perplexity	of immobilization followed by a structured physical therapy program to regain strength, flexibility, and proprioception. The success rate of surgical treatment for chronic lateral ankle instability is generally high, with most patients experiencing improved stability and function. However, as with any surgical procedure, there's no guarantee of complete resolution of symptoms or return to pre-injury levels of activity. In summary, while surgical therapy is not the first-line treatment for lateral ankle sprains, it plays an important role in managing severe or chronic cases that don't respond to conservative measures, aiming to restore stability and function to the lateral ankle joint. Surgical therapy plays a limited role in the treatment of most lateral ankle sprains. The vast majority of lateral ankle sprains, even severe ones, can be managed successfully with conservative treatment. However, there are a few specific indications for surgical intervention in lateral ankle sprains: 1) A third-degree sprain of the distal tibiofibular ligament that causes widening of the lateral ankle mortise. 2) A deltoid ligament sprain where the ligament is caught intra-articularly and there is widening of the medial lateral ankle mortise. 3) In selected young patients with high athletic demands who have complete ruptures of both the anterior talofibular and calcaneofibular ligaments, surgical repair may be considered. 4) Chronic lateral	Yes	No	No	No
	ChatGPT	ankle instability that has failed conservative management may require delayed ligamentous reconstruction. For acute lateral ligament sprains, surgical repair is rarely indicated as studies have shown outcomes comparable to conservative management. When chronic instability develops, delayed ligamentous reconstruction can be performed with good results. These reconstructions are classified as either anatomical (e.g., the Brostrom procedure) or non-anatomical (e.g., using the peroneus brevis tendon). Non-anatomical reconstructions are typically reserved for patients with hypermobility disorders or as salvage procedures. It's important to note that most third-degree sprains of the anterior talofibular ligament and medial lateral ankle ligaments do not require surgical repair for good outcomes. The decision for surgical intervention should be based on specific indications and individual patient factors. The role of surgical therapy in the treatment of lateral ankle sprains is generally reserved for cases where there is severe ligament damage, chronic instability, or when conservative treatments have failed. Surgery may involve repairing or reconstructing the damaged ligaments to resure stability and function to the lateral ankle, and it is typically considered when non-surgical interventions do not result in adequate recovery or in cases of recurrent sprains with significant functional impairment	Yes	Yes	No	Yes
14. What is the role of functional support in the prevention of lateral ankle sprains?	Claude	Functional support plays a significant role in the prevention of lateral ankle sprains, particularly for individuals with a history of previous sprains or those participating in high-risk activities. The primary purpose of functional support is to provide external stability to the lateral ankle joint while allowing for necessary movement during activities. This support can come in various forms, including athletic tapes, elastic bandages, lace-up braces, semi-rigid braces, and high-top shoes. These supportive devices work by limiting excessive inversion and eversion of the lateral ankle, which are the most common mechanisms of lateral ankle sprains. Taping and bracing can enhance proprioception, the body's ability to sense joint position and movement, which is often impaired after an lateral ankle sprain. This improved proprioception can lead to better neuromuscular control and faster reaction times to potentially injurious positions. Functional support is particularly beneficial during the early phases of return to activity after an lateral ankle sprain, as it provides additional stability while the ligaments are healing and muscle strength is being rebuilt. For athletes, the use of lateral ankle supports has been shown to reduce the incidence of lateral and volleyball. However, it's important to note that functional support should not be relied upon as the sole preventive measure. It should be used in conjunction with proper conditioning, including strength training, balance exercises, and sport-specific drills. The type of functional support required. While some studies suggest that long-term use of external supports may lead to a dependency effect or muscle weakness, the	Yes	No	No	No

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Question	Chatbot	Answers	A	0	S	I
		benefits of preventing recurrent sprains often outweigh these potential drawbacks, especially in high-risk situations. Proper application and fit of the support device are crucial for effectiveness. Additionally, functional support should be combined with a comprehensive injury prevention program that addresses underlying risk factors such as muscle weakness, poor flexibility, or biomechanical issues. In summary, functional support serves as an important tool in preventing lateral ankle sprains by providing external stability, enhancing proprioception, and limiting excessive joint motion, particularly in individuals with a history of lateral ankle injuries or those engaged in high-risk activities.				
	Perplexity	Functional support plays a significant role in the prevention of lateral ankle sprains, particularly for athletes and individuals with a history of lateral ankle injuries. Research indicates that functional support, which includes braces, elastic bandages, tape, softcasts, or wraps, is generally preferable to immobilization for most lateral ankle sprains. Functional support offers several advantages: it allows for a higher percentage of people returning to sports, shorter time to return to work, less persistent swelling, and greater range of motion compared to immobilization. The use of lateral ankle braces appears to offer the best outcomes in terms of cost and risk reduction for both uninjured and previously injured populations. Mechanical support is thought to be the primary benefit of lateral ankle targes is recommended for at least 6 months following injury. However, the role of functional support in primary prevention of lateral ankle sprains is less evident. The type of functional support used may depend on the desired outcome, as different types (elastic bandage, tape, semi-rigid support, and lace-up lateral ankle support) have been found to be equally effective in reducing pain, swelling, lateral ankle instability, and preventing recurrent sprains. Overall, functional support is an important component of comprehensive lateral ankle sprain prevention programs, which may also include proprioceptive exercises and other strategies for injury reduction.	Yes	Yes	Νο	No
	ChatGPT	The role of functional support in the prevention of lateral ankle sprains is to provide additional stability and protection to the lateral ankle during activities that involve high risk of injury. This can include the use of lateral ankle braces, supports, or orthotics that help to stabilize the joint, reduce excessive movement, and prevent abnormal stress on the ligaments, thereby decreasing the likelihood of sprains, especially in individuals with a history of lateral ankle instability or those engaging in sports and high-impact activities.	Yes	Yes	No	No
Is. What is the fole of exercise therapy in the prevention of lateral ankle sprains?	Pernlexity	exercise therapy plays a cructal role in the prevention of lateral ankle sprains by addressing various risk factors and improving overall lateral ankle function. A comprehensive exercise program typically includes components aimed at enhancing strength, flexibility, proprioception, and balance. Strengthening exercises focus on the muscles surrounding the lateral ankle, particularly the peroneal muscles, which are crucial for providing lateral stability. This can include resistance band exercises, calf raises, and functional movements that mimic sport-specific or daily activities. Improving lateral ankle and calf flexibility through stretching exercises helps maintain proper range of motion and reduces the risk of injury due to tight muscles. Proprioceptive training is essential for enhancing the body's ability to sense joint position and movement, which is often impaired after an lateral ankle sprain or in individuals with chronic lateral ankle instability. This typically involves exercises such as single-leg stands, use of balance boards or wobble boards, and progressing to more dynamic balance activities. Balance exercises further complement proprioceptive training by improving overall stability and control. Neuromuscular training, which combines aspects of strength, balance, and agility, has been shown to be particularly effective in reducing lateral ankle sprain risk. This may include plyometric exercises, agility drills, and sport-specific movement patterns. Core strengthening is also important as it contributes to overall lower extremity stability. Exercise therapy should be tailored to the individual's needs, considering factors such as previous injury history, activity level, and specific sport or occupational demands. A progressive approach is typically used, starting with basic exercises and advancing to more complex, functional activities as strength and control improve. Regular participation in exercise therapy not only helps prevent initial lateral ankle sprains but also plays a crucial role in red	Yes	Νο	No	No
	Perplexity	Exercise therapy plays an important role in preventing lateral ankle sprains by improving strength, proprioception, and neuromuscular control around the lateral ankle joint. Key components of effective exercise programs for lateral ankle sprain prevention include: 1) Strengthening exercises targeting the muscles that support the lateral ankle, particularly the peroneal muscles. This can include exercises like calf raises, resistance band work, and plyometrics. 2) Balance and proprioception training to improve joint position sense and postural control. Examples include single-leg balance exercises, wobble board training, and sport-specific drills emphasizing quick changes of direction. 3) Neuromuscular training to enhance dynamic stability of the lateral ankle during functional movements. This often incorporates agility drills and exercises that challenge lateral ankle control in multiple planes of motion. 4) Flexibility exercises to maintain optimal range of motion in the lateral ankle joint and surrounding soft tissues. Research has shown that comprehensive exercise programs	Yes	No	No	No

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Question	Chatbot	Answers	A	0	S	I
	ChatGPT	incorporating these elements can significantly reduce the risk of lateral ankle sprains, especially in athletes with a history of previous sprains. Systematic reviews have found that exercise interventions can reduce the risk of lateral ankle sprains by up to 35–50% compared to no intervention. The protective effect appears to be greatest for individuals with a history of previous lateral ankle sprains. To be most effective, exercise programs should be performed consistently over time, ideally as part of ongoing training or warm-up routines. While exercise therapy alone may not completely prevent all lateral ankle sprains, it is a crucial component of comprehensive injury prevention strategies, particularly when combined with other interventions like proper footwear and external supports when appropriate. The role of exercise therapy in the prevention of lateral ankle sprains is to enhance the strength, flexibility, and proprioception of the lateral ankle and surrounding muscles. This includes exercises to support the ligaments and tendons. By addressing these factors, exercise therapy helps to reduce the risk of sprains by improving the lateral ankle's ability to withstand and advant of the strength when component factors, exercise therapy helps to reduce the risk of sprains by improving the lateral ankle's ability to withstand and	Yes	No	No	No
16. What is the role of footwear in the prevention of lateral ankle sprains?	Claude	adapt to suressors during physical activities. Footwear plays a significant role in the prevention of lateral ankle sprains by providing stability, support, and proper biomechanical alignment during various activities. The right shoes can help distribute forces evenly across the foot and lateral ankle, reducing the risk of sudden inversion or eversion movements that often lead to sprains. High-top shoes, particularly in sports like basketball, offer additional lateral ankle support by restricting extreme movements. However, it's important to note that while high-tops may reduce the risk of lateral ankle sprains, they don't eliminate it entirely and shouldn't be relied upon as the sole preventive measure. Shoes with a wide, stable base help improve balance and reduce the likelihood of rolling the lateral ankle. Good lateral support in shoes is crucial, especially for activities involving side-to-side movements. Proper cushioning helps absorb shock and reduce stress on the lateral ankle joint. The fit of the shoe is equally important; shoes that are too loose can allow excessive movement within the shoe, while overly tight shoes can restrict natural movement and lead to other foot problems. For individuals with specific foot types (such as high arches or flat feet), shoes with appropriate arch support or the use of custom orthotics can help maintain proper foot alignment and reduce strain on the lateral ankle. In sports-specific footwear, features like cleats or spikes should be appropriate for the playing surface to provide adequate traction without increasing the risk of the foot getting stuck and causing the lateral ankle to twist. Regular replacement of athletic shoes is necessary as worn-out shoes lose their supportive properties and can increase injury risk. For individuals with a history of lateral ankle sprains, shoes that accommodate lateral ankle braces or provide additional built-in support may be beneficial. It's also worth noting that while proper footwear is important, it should be used in conjuncti	Yes	No	Yes	No
	Perplexity	The role of footwear in preventing lateral ankle sprains is somewhat controversial, with mixed evidence from research studies. High-top shoes have been traditionally recommended for lateral ankle sprain prevention due to their ability to limit extreme ranges of motion, provide additional proprioceptive input, and decrease external joint stress. Some studies support the use of high-top shoes, especially when combined with lateral ankle taping, for reducing the frequency of lateral ankle sprains, particularly in individuals with previous injuries. However, other research has found inconclusive evidence regarding the clinical benefit of high-top shoes in preventing lateral ankle sprains. The effect of shoe type and design on sprain incidence remains speculative, with limited well-designed studies addressing this topic. One study found that basketball players wearing shoes with air cells were 4 times more likely to sustain an lateral ankle injury than those without air cells, while another study examining spring-like rear-foot cushioning found no difference in lateral ankle sprain prevalence among different shoe types. Overall, the current evidence suggests that while footwear may play a role in lateral ankle sprain prevention, its effectiveness is not definitively established. More research is needed to determine the optimal shoe characteristics for preventing lateral ankle sprains across various sports and activities. It's important to consider footwear as part of a comprehensive approach to lateral ankle sprain prevention, which may include other strategies such as proprioceptive training, strengthening exercises, and the use of external supports when appropriate.	Yes	No	Yes	Yes
	ChatGPT	The role of footwear in the prevention of lateral ankle sprains is to provide proper support, cushioning, and stability to the feet and lateral ankles. Well-designed footwear can help maintain correct foot alignment, absorb impact forces, and reduce the risk of excessive lateral ankle movements that could lead to sprains. Properly fitted shoes with adequate arch support and lateral ankle support are particularly important for preventing injuries, especially during high-impact activities or sports.	Yes	No	No	No
17. Are there specific recommendations for returning to work after an lateral ankle sprain?	Claude	Recommendations for returning to work after an lateral ankle sprain depend on several factors, including the severity of the sprain, the type of work involved, and the individual's recovery progress. Generally, a graded return-to-work approach is recommended. For mild (Grade I) sprains, individuals may return to sedentary work within a few days, provided they can comfortably bear weight and have appropriate accommodations. For moderate (Grade II) sprains, return to sedentary work may be possible within 1–2 weeks, while more physically demanding jobs may require 2–4 weeks. Severe (Grade III) sprains typically require a longer recovery period, often 4–8 weeks or more before returning to work, especially for jobs requiring significant physical activity. Key recommendations include: ensuring adequate pain	Yes	No	No	No

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Question	Chatbot	Answers	A	0	S	I
18. Are there any recommendations for returning to sports after lateral lateral ankle sprains?		control and ability to bear weight comfortably before returning; using appropriate supportive devices (braces, compression bandages) during work hours; modifying work duties or environments to reduce strain on the lateral ankle (e.g., avoiding prolonged standing, climbing, or heavy lifting initially); gradually increasing work hours and duties as tolerated; continuing prescribed rehabilitation exercises, even after returning to work; and maintaining open communication with healthcare providers and employers about progress and any necessary accommodations. For physically demanding jobs, a functional capacity evaluation may be beneficial to assess readiness for specific work tasks. It's crucial to avoid returning to work too soon, as this can lead to re-injury or prolonged recovery. The return-to-work plan should be individualized, considering the specific demands of the job and the patient's recovery progress. Employers should be encouraged to provide necessary accommodations, such as modified duties or ergonomic adjustments, to facilitate a safe and effective return to work. Regular follow-ups with healthcare providers during the return-to-work plase can help ensure appropriate progression and address any emerging issues promptly.				
	Perplexity	Based on the search results, there are several recommendations for returning to work after an lateral ankle sprain: 1) The timing of return to work depends on the severity of the sprain, with Grade 1 (mild) sprains taking about 3–5 weeks to heal, Grade 2 (moderate) sprains taking 4–6 weeks, and Grade 3 (severe) sprains taking 3–6 months. 2) For desk jobs, you may be able to return as soon as your pain allows, while manual labor jobs requiring climbing or lifting may take 6–8 weeks. 3) By weeks 2–3, you should be able to return to work unless your job involves long-distance driving or standing for more than 6 hours. 4) Using an lateral ankle support or brace can help you return to work sooner by providing stability and compression. 5) Early weight-bearing and movement within pain limits is recommended to promote healing. 6) Gradually increasing activities and following a rehabilitation program with exercises can help speed recovery. 7) You do not need to be completely symptom-free before returning to work - continuing normal activities can aid recovery. 8) If you still have significant pain or limitations after 3 months despite rehabilitation, you may need to consult an orthopedic specialist. 9) The most important factors are that your lateral ankle is improving and you can safely perform your work duties. Overall, a gradual return to work activities as tolerated, potentially with modifications or supports initially, is recommended for most lateral ankle sprains.	Yes	No	Yes	No
	ChatGPT	Specific recommendations for returning to work after an lateral ankle sprain include ensuring that the lateral ankle has regained sufficient strength, stability, and range of motion, as well as being pain-free during activities similar to those required at work. The timing of return depends on the severity of the sprain and the demands of the job. For sedentary work, a return may be possible within a few days to a week, while physically demanding jobs may require a longer recovery period and possibly a phased return. It's also recommended to continue rehabilitation exercises and use supportive devices like braces if necessary to prevent re-injury.	Yes	No	No	No
	Claude	Recommendations for returning to sports after lateral lateral ankle sprains typically follow a graded, functional approach based on the severity of the injury and the individual's recovery progress. The general principle is to ensure the athlete can perform sport-specific movements safely and effectively before full return to play. Key recommendations include: completing a full rehabilitation program focusing on restoring range of motion, strength, proprioception, and balance; achieving full, pain-free range of motion and at least 90% strength in the affected lateral ankle compared to the uninjured side; demonstrating good dynamic stability and neuromuscular control during functional tests; successfully completing sport-specific drills and movements without pain or instability; using appropriate lateral ankle support (taping or bracing) during initial return to sport; and following a gradual progression of activity intensity and cutting drills. The time frame for return to sport varies depending on the grade of sprain: Grade 1 sprains may allow return within 1–2 weeks, Grade II within 2–4 weeks, and Grade III often requiring 4–8 weeks or longer. However, these are general guidelines, and individual recovery rates may vary. It's crucial to avoid premature return to play, as this increases the risk of re-injury and chronic lateral ankle instability. A comprehensive return-to-play assessment should evaluate not only the lateral ankle but also overall lower extremity and core strength, as well as sport-specific skills and conditioning. Continued use of preventive measures such as proper warm-up, lateral ankle strengthening exercises, and proprioceptive training is recommended even after full return to sport. Athletes should be educated about the importance of reporting any recurrence of symptoms. For high-level or professional athletes, more stringent criteria and advanced functional testing may be employed. The decision to return to sport should be a collaborative one, involving the athlete, medical team, coaches,	Yes	No	Yes	No
	Perplexity	Based on the search results, to channel a sace and chectre fetulin to phy. Based on the search results, there are several recommendations for returning to sports after lateral lateral ankle sprains: 1) Return to sport timing depends on the severity of the sprain, with Grade 1 (mild) sprains taking about 3–5 weeks, Grade 2 (moderate) sprains taking 4–6 weeks, and Grade 3 (severe) sprains taking 3–6 months to heal. 2) The PAASS framework should be considered, which evaluates Pain, Lateral ankle impairment, Athlete perception, Sensorimotor control, and Sport/functional performance. 3) Pain severity during sport participation and over the last 24 hours should be minimal. 4) Range of motion, muscle strength, endurance, and power should be evaluated and restored. 5) The athlete should feel confident and psychologically ready to return to sport. 6) Good proprioception and dynamic postural control should be demonstrated. 7) The athlete should be able to tolerate sport- specific activities, hopping, jumping, and agility drills. 8) The ability to complete a full training session is considered a final criterion. 9) Using an lateral ankle support or brace can help provide stability and compression during return to sport. 10) Early weight-bearing and	Yes	Yes	Yes	Yes

(continued on next page)

			Grading			
Question	Chatbot	Answers	A	0	S	I
	ChatGPT	movement within pain limits is recommended to promote healing. 11) A gradual return to activities and following a rehabilitation program with exercises can help speed recovery. 12) The Lateral ankle-GO score, which incorporates various functional tests and patient-reported outcomes, can be used to assess readiness for return to sport and predict risk of reinjury. 13) Athletes should be educated on the potential benefits of a slightly longer recovery time to reduce the risk of chronic lateral ankle instability. Recommendations for returning to sports after lateral lateral ankle sprains include ensuring that the lateral ankle has fully regained strength, stability, and range of motion, and that the athlete is pain-free during sport-specific movements. A gradual return to activity is advised, starting with controlled, low-impact exercises and progressively increasing intensity. Functional testing to assess balance, agility, and proprioception should be completed successfully before full participation. Continuing rehabilitation exercises, wearing an lateral ankle brace or taping, and closely monitoring for any signs of instability or pain are also recommended to prevent re-injury.	No	No	No	No
19. What are cost effectiveness tools in the treatment of lateral ankle sprains?	Claude	Cost-effectiveness tools in the treatment of lateral ankle sprains aim to balance optimal patient outcomes with efficient use of healthcare resources. These tools include: clinical prediction rules like the Ottawa Lateral ankle Rules, which help reduce unnecessary X-rays; standardized treatment protocols that guide evidence-based care and minimize overtreatment; early functional rehabilitation programs that can reduce long-term costs by promoting faster recovery and preventing chronic instability; appropriate use of lower-cost interventions like home exercise programs and self-management strategies; targeted use of more expensive treatments (e.g., MRI, surgery) only for cases that don't respond to conservative management; telehealth or remote monitoring for follow-up care, reducing the need for in-person visits; group rehabilitation sessions, which can be more cost-effective than individual therapy; proper patient education to improve adherence to treatment and reduce the risk of recurrence; use of over-the-counter pain medications and PRICE (Protection, Rest, Ice, Compression, Elevation) as first-line treatments before considering more expensive interventions; implementation of preventive programs in high-risk populations to reduce the incidence of sprains; and cost-benefit analysis of different treatment modalities to inform clinical decision-making. Economic evaluation tools such as cost-utility analysis or quality-adjusted life years (QALYs) can be used to compare different treatment strategies. Utilizing appropriate functional support tools that help clinicians choose the most appropriate and cost-effective treatment based on specific patient factors can also be valuable. Additionally, considering indirect costs such as time off work in treatment decisions can lead to more comprehensive cost-effective strategies. Regular review and updating of treatment guidelines based on new evidence and cost-effectiventes data is crucial. By implementing these cost-effectiveness tools, healthcare providers can ensure th	Yes	No	No	No
	Perplexity	Based on the search results, there are several cost-effectiveness tools and considerations for the treatment of lateral ankle sprains: 1) Bracing has been found to be a cost-effective intervention for preventing recurrent lateral ankle sprains compared to neuromuscular training or a combined approach. One study found bracing to have an incremental cost-effectiveness ratio of -€2828.30 compared to a combined bracing and neuromuscular training approach. 2) Neuromuscular training programs, while slightly less cost-effective than bracing alone, still showed positive cost-effectiveness compared to no intervention. 3) The PAASS framework (evaluating Pain, Lateral ankle impairment, Athlete perception, Sensorimotor control, and Sport/functional performance) can be used to guide return-to-sport decisions in a systematic way. 4) The Lateral ankle-GO score incorporates functional tests and patient-reported outcomes to assess readiness for return to sport and predict reinjury risk. 5) Early guided movement, weight-bearing, and functional support have been found to be more cost-effective than immobilization for most lateral ankle sprains. 6) Non-steroidal anti-inflammatory drugs have shown good cost-effectiveness for cused cost-effectiveness and are not recommended. 8) Exercise programs, particularly those focused on balance and proprioception, are cost-effective for both prevention of recurrent sprains and management of chronic lateral ankle instability.9) For severe sprains, a short period (10 days) of immobilization followed by functional rehabilitation may be most cost-effective. 10) Considering both direct medical costs and indirect costs like lost productivity is important for comprehensive economic evaluations of lateral ankle sprain interventions. Cost-effectiveness tools in the treatment of lateral ankle sprains include the use of clinical guidelines to determine the most efficient treatment strategies, cost-benefit analyses to	Yes	Yes	Yes	Yes
		compare the outcomes of different treatments, and decision-making models like cost-utility analysis to assess the value of interventions based on quality-adjusted life years (QALYs). These tools help identify treatments that provide the best outcomes at the lowest cost, such as prioritizing conservative management over surgery when appropriate, using cost-effective rehabilitation programs, and optimizing the use of diagnostic imaging based on clinical criteria.				

A: Accuracy, O: Overconclusiveness, S: Supplementary, Incompleteness.

established. However, the "supplementary" criterion was not included in this evaluation.

#### 2.3. Statistics

Given the non-parametric nature of the data, the Kruskal-Wallis test was employed for statistical analysis. Statistical analysis was conducted with GraphPad Prism 9.5.1 (GraphPad Software, San Diego, USA).

#### 3. Results

#### 3.1. Questionaire

Each chatbot responded to the 19 questions as described in Materials and methods. The (responses and scores are summarized in Table 1). In the collective analysis of all criteria, Perplexity achieved significantly higher scores compared to Claude and ChatGPT (p < 0.001), primarily due to the criterion "supplementary". However, when this criterion was excluded, no significant differences were observed between the scores of the chatbots' responses (Fig. 1).

Regarding the individual analysis of responses, the only significant difference between the three chatbots' was observed for the criterion "supplementary". Perplexity showed a significantly higher score than Claude and ChatGPT (p = 0.001) (Fig. 1). The pass threshold of 60% correct answers (without the criterion "supplementary") was met by all chatbots (Claude: 79.0 ± 41.1 %, Perplexity: 80.7 ± 39.8 %, ChatGPT: 73.7 ± 44.4 %).

No significant difference was observed for the other three criteria when analyzed individually (Fig. 2).

#### 3.2. Algorithm

Each chatbot created an algorithm for treating LAS (responses and scores are shown in Table 2). In the collective analysis of all criteria, ChatGPT showed a significantly higher score than Claude and Perplixity (p = 0.023) (Fig. 3). The pass threshold of 60 % correct answers (without the criterion "supplementary") was met by Claude and ChatGPT, but not by Perplexity (Claude:  $60.0 \pm 50.7$  %, Perplexity:  $53.3 \pm 51.6$  %, ChatGPT:  $86.7 \pm 35.2$  %).

The individual analysis of the criteria showed no significant differences.

A review of the individual criteria analysis revealed that all chatbots tend to be overly conclusive regarding the "initial assessment and physical examination" criteria. Specifically, the chatbots listed the talar tilt and squeeze tests, which are commonly mentioned in the literature but are not recommended in the consensus statement. In addition, Claude and Perplixity lacked essential tests for differential diagnosis such as the check for tenderness along the lateral, medial malleoli, base of the 5th metatarsal, and navicular bone. The most correct version of the initial assessment and physical examination was provided by ChatGPT. The criterion "diagnosis/ classification" was correctly stated by all of them, with ChatGPT in particular adding the differentiation from differential diagnoses. The actual treatment protocol was only stated by Perplexity concordantly with the recommendations of the consensus statement. Claude and Perplexity either did not mention recurrence prevention at all or addressed it insufficiently, and Perplexity also failed to provide any recommendations for follow-up (Fig. 4).

#### 4. Discussion

In light of the recent development of AI-powered, easily accessible chatbots, their clinical use by healthcare practitioners and patients has come under scrutiny. Although the study found some alignment between the recommendations provided by the three freely accessible chatbots and existing guidelines for LAS, the chatbots tested cannot yet replace the adherence to and use of clinical guidelines by healthcare professionals.

The study evaluated chatbots using two approaches: 1) analysis of responses to a questionnaire and 2) development of an algorithm for treating lateral ankle sprains (LAS). Regarding the questionnaire, Perplexity outperformed the other chatbots by providing literature references, either in the collective analysis of all criteria and in the individual analysis of questions. When omitting the criteria "supplementary", there was no difference between the chatbots' scores. Perplexity consistently supports its responses with literature references, even in its free version, which differs from the free versions of Claude and ChatGPT. The references provided by Perplexity are based on an internal, unpublished algorithm. When asked about its reference selection process, Perplexity stated that it chooses references based on relevance, credibility, recency, diversity, and user preferences. Upon our examination, the first listed references often aligned with the specific question, relevant topics, and keywords. For example, when queried about appropriate diagnostic tests, the first reference was "Diagnosis and treatment of acute ankle injuries: development of an evidence-based algorithm". [9] Similarly, for a question about immobilization, the first reference was "Early mobilization versus immobilization in the treatment of lateral ankle sprains". [3] While Perplexity claimed to select references based on relevance, credibility, and recency, some citations were outdated or drawn from non-peer-reviewed online sources. The algorithm appeared to rely heavily on keyword matching rather than prioritizing meta-analyses or guidelines with the most relevant information. Notably, although the guideline used as a benchmark in this study was published in 2018, [12] it was never referenced by Perplexity.

In terms of accuracy, overconclusiveness, and incompleteness, the three chatbots did not show significant differences. The most common inaccuracies involved recommending stress radiography for diagnostics or suggesting specific footwear for prevention without sufficient evidence. Frequent overconclusive responses were noted in statements about inadequate warm-up and overweight as predisposing factors, and again, the use of stress radiography or the talar tilt test for diagnostics. While the talar tilt test is a standard diagnostic tool, it is not mentioned in the guidelines for this purpose. Regarding the criterion of "incompleteness," all three chatbots lacked two key points: 1) a clear statement that magnetic resonance imaging is a superior and more reliable, user-independent diagnostic tool compared to ultrasound, and 2) the precise recommendation that exercise therapy should be initiated as soon as possible.

All three chatbots successfully met the 60% pass threshold, demonstrating a broad alignment with the guidelines. This finding is consistent with studies comparing ChatGPT's adherence to guidelines in spine surgery, which showed that ChatGPT generally aligns with the guidelines for lumbar disc herniation, lumbar spinal stenosis, low back pain, and thromboembolic prophylaxis. [2,7,10,11] However, all chatboths tested in this study demonstrated a higher rate of correct answers (Claude and Perplexity with 89.5 ± 30.1 % and ChatGPT with  $68.4 \pm 46.5\%$ ) compared to the accuracy rates reported for ChatGPT in spine surgery studies (52 % in Mejia et al. [7], 2024, or 33% in Duey et al. [2]). While ChatGPT's accuracy in the current study aligns more closely with the findings from previous spine surgery research, Claude and Perplexity exhibited superior accuracy. This may suggest that the free versions of Claude and Perplexity have more effective algorithms for answering questions related to LAS.

Regarding the required algorithm for the treatment of LAS, ChatGPT outperformed both Claude and Perplexity. Notably, Perplexity was the only chatbot that did not meet the 60% pass threshold and therefore failed to generate a sufficiently acceptable treatment protocol. It is important to note that the pass threshold

			Grading			
	Chatbot	Answers	Accuracy	Overconclusiveness	Supplementary	Incompleteness
Assessment, physical	Claude	Initial Assessment: - Obt in pariant history (machanism of	No	Yes (talar tilt, squeeze test)	No	Yes
exammatic imaging		<ul> <li>UDUALIT PALIEITI IIISUUY (IIIECIIAIIISIII UI iniirry symptoms)</li> </ul>				No recommendation to screen for
		<ul> <li>Perform visual inspection (swelling,</li> </ul>				previous ankle / chronic ankle
		bruising, deformity)				instability.
		Priysical Examination: - Particularies for tenderness				No recommendation to check for
		<ul> <li>Assess range of motion</li> </ul>				tenderness along the lateral medial
		<ul> <li>Perform specific tests:</li> </ul>				malleoli. base of the 5th metatarsal.
		o Anterior drawer test				and navicular bone.
		o Talar tilt test				
		o Squeeze test				No recommendation for further
		o Ottawa Ankle Rules to rule out				diagnostic proceeding
		fracture				
		Diagnostic Imaging:				
		<ul> <li>X-ray if Ottawa Ankle Rules positive</li> </ul>				
		<ul> <li>Consider MRI for severe cases or unclear</li> </ul>				
		diagnosis				
	Perplexity	Initial Assessment:	No	Yes	No	Yes
		<ul> <li>Conduct a thorough history and physical</li> </ul>				
		examination to assess the mechanism of		Ultrasound: For assessing		No recommendation to screen for
		injury and symptoms such as pain,		ligamentous injuries and		previous ankle injury or history of
		swelling, and bruising [1][3].		joint instability		chronic ankle instability.
		<ul> <li>Use the Ottawa Ankle Rules to</li> </ul>				
		determine the need for radiography to				No recommendation to check for
		rule out fractures [1][3][4].				tenderness along the lateral, medial
		Diagnostic Imaging:				malleoli, base of the 5th metatarsal,
		<ul> <li>X-ray:</li> </ul>				and navicular bone.
		o To rule out fractures if indicated by				
		Ottawa Ankle Rules [4].				No details for physical examination
		o Ultrasound: For assessing ligamentous				(inspection, palpation, ROM,
		injuries and joint instability [4].				functional tests)
		<ul> <li>MRI:</li> </ul>				
		o Considered the gold standard for				No recommendation for further
		detecting ligament tears and				diagnostic proceeding
		syndesmotic injuries, though not				
		routinely used due to cost and				
		accessibility [4].				
	ChatGPT	Initial Assessment:	Yes	Yes (talar tilt, squeeze test)	Yes	No
		<ul> <li>History Taking</li> </ul>				
		o Mechanism of Injury: Determine			Summary regarding the	
		how the injury occurred (inversion,			application of Ottawa Ankle	
		eversion, twisting).			Rules and imaging	
		o Symptoms: Assess pain location,			proceedings	
		swelling, bruising, instability, and				
		weight-bearing ability.				
		o Previous Injuries: Inquire about any				
		history of ankle injuries or chronic				
		Instablinty.				
		Physical Examination:				
		Inspection:				
		o Ubserve Ior swelling, bruising,				
		deformity, and signs of trauitid.				

 Table 2

 Treatment algorithm developed through chatbot interaction and evaluation.

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Table

			Grading				:n, F.
	Chatbot	Answers	Accuracy	Overconclusiveness	Supplementary	Incompleteness	м. н
		o Check the patient's ability to bear weight and walk.					iahn, K.
		<ul> <li>Palpation:</li> <li>Palpate key areas: lateral and medial</li> </ul>					. Jäckl
		malleolus, Achilles tendon, base of the 5th metatarsal, and the syndesmosis.					e et al
		o Identify areas of tenderness, warmth, or					
		<ul> <li>Range of Motion (ROM):</li> </ul>					
		o Assess active and passive ROM in dorsiflexion. plantarflexion. inversion.					
		and eversion.					
		<ul> <li>Ligament Stability Tests: o Anterior Drawer Test: Assess the</li> </ul>					
		anterior talofibular ligament (ATFL).					
		o Talar Tilt Test: Evaluate the calcaneofibular ligament (CFI)					
		o Squeeze Test: For syndesmotic injury					
		(high ankle sprain). Decision Boint for Imment.					
		<ul> <li>Apply Ottawa Ankle Rules, perform X-</li> </ul>					
		rays if:					
		o Bone tenderness at the posterior					
		edge or tip of the lateral or medial					
		o Bone tenderness at the base of the					
		5th metatarsal or navicular bone.					
		o Inability to bear weight both					
		immediately and in the clinic.					
		If the Ottawa Ankle Kules indicate a low mich of fraction accord to Change					
		"Diagnosis" without imaging					
		Imaging (If Indicated)					
		X-ray: To rule out fractures.					
		Ultrasound: For soft tissue assessment if					
		needed. MRI: For severe cases, suspected					
		syndesmotic injury, or if surgery is					
: : : :	-	considered.	;	;	:	;	
Diagnosis/Classification	Claude	Grading ■ Grade I: Mild stretching. no tearing	Yes	NO	No	NO	
		<ul> <li>Grade II: Partial ligament tear</li> </ul>					Foot
	Pernlexity	<ul> <li>Grade III: Complete ligament tear Classification of Sprain Severity.</li> </ul>	Ves	NO	NO	CZ Z	and
	t ci provid	<ul> <li>Grade I (Mild): Microscopic injury</li> </ul>				2	i An
		without ligament stretching.					kle S
		<ul> <li>Grade II (Moderate): Macroscopic stretching with partial ligament tear.</li> </ul>					surge
		<ul> <li>Grade III (Severe): Complete ligament</li> </ul>					ry 3
		rupture, otten requiring ruturer testing for fractures [4].					1 (20
						(continued on next page)	25)3 (ค.

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Tab

			Grading			
	Chatbot	Answers	Accuracy	Overconclusiveness	Supplementary	Incompleteness
	ChatGPT	Grade the Sprain:	Yes	No	Yes	No
		<ul> <li>Grade I (Mild): Minimal ligament</li> </ul>				
		damage, mild swelling, no instability,			Differential diagnoses	
		and little functional loss.				
		<ul> <li>Grade II (Moderate): Partial ligament</li> </ul>				
		tear, moderate swelling, bruising, mild				
		to moderate instability, and loss of				
		function.				
		<ul> <li>Grade III (Severe): Complete ligament</li> </ul>				
		tear significant swelling hruising				
		marked instability and severe loss of				
		runction.				
		Rule Out Differential Diagnoses:				
		<ul> <li>Achilles Tendon Rupture: Perform the</li> </ul>				
		Thompson Test.				
		Eracture: Confirm with imaging if				
		suspected.				
		Syndesmotic Injury: Confirm with Squeeze				
		Test and/or MRI.				
Treatment Protocol	Claude	Acute phase (first 48–72 hours):	No	No	No	No
		RICE protocol (Rest. Ice. Compression.				
		Elaution)	Important things are not mentioned			
		<ul> <li>Pain management (NSAIDs,</li> </ul>	or implemented:			
		acetaminophen)				
		Grade-specific treatment:	There is no evidence that RICE alone,			
		Grade I:	or cryotherapy, or compression			
		- Destanted unsight hoseing	there along her and another			
		Protected weight-bearing				
		<ul> <li>Ankle brace or tape</li> </ul>	influence on pain, swelling or patient			
		<ul> <li>Early range of motion exercises</li> </ul>	function.			
		Grade II:				
		- Immobilization (1 ) under	Eventice therease is anoformed as it			
		<ul> <li>Immobilization (1-2 weeks)</li> </ul>	Exercise unerapy is prejerred as it			
		<ul> <li>Gradual weight-bearing</li> </ul>	provides better outcomes compared			
		Physical therapy	with immobilization. Immobilization			
		Crada III.	for a maximim of 10 days			
			tot a maximum of to ando.			
		<ul> <li>Immobilization (2–3 weeks)</li> </ul>				
		<ul> <li>Possible surgical consultation Intensive</li> </ul>	Combine exercise and manual			
		physical therapy	therapy.			
		Rehahilitation.	5			
		- Drogensting avariant for:				
		o Kange of motion				
		o Strength				
		o Proprioception				
		o Balance				
		Return to Activity				
		Cradial return based on:				
		- Din free movement				
		Full strength and stability				
	•	<ul> <li>Sport-specific training</li> </ul>	:	:	:	:
	Perplexity	Acute Management (First & Days):	Yes	No	No	No
		<ul> <li>Apply RICE protocol: Rest, Ice,</li> </ul>				
		Compression, and Elevation [2].	It is not mentioned that there is no			
		<ul> <li>Use NSAIDs for pain management [2].</li> </ul>	role for RICE alone in the treatment			
		Functional Treatment:	of acute LAS.			

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		Grading			
Chatbot	Answers	Accuracy	Overconclusiveness	Supplementary	Incompleteness
	<ul> <li>Encourage early mobilization and functional exercises to promote recovery and prevent stiffness [1][4].</li> <li>Avoid unnecessary immobilization and encourage weight-bearing as tolerated [2].</li> <li>Rehabilitation:</li> <li>Implement a supervised rehabilitation program focusing on range of motion, strengthening, and proprioceptive exercises [4].</li> <li>Tailor rehabilitation to individual needs, especially in athletes, considering factors like pre-injury fitness and coexisting conditions [2].</li> <li>Surgical Considerations:</li> <li>Reserve surgical intervention for severe grade III sprains or when conservative treatment fails [4].</li> </ul>	However, Perplexity states the importance of early mobilization and functional exercises.	2		
ChatGPT	Grade I (Mild Sprain) RICE Protocol: Rest. Ice. Compression.	No	No	No	No
	Elevation for 48–72 hours. • Analgesics: NSAIDs for pain relief. • Early Mobilization: Begin gentle ROM exercises as pain allows.	Due to the abbreviated treatment protocol, several points are not listed.			
	<ul> <li>Rehabilitation: Strengthening exercises and balance training. Grade II (Moderate Sprain)</li> </ul>	It is not mentioned that there is no role for RICE alone in the treatment of acute LAS.			
	<ul> <li>NICE PTOTOCOL: AS ADOVE, DUL LONGET duration (up to 1 week).</li> </ul>	Exercise therapy is preferred as it			
	<ul> <li>Immobilization: Consider an ankle brace or air cast for support.</li> <li>Analgesics: NSAIDs for pain relief.</li> <li>Pablakilitation Coded Incorrection to pathalilitation Coded Incorrection to</li> </ul>	provides better outcomes compared with immobilization. Immobilization for a maximum of 10 days.			
	<ul> <li>retraduidation: viacual progression to weight-bearing, strengthening, and proprioceptive exercises.</li> <li>Follow-Up: Reasess in 1–2 weeks for</li> </ul>	Combine exercise and manual therapy.			
	progress. Grade III (Severe Sprain) I Immobilization: May require a walking boot or cast for up to 3 weeks. RICE Protocol: As needed for pain and swelling.				
	<ul> <li>Analgesics: NSAIDs or stronger pain relief if necessary.</li> <li>Rehabilitation: After immobilization, start with gentle ROM exercises.</li> </ul>				
	followed by strengthening and balance training. • Referral: Consider referral to an orthopedic specialist for potential				
	surgical evaluation. Follow-Up: Regular follow-up to monitor healing and prevent chronic instability.				

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			Grading			
	Chatbot	Answers	Accuracy	Overconclusiveness	Supplementary	Incompleteness
<b>Prevention of Recurrence</b>	Claude		No	No	No	Yes
	Pernlexity	Educate natients on preventive measures.	GN	Q	oN	Not mentioned at all. Yes
		such as using ankle supports or braces during high-risk activities and continuing	2			Only very few points listed.
	ChatGPT	strength and balance exercises [5]. Rehabilitation:	Yes	No	No	No
		<ul> <li>Gradual return to full activity, focusing on strengthening, balance, and proprioceptive training.</li> <li>Functional Bracing: Consider using a brace during activities that pose a</li> </ul>				
		ngher risk of re-injury. Prevention: Education: Teach proper footwear, ankle strenothening exercises and halance				
		<ul> <li>Propriore training: Ongoing exercises to prevent future sprains, exercises to prevent future sprains,</li> </ul>				
Follow-up	Claude	particularly for athletes or those with a history of ankle sprains. Regular assessments	Yes	No	No	°Z
	Perplexity	<ul> <li>Address any persistent issues</li> </ul>	No	No	No	Yes
	ChatGPT	Monitor Progress:	Yes	No	Yes	Not listed at all. No
		<ul> <li>Regular follow-up visits to assess healing, functional status, and adherence to rehabilitation protocols.</li> </ul>			Evaluation of chronic instability	
		<ul> <li>Adjust the treatment plan as necessary based on progress or complications.</li> <li>Evaluate for Chronic Instability:         <ul> <li>If symptoms persist beyond expected healing time, consider further evaluation for chronic and instability.</li> </ul> </li> </ul>			C.	
References as given by Perplexity	[1] https:/// [2] https:/// [3] http://kc [4] https://kc	or other complications and inserting or other complications www.ncbi.nlm.nih.gov/pmc/articles/PMC33869 www.ncbi.nlm.nih.gov/pmc/articles/PMC774549 re.fgov.be/sites/default/files/2021-11/KCE_197C_ www.physio-pedia.com/Management.of_Ankle_	)3/  3/  2011-02-GCP_Ankle%20sprain_0_1.pdf  Sprains		5	
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**Fig. 1.** Correct answers of the chatbots to the questionnaire (collective analysis). Percentage of chatbots' correct answers to the 19 questions compared to the consensus statement. Perplexity showed significantly higher scores than Claude and ChatGPT. This effect was mainly driven by the criterion "supplementary". ChatGPT: chat generative pre-trained transformer.



Fig. 2. Correct answers of the chatbots to the questionnaire (individual analysis). Accuracy, overconclusiveness, supplementary, and incompleteness of the chatbots' answers on the 19 questions in comparison to the consensus statement. The results indicated that, although not statistically significant, both Claude and Perplixity demonstrated a higher level of accuracy, with 89.5 ± 30.1 % correct answers, respectively, compared to ChatGPT, which yielded  $68.4 \pm 46.5\%$  accuracy. All three chatbots demonstrated a minimal tendency toward overconclusiveness in their responses, with Claude exhibiting 26.3 ± 44.0 %, Perplixity 21.1 ± 40.1 %, and ChatGPT 11.0 ± 30.1 %. Each response from Perplixity included a reference to the relevant literature, resulting in a score of 100.0  $\pm$  0.0 % for the supplement. This resulted in a significantly higher score than Claude and ChatGPT (p < 0.001). Neither Claude nor ChatGPT provided a literature reference, yet some answers were notably detailed, thus warranting points for supplementary information (Claude: 32.0 ± 46.5 %, ChatGPT: 5.3 ± 22.3 %). The chatbots exhibited incompleteness in approximately one-third of all responses (Claude: 21.1 ± 40.7 %, Perplixity: 21.1 ± 40.7 %, ChatGPT: 31.6 ± 46.5 %) ChatGPT: chat generative pre-trained transformer.

was set without the "supplementary" criterion, which may partly explain Perplexity's poorer performance. Additionally, Perplexity frequently exhibited incompleteness, particularly with regard to the "prevention" and "follow-up" criteria. ChatGPT's strong performance is attributed to its high accuracy in the "initial assessment," "prevention," and "follow-up" criteria, as well as its 100% completeness of responses compared to the other chatbots. The creation of a comprehensive algorithm has not yet been tested in the studies we are aware of. [2,7,10,11] Generally, it appears that chatbots currently perform worse under the criteria for developing a complete



**Fig. 3.** Correct chatbots' responses when creating an algorithm (collective analysis). Percentage of chatbots' correct answers on the treatment algorithm compared to the consensus statement. ChatGPT showed significantly better outcome than Claude and Perplexity (p = 0.023). ChatGPT: chat generative pre-trained transformer.

algorithm than they do when answering individual questions. This may be related to the issue described by Mejia et al. [7], where the specificity of the questions themselves is of high importance. Expertdefined questions tailored to medical contexts and facts may elicit more precise answers than requests for a complete treatment algorithms.

The study has several limitations. First, the guidelines used were published in 2018 and may no longer be current. [12] While all chatbots would have had access to these guidelines, their responses might reflect newer, accurate findings that are not yet included in the guidelines. This necessitates a careful review of their answers in light of this potential discrepancy. Second, as noted by Duey et al. [2], ChatGPT models are continually evolving, which can lead to variations in responses based on factors such as location, prior searches, and ongoing information updates. Despite asking all chatbots about this issue, they did not address it. Our experience showed that responses could vary depending on the computer used, repetition of the question, or the use of an open chat. To minimize this bias, we used a new chat for each question, as recommended by Mejia et al. [7]. Third, the evaluation of chatbot responses by reviewers was a crucial aspect. Frequently, the chatbots provided lengthy and detailed answers, which sometimes made it challenging to determine their correctness. Reviewers had to carefully assess whether the main aspects were covered adequately. This process inherently introduced a weighting of content, where some points, like the importance of exercise therapy over immobilization, were considered more significant than others, such as the role of analgesics in pain relief. Omitting the former could lead to an inaccurate response, while omitting the latter would still result in a correct answer, provided all other necessary points were included. Furthermore, evaluating the criterion of "supplementary" information proved to be challenging. As outlined by Mejia et al. [7], supplementary information was defined as responses that include significant additional details, such as references to peer-reviewed literature or further elaborations beyond the consensus statement. Perplexity consistently provided references for their responses, while Claude and ChatGPT did not, resulting in a perfect score for the "supplementary" criterion. Consequently, this criterion was not included in the pass threshold of 60% and was only considered once in the evaluation of the algorithm.



Fig. 4. Chatbots' responses when creating an algorithm (individual analysis). Accuracy, overconclusiveness, supplementary, and incompleteness of the chatbots answers on the treatment algorithm compared to the consensus statement. ChatGPT: chat generative pre-trained transformer.

#### 5. Conclusions

The free versions of the chatbots Claude, Perplexity, and ChatGPT generally provided correct answers for the treatment of LAS. However, they sometimes omitted crucial information that would be particularly valuable for healthcare practitioners and experts in the field. Overall, the chatbots performed better when addressing specific clinical questions, providing responses that were largely in line with established guidelines rather than developing a comprehensive treatment algorithm. In this context, ChatGPT outperformed both Claude and Perplexity, with Claude failing to meet the pass threshold. Notably, Perplexity is the only chatbot that cites literature, although these references may not always be the most pertinent. The authors recommend that healthcare practitioners and experts rely primarily on established guidelines, while patients and non-healthcare professionals should use chatbots as supplementary sources of information rather than substitutes for professional medical consultation.

#### Ethical approval and informed consent statements

Institutional Review Board (IRB) approval was deemed unnecessary for this study, as it utilized publicly available free chatbots and did not involve human subjects research.

#### Funding

None.

#### **CRediT** authorship contribution statement

All authors were fully involved in the study. Each author focused on a particular issue: Conceptualization: FER, PJR. Data curation: FER, KJ. Formal analysis: FER, MPM. Funding acquisition, Investigation: FER, FMH. Methodology: HS, PJR, KJ, HS. Project administration: PJR. Resources: WL. Software: FER. Supervision: WL, RP, HS, PJR. Validation: WL. Visualization: FMH, FER. Writing – original draft: FER, FMH MPM. Writing – review & editing: PJR, RP. All authors read and approved the final version of this manuscript.

#### Data availability statement

The datasets used and/or analysed during the current study available from the corresponding author on reason- able request.

#### **Declaration of Competing Interest**

The authors hereby declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

### Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used Claude, Perplexity, and Chatgpt due to the nature of the manuscript. After using these services, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

#### Acknowledgements

We would like to acknowledge the contributions of the large language models Claude, Perplexity, and ChatGPT, whose capabilities were instrumental in supporting the completion of this study.

#### **Disclosure information**

All authors disclose any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work (e. g. employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding).

#### **Exclusive submission**

The authors hereby declare that the manuscript, including related data, figures and tables has not been previously published and the manuscript is not under consideration elsewhere.

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