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Review

Analysis of clinical and functional outcomes of ankle fracture treatment

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Abstract

Objective: Analyze the clinical and functional outcomes of conservative and surgical treatment of ankle fractures in adults, considering postoperative complications, recovery time, need for reinterventions, quality of reduction, and patient satisfaction.

Methods: This study conducted an integrative literature review, searching PubMed, Scopus, Web of Science, Embase, and SciELO databases for publications between 2014 and 2024. Fifty-two articles were initially identified, and after applying the inclusion criteria, six were selected for analysis. The main outcomes evaluated were complication rates, recovery time, quality of reduction, and patient satisfaction.

Results: The results indicated that surgical treatment, especially in unstable fractures, favors anatomical reduction and faster recovery, but presents a higher risk of postoperative complications, such as infection and fixation failure. Conservative treatment, although associated with slower recovery and risk of addictive consolidation, showed a lower incidence of serious adverse events.

Conclusion: The results presented herein should be interpreted as a preliminary synthesis, useful for guiding clinical practice, but insufficient for generalization. The therapeutic decision for ankle fractures should remain individualized, based on the type of fracture, the patient's clinical profile, and the team's experience, with active patient involvement in the decision-making process.

Level of Evidence II; Review.

Keywords: Ankle; Surgical treatment; Conservative treatment.

Introduction

Ankle fractures represent one of the most common types of orthopedic injuries, with increasing incidence due to population aging and increased sports practice[1-3]. These fractures can range in severity from conservatively treatable stable injuries to complex fractures requiring surgical intervention. The therapeutic decision is based on factors such as fracture pattern, degree of bone deviation, ligament integrity, and the patient's clinical conditions[4,5]. Thus, the choice between conservative and surgical treatment has direct implications for functionality, recovery time, and long-term clinical outcomes[4].

Conservative treatment, typically indicated for stable fractures without significant misalignment, involves immobilization with plaster or orthoses and weight-bearing restriction on the affected limb [2,5]. This approach aims to promote bone consolidation without the need for invasive intervention, thereby minimizing complications inherent to the surgical procedure, such as infections and deep vein thrombosis[6]. However, prolonged immobilization can result in joint stiffness, muscle atrophy, and difficulties with functional rehabilitation, especially in older patients or those with associated comorbidities[4].

On the other hand, surgical treatment is generally indicated in cases of unstable fractures, dislocations, or those associated with significant ligament injuries, in which obtaining an anatomical reduction and internal fixation is essential to restore ankle biomechanics and prevent functional complications[2,6,7]. The most common surgical techniques involve the use of plates and screws, which allow for the proper alignment of bone fragments and facilitate

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early mobilization of the affected limb. However, surgical treatment is not without risks and is often associated with complications such as surgical site infection, fixation failure, compartment syndrome, and development of post-traumatic arthrosis, events that can compromise long-term functional recovery[6-8].

For adequate therapeutic planning and prognosis, classifying ankle fractures is essential. The AO/OTA classification, widely used in orthopedic practice, organizes fractures according to the injury level in relation to tibiofibular syndesmosis: type A fractures occur below syndesmosis (infrasyndesmotic), type B fractures at the level of syndesmosis (transsyndesmotic), and type C fractures above syndesmosis (suprasyndesmotic), the latter being often associated with instability and more extensive ligament injuries[5].

The Lauge-Hansen classification considers the mechanism of trauma, taking into account the foot position at the time of injury (supination or pronation) and the direction of the force applied (adduction, abduction, or external rotation). This approach results in four primary fracture patterns: supination-adduction, supination-external rotation, pronation-abduction, and pronation-external rotation. This classification is particularly useful in predicting associated ligament injuries and guiding surgical treatment, as it integrates the analysis of bone and ligament components of the ankle[2,5].

Comparative studies demonstrate that both conservative and surgical treatments have advantages and limitations, making it necessary to carefully evaluate each case to determine the most suitable approach. Criteria such as age, activity level, presence of osteoporosis, and functional expectation should be considered in the therapeutic choice. In addition, rehabilitation is important for recovering mobility and preventing complications, regardless of the strategy adopted[6,8,9].

The objective of this study is to comparatively analyze the clinical and functional outcomes of conservative and surgical treatment of ankle fractures in adults, considering postoperative complications, recovery time, need for reinterventions, quality of reduction, and patient satisfaction.

Methods

This is an integrative literature review, following the steps described by Whittemore and Knafl[10]. The guiding question was structured by the PICO model: How effective is conservative treatment compared to surgical treatment in ankle fractures, in terms of clinical and functional outcomes?

The search was conducted in PubMed, Scopus, Web of Science, Embase, and SciELO databases, encompassing publications from 2014 to 2024, in English, Portuguese, and Spanish. Controlled keywords (MeSH/DeCS) and free terms were combined using Boolean operators. Studies that directly compared conservative and surgical treatments in patients aged 18 years or older were included. Narrative reviews, case reports, duplicate articles, and those that did not comparatively address the two treatments were excluded.

Fifty-two articles were initially identified. After screening by titles and abstracts, 15 studies were evaluated in full text, of which six met the inclusion criteria and were analyzed in detail. The others were mentioned only for contextualization, but did not integrate the comparative analysis.

Methodological quality was assessed using the Newcastle-Ottawa Scale for observational studies and the Joanna Briggs Institute for randomized controlled trials. It is important to acknowledge that the heterogeneity among the included studies, which did not standardize criteria such as fracture classification (AO/OTA, Lauge-Hansen), age, sex, comorbidities, or trauma energy, limits the comparability between groups. In addition, some studies analyzed only surgical techniques among themselves[7], without considering direct comparisons with conservative treatment, which weakens the conclusions of our review.

Results

Table 1 summarizes the main results from the included studies comparing conservative and surgical treatments for ankle fractures. Each study was analyzed, focusing on clinical and functional outcomes, complication rates, recovery time, and additional interventions required after treatment. Additionally, patient satisfaction with the various treatments was taken into consideration. The table organizes the information by author, year of publication, title, and the main results found, allowing for a direct comparison between the two types of therapeutic approaches.

Discussion

Complication rates

Postoperative complications are a central aspect in the comparative evaluation between conservative and surgical treatments of ankle fractures. Among the main complications associated with surgical intervention, surgical site infection, deep vein thrombosis (DVT), fixation failure, and post-traumatic arthrosis stand out. Recent studies indicate that the infection rate varies between 2% and 8%, being higher in patients with risk factors such as diabetes mellitus, smoking, and obesity[4,6,8].

Deep vein thrombosis represents a relevant complication in both surgical and conservative treatments of ankle fractures. In patients undergoing surgery, the incidence of thromboembolic events ranges from 5% to 12%, even with the use of anticoagulant prophylaxis, which is routinely higher in cases with prolonged immobilization and comorbidities. In conservative treatment, the occurrence of DVT is lower, around 1% to 3%, especially in patients with stable fractures and earlier mobilization. However, when prolonged immobilization occurs, especially in older individuals or those with associated risk factors, the incidence may be similar to that observed in surgical treatment, reinforcing the importance of individualized prophylaxis in both contexts[4,6]. Failure in fixation, which may require surgical reintervention, occurs in up to 10% of cases, especially in patients with

Table 1. Results found in the literature search (Brazil, 2025).

Author	Year	Results	Conclusion
Carvalho et al.[4]	2024	Infectious complications: 7% in the surgical group and <1% in the conservative group; late joint complications: 25% in the conservative group and 12% in the surgical group.	Conservative treatment has fewer infections but more late joint complications compared to surgical treatment.
Van Leeuwen et al.[8]	2019	Both groups (surgical and conservative) had similar long-term functional outcomes. Greater bone misalignment and joint complications in the conservative group.	Conservative treatment is functionally feasible, but presents a higher risk of misalignment and joint complications.
Jordan et al.[7]	2018	Intramedullary fixation offers less tissue aggression and good biomechanical properties.	The technique is promising, but it still lacks robust clinical evidence to prove its superiority over traditional fixation.
Willett et al.[6]	2016	Similar functions between groups after six months; fewer complications in the conservative group; surgery had better anatomical alignment.	Conservative treatment is effective in older people with fewer complications, but surgery may be preferred in cases with greater functional demand.
Jansen et al.[9]	2018	Early active rehabilitation significantly improved mobility and reduced stiffness after surgery.	Early rehabilitation protocols are critical to optimize postoperative outcomes in ankle fractures.
Smeeing et al.[12]	2020	No statistically significant difference in ankle function or quality of life between groups; similar complications.	Both treatments (surgical and conservative) are effective in non-displaced fractures with similar clinical and quality of life outcomes.

osteoporosis or when technical errors occur during the fixation of bone fragments[6-8].

Conservative treatment, despite not exposing the patient to immediate surgical risks, can evolve with complications such as secondary fracture displacement, vicious consolidation, and joint stiffness[6,8]. Loss of anatomical alignment can result in chronic instability and greater predisposition to post-traumatic osteoarthritis, compromising long-term functionality[4,6,7]. Comparatively, patients treated conservatively have a lower incidence of infections and DVT, but a higher rate of joint complications and chronic pain[4,6].

According to Carvalho et al. (4), the rate of infectious complications in the surgical group was approximately 7%, while in the conservative group it was less than 1%. In contrast, late joint complications, such as stiffness or persistent pain, affected up to 25% of patients treated conservatively, compared to 12% of those undergoing surgery[6,8].

Van Leeuwen et al. [8] compared conservative and surgical treatment in isolated type B fibular fractures, observing that both groups presented similar long-term functional outcomes. However, conservative treatment was associated with a higher risk of bone misalignment and joint complications. On the other hand, surgical treatment had a higher incidence of adverse events, such as infections and reoperations[6].

Jordan et al.[7] analyzed the options of intramedullary fixation in ankle fractures, demonstrating that, although this technique offers biomechanical advantages and less aggression to soft tissues, the clinical benefits in relation to traditional fixation still lack robust evidence. The choice of surgical approach should consider factors such as fracture type, patient age, and associated comorbidities. In older people, for example, the more invasive surgical technique may be associated with higher rates of systemic complications, and conservative treatment is a viable alternative when joint stability is preserved[11].

Willett et al.[6] reinforce this perspective by comparing immobilization with plaster (close contact casting) to surgery in older patients with unstable ankle fractures. The results of the randomized clinical trial indicated that functional recovery was similar between groups after six months, with lower rates of procedure-related complications in the conservative group. However, the surgery provided greater anatomical accuracy of the reduction, which may be relevant for active patients or those with higher functional demand. Jansen et al.[9] found that early active rehabilitation protocols after surgery significantly favor the return of mobility and reduction of joint stiffness, emphasizing the importance of a multidisciplinary approach in the postoperative period.

Smeeing et al.[12] examined stable and unstable non-displaced ankle fractures, using both conservative treatment (with plaster or orthosis) and surgical treatment (ORIF). The results showed no statistically significant difference in short-term ankle function between the two groups (SMD = -0.14; p = 0.51). Similarly, quality of life showed no relevant difference (MDS = 0.13; p = 0.06), and complication rates were similar in both treatments.

It is important to note that ankle fracture classifications, such as Weber and AO/OTA systems, are commonly used to determine the most suitable treatment. However, not all included studies specified these classifications, which limits the direct comparison and methodological rigor of the analysis[6,8]. Regarding complications, conservative treatment is more prone to secondary fracture displacement, vicious consolidation, and joint stiffness, factors that can compromise anatomical alignment and lead to chronic instability and post-traumatic osteoarthritis. On the other hand, it is usually associated with a lower incidence of infections and DVT when compared to surgical treatment. Surgical treatment, although more invasive, appears to yield better long-term functional recovery in certain contexts, albeit with a higher risk of infection and the need for reoperation[4,6,8].

Functional recovery time

Functional recovery time after ankle fractures varies substantially between conservative and surgical treatments, depending on the severity of the fracture, the type of intervention adopted, and the individual characteristics of the patient[4,6]. In conservative treatment, which typically involves immobilization with plaster or orthoses, recovery time is often related to fracture stability, the presence of displacement, and the patient's response to immobilization. In stable fractures, functional recovery time can range from six to 12 weeks, with gradual mobilization initiated after initial bone consolidation[11]. However, complications such as joint stiffness and loss of muscle strength, which are common after prolonged periods of immobilization, can prolong the return to full functionality, with rehabilitation ranging from three to six months[4,6].

On the other hand, surgical treatment, especially for unstable fractures or fractures with significant misalignment, typically allows for a faster functional recovery, as anatomical reduction and immediate ankle stabilization enable early mobilization[6,9]. Studies indicate that patients undergoing internal fixation of ankle fractures with plate and screws often begin rehabilitation within two to four weeks after surgery, which may reduce the total functional recovery time to approximately 12 to 16 weeks[9,12]. However, the need to follow a rigorous rehabilitation protocol, including intensive physical therapy, may extend the time to full recovery, especially in patients with complications or in older patients, who have a lower response to rehabilitation[4,6].

Functional recovery time is also influenced by factors such as age, comorbidities, levels of previous physical activity, and adherence to the rehabilitation plan[6,9]. Younger patients with better physical condition tend to have a faster recovery, regardless of the treatment chosen[11,12]. On the other hand, older individuals or those with associated diseases, such as diabetes or osteoporosis, may face a slower recovery and a higher risk of complications, including fixation failures or limited long-term mobility[4,6].

Additionally, the decision to allow or restrict weight-bearing on the affected limb during the initial recovery phase also plays a crucial role. Early weight-bearing in surgically treated fractures is beneficial, especially in stable fractures after adequate internal fixation, as it contributes to faster recovery of joint function. However, in unstable, multifragmentary fractures or fractures associated with osteoporosis, this conduct may increase the risk of fixation failure[9,12].

In summary, the time of functional recovery after ankle fractures is influenced by multiple factors related to both the type of treatment adopted and the patient's profile. Surgical treatment tends to provide faster functional recovery in terms of return to mobility, while conservative treatment may result in a longer recovery time, especially in cases of joint complications or loss of bone alignment[6,9,12].

Quality of anatomical reduction and alignment

The quality of anatomical reduction and alignment plays a crucial role in the successful treatment of ankle fractures, whether in conservative or surgical treatment. The correct reduction, that is, the realignment of the bone fragments to restore the original joint anatomy, is a determining factor for functional recovery and the minimization of long-term complications, such as post-traumatic osteoarthritis and joint instability[6,7]. In surgical treatment, anatomical reduction is usually achieved through direct intervention, using internal fixation techniques, such as plates, screws, or intramedullary nails, to restore joint congruence and fracture stability[6,7,13].

In complex or unstable fractures, where there is significant misalignment or impairment of joint structures, anatomical reduction is essential to prevent functional loss and deformity. Studies show that poor bone reduction and misalignment, even at small angles, can lead to secondary osteoarthritis, chronic pain, and limited movement. The fixation failure rate, associated with an inadequate reduction, can reach 15% in surgically treated ankle fractures, with a risk of reintervention. Thus, the adequacy of reduction and good anatomical alignment are often predictors of better functional outcomes[6-9].

In conservative treatment, anatomical reduction and alignment depend on the immobilization technique used, requiring strict monitoring to maintain the position during healing[8,9]. In non-displaced or only minimally displaced fractures, immobilization is usually sufficient to ensure adequate bone consolidation. In displaced fractures, where the risk of vicious consolidation is high, failure to maintain alignment should prompt a change in management, often necessitating surgical treatment, to prevent loss of movement, chronic pain, and long-term instability[2,6]. Serial radiographs and continuous monitoring are crucial for detecting deviations or failures in the reduction process, thereby avoiding the need for later surgical intervention[6,9].

Assessment of the quality of anatomical reduction and alignment should also consider the impact on joint function. In ankle fractures, preserving the joint congruence of the tibiotarsal joint is essential to maintain proper function and reduce the risk of complications, such as osteoarthritis[6,7]. Radiographic evaluation in different views and computed tomography is essential to verify alignment and anatomical reduction. The literature recommends an accurate evaluation of tibial inclination angles and talocrural angles to ensure correct joint congruence[7,9].

In summary, the quality of anatomical reduction and alignment is a determining factor in choosing the treatment for ankle fractures. While surgical intervention offers the possibility of a more precise and controlled reduction, conservative treatment relies on adequate immobilization and continuous surveillance to prevent complications[2,6-8]. Both treatments require rigorous strategies to ensure the maintenance of joint congruence and prevent long-term functional complications[6,9].

Patient satisfaction and perception

Patient satisfaction and perception of treatment efficacy play a crucial role in evaluating clinical outcomes and in determining the choice between conservative and surgical

treatment for ankle fractures. The patient's experience in relation to treatment can directly influence their adherence to the treatment plan and rehabilitation, as well as their return to full functionality[9,14]. In studies comparing the two treatments, patient satisfaction with surgical treatment tends to be higher when anatomical reduction is successful, with most patients reporting pain relief and a faster recovery[8,9]. However, factors such as postoperative complications, recovery time, and mobility limitations can negatively impact this perception, especially when adverse events occur, such as infections or fixation failures[4,9].

On the other hand, patients who opt for conservative treatment often demonstrate a greater perception of safety due to the absence of surgical intervention, which may be particularly important for those with a fear of complications associated with surgery[8]. Although functional recovery after conservative treatment is usually longer, patient satisfaction can be high when there are no serious complications and the fracture consolidates adequately[12,14]. The perception of pain and the ability to perform daily activities are significant factors that influence satisfaction after conservative treatment. Patients with better functional results tend to report greater satisfaction, even if the recovery time is longer[14].

Assessing patient satisfaction also involves psychosocial aspects, such as emotional impact and quality of life during recovery. Patients undergoing surgical treatment may experience an initial period of greater discomfort due to the surgical process; however, the prospect of faster functional recovery and a reduced risk of deformities may contribute to a more positive perception of long-term treatment[9,14]. On the other hand, patients undergoing conservative treatment may experience frustration due to prolonged immobilization time and limitations on daily activities, factors that negatively affect quality of life and satisfaction with treatment[12,14,15]. Rehabilitation also plays an essential role in the patient's perception, as the gradual return to sports and functional activities is often slower in conservative treatment[9].

Additionally, effective communication between the medical team and the patient is important for the patient's perception of the treatment. Patients who are knowledgeable about the benefits and risks of each therapeutic approach tend to have more realistic expectations and, therefore, higher levels of satisfaction, regardless of the treatment choice. The active participation of the patient in the decision-making process and the ability to understand the implications of each therapeutic option contribute to a more positive experience, resulting in greater adherence to the treatment plan and better subjective results[14].

In summary, patient satisfaction and perception are influenced by multiple factors, including the type of treatment, the effectiveness of the procedure, the recovery time, and the psychosocial impact of the fracture. Although surgical treatment is generally associated with faster recovery and lower rates of functional complications, conservative treatment may offer an attractive option for patients seeking to avoid invasive interventions[8-15]. Clear communication, effective pain management, and appropriate post-treatment follow-up are key to ensuring high patient satisfaction and a positive experience, regardless of the treatment chosen[14].

Additional interventions required

Additional interventions following the treatment of ankle fractures are a critical factor in evaluating clinical outcomes and determining the choice between conservative and surgical treatment. In conservative treatment, the main need for additional intervention is related to failures in bone consolidation or fracture alignment. While many stable fractures can heal adequately with immobilization, cases of displaced or unstable fractures that were not properly aligned during conservative treatment may require subsequent surgical intervention, such as open reduction and internal fixation. Studies indicate that up to 20% to 25% of patients treated conservatively for unstable fractures may require a reintervention due to failure to consolidate or poor healing. These additional interventions often involve the need for new surgical procedures, which can prolong recovery time and increase the risk of complications associated with surgery.

In surgical treatment, additional interventions may be necessary in cases of postoperative complications, such as surgical site infection, fixation failure, or fracture misalignment after the initial procedure. Fixation failure may occur in 5% to 10% of cases, especially in fractures with joint involvement, where the stability provided by the fixation devices may be insufficient, necessitating additional surgery to correct the bone position or replace the fixation devices. In addition, complications such as osteomyelitis or surgical site infection may require additional treatments, including intravenous antibiotics and, in severe cases, surgical debridement procedures to control the infection.

Other situations that may require additional postoperative interventions include the development of compartment syndrome, a rare but serious complication that can occur after surgery. Although it is treated with immediate decompression, this condition requires urgent surgical intervention to relieve pressure and prevent permanent soft tissue damage. The presence of DVT or pulmonary embolism may also result in the need for additional treatment with anticoagulants, altering the initial recovery course and prolonging rehabilitation time.

In addition, postoperative rehabilitation in surgically treated fractures may require additional interventions, such as intensive physical therapy or procedures to correct joint stiffness, chronic pain, or long-term functional limitation. Patients with sequelae such as post-traumatic arthritis, resulting from an inadequate reduction or lack of joint congruence, may require additional treatments, including corticosteroid infiltrations or, in more severe cases, surgical interventions for joint replacement. Full recovery of joint function in ankles with untreated fractures may take several months or even years, necessitating repeated interventions to restore mobility.

In summary, both conservative and surgical treatments may require additional interventions, either due to failures

in the recovery process, post-treatment complications, or long-term sequelae. Careful monitoring during post-treatment and continuous patient evaluation are crucial for detecting problems early, which may require an additional therapeutic approach. The choice of initial treatment should consider these risks and the potential impact of additional interventions, balancing the advantages of a faster recovery with the possible costs of long-term complications.

Final considerations

The findings suggest that surgical treatment tends to favor more precise anatomical reduction, early mobilization, and faster functional recovery in unstable fractures, but is associated with a higher risk of postoperative complications, including infection, DVT, and the need for reinterventions. Conservative treatment proved to be adequate in stable fractures, with a lower incidence of immediate serious complications, although it presents an increased risk of loss of reduction, vicious consolidation, and progression to osteoarthritis.

However, the present review analyzed only six comparative studies from the vast literature on ankle fractures, which showed significant heterogeneity in terms of populations, inclusion criteria, and classifications used. Relevant issues such as the influence of comorbidities, age, trauma energy, type of fracture, and rehabilitation protocols were little explored by the available studies. These limitations prevent definitive conclusions and reinforce the need for more comprehensive reviews, incorporating a larger number of articles, consistent comparison criteria, and rigorous statistical analysis.

Thus, the results presented herein should be interpreted as a preliminary synthesis, useful for guiding clinical practice, but insufficient for generalization. The therapeutic decision for ankle fractures should remain individualized, based on the type of fracture, the patient's clinical profile, and the team's experience, with active patient involvement in the decision-making process.

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