Initial clinical-surgical management in open fracture: a systematic review

Manejo inicial clínico-quirúrgico en fractura expuesta: una revisión sistemática

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Abstract

The present article aimed to analyze the best clinical and surgical practices in the initial management of open fractures, complex traumatic injuries associated with a high risk of complications, such as serious infections and amputations. To achieve this objective, a systematic review of 20 studies published in the last eight years, indexed in databases such as PubMed and SciELO, was conducted. The review followed the PRISMA methodology and considered inclusion criteria such as the timeliness, clinical relevance, and methodological rigor of the studies. The findings highlighted the importance of debridement, irrigation, the use of muscle flaps, and early antibiotic administration to reduce complications. It was also confirmed that the Gustilo-Anderson classification remains a key reference, although a more comprehensive approach is proposed that considers both fracture severity and the patient's clinical status. Consequently, standardized and personalized management protocols are proposed to optimize clinical outcomes and reduce morbidity. This is especially important given the high incidence of traffic accidents in young populations, which reinforces the need for immediate and effective care to improve the quality of life of affected patients.

Keywords: antibiotics, fracture, protocols.

Resumen

El presente artículo tuvo como objetivo analizar las mejores prácticas clínicas y quirúrgicas en el manejo inicial de las fracturas expuestas, lesiones traumáticas complejas asociadas a un elevado riesgo de complicaciones, tales como infecciones graves y amputaciones. Para lograrlo, se llevó a cabo una revisión sistemática de 20 estudios publicados en los últimos ocho años, indexados en bases de datos como PubMed y SciELO. La revisión se realizó siguiendo la metodología PRISMA y considerando criterios de inclusión como la actualidad, la relevancia clínica y el rigor metodológico de los estudios. Los hallazgos resaltaron la importancia del desbridamiento, la irrigación, el uso de colgajos musculares y la administración temprana de antibióticos para la reducción de complicaciones. Asimismo, se confirmó que la clasificación de Gustilo-Anderson sigue siendo una referencia clave, aunque se propone un enfoque más integral que considere tanto la gravedad de la fractura como el estado clínico del paciente. En consecuencia, se proponen protocolos de manejo estandarizados y personalizados con el fin de optimizar los resultados clínicos y disminuir la morbilidad. Esto reviste especial importancia dada la alta incidencia de accidentes de tránsito en poblaciones jóvenes, lo que refuerza la necesidad de una atención inmediata y efectiva para mejorar la calidad de vida de los pacientes afectados.

Palabras clave: antibióticos, fractura, protocolos.

Introduction

This article explores the initial clinical-surgical management of open fractures, a complex and common traumatic injury that carries a high risk of complications, particularly severe infections. These complications can lead to amputations or, in more severe cases, death (Campodorro et al., 2015).

Furthermore, this research focuses on the lack of global consensus regarding best practices for the immediate treatment of these fractures, resulting in significant heterogeneity in clinical approaches adopted worldwide (Álvarez et al., 2011). Therefore, this study aims to identify and analyze the most effective strategies for the initial management of open fractures, with the goal of proposing standardized protocols that can be implemented internationally. It is anticipated that these recommendations will contribute to improved clinical outcomes and reduced complication rates among affected patients.

In this regard, the relevance of the topic lies not only in improving the quality of life for patients but also in optimizing the use of hospital resources and reducing recovery times. The high incidence of accidents, particularly among young populations, underscores the importance of addressing this issue within the current public health context (García et al., 2015).

It is important to note that this analysis is also grounded in theories related to trauma biomechanics and wound pathophysiology, which emphasize the importance of early intervention to minimize infections and promote healing. The Gustilo-Anderson classification has been widely used as a reference to guide treatment (Shiraishi & Lozada, 2019); however, recent studies have questioned its uniformity and highlighted the need for multidisciplinary approaches. These include perioperative antimicrobial prophylaxis (AP), advanced techniques such as muscle flaps for tissue coverage, and early rehabilitation to reduce complications (OMS, 2022).

Similarly, existing literature emphasizes the importance of immediate surgical debridement, adequate irrigation, and the strategic use of muscle flaps to cover injuries (Gutiérrez et al., 2008). Arango et al. (2007) documented a protocol based on antibiotic prophylaxis without initial surgical debridement, achieving satisfactory results with no reported infections. Nonetheless, significant gaps persist regarding the standardization of key interventions, such as the optimal type and duration of antimicrobial prophylaxis.

Finally, in this context, the present article provides a critical review of current practices and includes recommendations based on recent clinical evidence. Thus, its purpose is to contribute to the development of more uniform protocols that can enhance therapeutic outcomes and reduce complications associated with open fractures.

Methodology

The methodology employed in this article adopted a qualitative approach, utilizing a descriptive research design based on a documentary review of relevant studies (Hernández et al., 2014). Additionally, to ensure rigor in the selection and analysis process, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method was implemented, which is widely recognized in systematic reviews (Yáñez et al., 2023).

The data collection process involved a comprehensive review of scientific and clinical documents related to the initial clinical-surgical management of open fractures. Academic and medical databases such as PubMed, Scopus, and Scielo were consulted to identify studies that met the established inclusion criteria, which included topic relevance, methodological design, and publication currency. The selected studies were analyzed in depth to extract key information regarding the most common clinical and surgical practices in the initial management of open fractures (Piza et al., 2019).

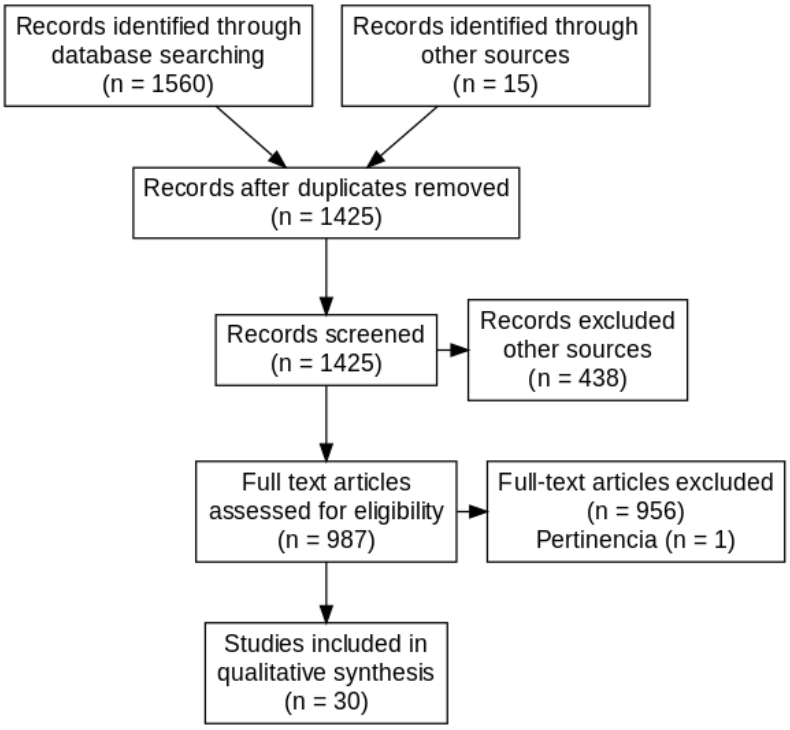
The inclusion criteria for selecting studies in this article were as follows:

- **Contemporary importance and relevance:** studies published in the last 8 years were included to ensure that the information utilized was current and relevant to the clinical-surgical management of open fractures.
- **Language:** only studies written in English and Spanish were selected, allowing for the analysis of a wide spectrum of scientific literature accessible in these languages.
- **Academic quality:** only articles indexed in recognized academic and scientific databases, such as PubMed, Scopus, and Scielo, were considered, ensuring the quality and validity of the reviewed studies.

Conversely, the exclusion criteria were:

- **Age:** any study published before the established time frame was excluded to maintain the relevance and currency of the content.
- **Language:** studies published in other languages were excluded due to limitations in access and comprehension.
- **Academic quality:** articles that were not indexed in reliable databases were not considered, as they did not meet the required academic quality standards.

Figure 1
PRISMA Methodology



Results

Through the systematic review, it was evident that the clinical-surgical management of open fractures remains a challenge that requires a comprehensive and multidisciplinary approach to minimize complications and optimize patient prognosis. In this regard, various studies have highlighted the importance of appropriate

classification and early treatment, which includes early antibiotic therapy, surgical debridement, and a strategy for bone stabilization. These interventions are crucial for preventing infections, stabilizing the fracture, and restoring function to the affected limb.

In this context, Quinaluisa et al. (2022) emphasize the need for early antibiotic therapy and radical debridement to reduce the risk of infection, aligning with the recommendations of Maldonado et al. (2024), who highlight the use of tools such as the Injury Severity Score (ISS) and the Gustilo-Anderson classification to guide therapeutic decisions. Similarly, Coombs et al. (2022) underscore that the early use of systemic antibiotics is essential for decreasing infection rates, and that aggressive irrigation and debridement also contribute to this goal.

On the other hand, Gardezi et al. (2020) point out the lack of consensus regarding the most effective irrigation solution, which remains a limitation in preventing infections. Filippini et al. (2020) reinforce the importance of early antibiotic therapy and meticulous debridement, although they caution that the role of early cultures remains debated. Orozco et al. (2021) and Angulo et al. (2024) agree that fracture classification should guide the type of fixation, prioritizing internal fixation for less complex cases and external fixation for more severe fractures, while Lana et al. (2022) highlight the importance of collaboration among specialists in trauma, plastic surgery, and vascular surgery for appropriate management.

Moreover, Quezada et al. (2024) and Uyaguari et al. (2023) reinforce the critical role of the Gustilo-Anderson classification in decision-making and the positive impact of early antibiotic therapy. In the same vein, Salazar et al. (2023) emphasize the need for a multidisciplinary team to improve outcomes in polytraumatized patients, highlighting the involvement of general surgeons in contexts with limited access to trauma specialists.

In addition, other studies, such as that by Duyos et al. (2017), suggest that debridement within the first 24 hours is key, although the risk of infection does not significantly increase until four days. Garner et al. (2020) review the evolution of antibiotic therapy, noting that there is no universally accepted standard regarding its duration and coverage. Basurto et al. (2024) emphasize that early fixation not only accelerates bone consolidation but also reduces morbidity and hospital stay.

From an innovative perspective, Atwan et al. (2020) highlight the effectiveness of using local powdered antibiotics as an emerging strategy, while Coles (2020) mentions the utility of negative pressure therapy in open wounds to decrease the risk of infection. Meanwhile, Brenes (2020) underscores the importance of immobilization and bone alignment in initial treatment, aspects also addressed by Puetzler et al. (2019), who warn about the lack of standardized international guidelines.

Finally, Amarilla et al. (2024) focus on the coverage of wounds with bone exposure, promoting the use of muscle flaps as an effective solution. Borja et al. (2023) reinforce the need for rapid and coordinated interventions in fractures resulting from accidents, noting that Staphylococcus aureus is the most commonly identified pathogen in these injuries.

Discussion

From the analysis of various therapeutic strategies, it is confirmed that early antibiotic therapy and meticulous surgical debridement are essential to reduce the risk of infections and optimize recovery. Furthermore, appropriate fracture classification allows for determining the most suitable type of fixation, which favors better clinical outcomes for patients.

There is a consistent pattern in the efficacy of early antibiotic administration and the importance of debridement within the first 24 hours. However, controversy persists regarding the most effective irrigation solution, reflecting the need for standardization in this aspect of treatment. Additionally, a trend toward personalized bone stabilization is evident, depending on the severity of the injury and the patient's condition.

On the other hand, the use of local powdered antibiotics and negative pressure therapy emerges as innovative strategies that positively impact infection prevention. These interventions complement conventional approaches and have the potential to significantly improve clinical protocols in the future.

The lack of consensus on the duration and coverage of antibiotic therapy, as well as the absence of standardized international guidelines, remains a significant obstacle to optimizing the management of open fractures. Nevertheless, the integration of different medical specialties in multidisciplinary treatment has proven to be a crucial factor in improving outcomes for polytraumatized patients.

Evidence suggests that prompt intervention in open fractures, particularly those resulting from traffic accidents, is fundamental to minimizing complications and reducing hospital morbidity. Moreover, implementing specific protocols for managing infections, considering predominant microbiology, could represent a significant advance in the quality of care.

In light of all the above, this article aligns with the urgent need to continue researching more effective and homogeneous therapeutic strategies, with the aim of developing more precise management guidelines tailored to various clinical realities. The ongoing evolution of technology and research in surgical techniques will continue to play a crucial role in improving treatments and outcomes for patients with open fractures.

Conclusions

It is evident that the initial management of open fractures requires a deep understanding of surgical techniques and human physiology, as well as a collaborative approach that integrates the expertise of multiple medical specialties. The diversity of factors influencing patient recovery, such as the severity of the fracture, the patient's overall condition, and the quality of prehospital care, underscores the importance of a standardized protocol that can be tailored to the individual needs of each case.

In this regard, the early administration of antibiotics is a crucial aspect that should not be underestimated; it has been demonstrated that this practice not only reduces the risk of infections but also directly impacts the patient's recovery time. However, while classifications such as Gustilo-Anderson are valuable, they can lead to a simplistic view that does not reflect the complexity of each case. Implementing a more holistic approach that considers not only the classification of the fracture but also the context in which the injury occurred and the characteristics of the patient could significantly improve outcomes.

Furthermore, it is essential for the medical community to remain open to new evidence and techniques that may emerge, incorporating approaches that evaluate the efficacy of less conventional methods of disinfection and healing. This will facilitate a move toward more personalized and effective treatments, continuously improving outcomes for patients with open fractures.

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