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OPEN FRACTURE MANAGEMENT: UPDATE ON INITIAL EVALUATION AND CLASSIFICATION

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ABSTRACT This article reviews the management of open fractures, which occur when there is a break in the skin exposing the underlying bone and soft tissues, leading to significant morbidity and mortality. The article focuses on the initial evaluation, classification, and treatment of these fractures. The Gustilo-Anderson classification system, which is based on the degree of soft tissue injury, is the most widely used classification system for open fractures. However, the Tscherne classification system, which focuses on the severity of soft tissue injury and the degree of fracture displacement, has been shown to be a more reliable predictor of infection and nonunion in some studies. The article also covers the AO/OTA classification system, a newer classification system that integrates important aspects of the Gustilo-Anderson classification system to provide more comprehensive guidance for the treatment of open fractures. Treatment of open fractures is complex and requires a multidisciplinary approach guided by the severity of the injury. Early antibiotics, early surgical debridement, and wound irrigation have been shown to reduce the risk of infection and improve outcomes. Patients with open fractures were more likely to have associated injuries, longer hospital stays, and higher hospital costs compared to patients with closed fractures.

KEYWORDS : Open fractures, Gustilo-Anderson classification system, Tscherne classification system, AO/OTA classification system, Multidisciplinary approach.

INTRODUCTION

Recent advances in the management of open fractures have improved outcomes and reduced complications. The use of early antibiotics, early surgical debridement, and wound irrigation has been shown to reduce the risk of infection and improve outcomes in patients with open fractures (1). Additionally, the classification of open fractures has been updated to better reflect the severity of the injury and help guide management (2).

Several classification systems have been proposed for open fractures, including the Gustilo-Anderson classification system, the Tscherne classification system, and the AO/OTA classification system. The Gustilo-Anderson classification system, which is based on the degree of soft tissue injury, remains the most widely used classification system for open fractures (3).

However, the Tscherne classification system, which focuses on the severity of soft tissue injury and the degree of fracture displacement, has been shown to be a more reliable predictor of infection and nonunion in some studies (4).

METHODS

A narrative review was conducted to update current knowledge on the initial evaluation and classification of fractures for patient management. Searches were conducted in the PubMed, Embase, Scopus, and Web of Science databases using the following MeSH terms and keywords: "fracture management," "initial evaluation," "fracture classification," "fracture diagnosis," "treatment," "rehabilitation," and "outcomes." English language studies published between January 2010 and December 2022 that addressed the initial evaluation and classification of fractures for patient management were included. Studies that were not related to the topic or did not meet the established quality criteria were excluded. A manual review of the reference lists of the selected studies was conducted to identify additional relevant studies. Study information was extracted and synthesized narratively, highlighting key findings and recommendations for clinical practice.

Epidemiology

Open Fractures are a significant cause of morbidity and mortality, with an estimated incidence of 11 to 25 cases per 100,000 persons per year. Several risk factors have been associated with the development of open fractures, including male gender, advanced age, and the presence of comorbidities such as diabetes and peripheral vascular disease. In addition, certain occupations and activities, such as construction work and high-impact sports, have been shown to increase the risk of open fractures (5). Under standing the epidemiology of open fractures is critical to developing strategies for prevention and management.

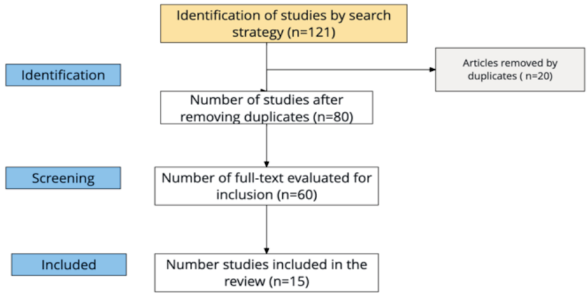

Figure 1. PRISMA.

A retrospective study of 136 open fractures conducted in a level I trauma center found that the most common mechanism of injury was motor vehicle accidents, followed by falls and pedestrian injuries. The study also found that patients with open fractures were more likely to have associated injuries, longer hospital stays, and higher hospital costs compared to patients with closed fractures. In another study, the incidence of open fractures was found to be higher in rural areas compared to urban areas, possibly due to differences in occupational and recreational activities (6).

Pathophysiology

Open fractures are injuries that result in a break in the skin, leading to exposure of the underlying bone and soft tissues. These fractures can result in a disruption of the blood supply to the affected area, leading to tissue damage and potential complications such as infection, delayed healing, and nonunion. The pathophysiology of open fractures involves a complex interplay of factors including soft tissue injury, bone damage, and disruption of the local immune system (7).

Soft tissue injury is a critical component of the patho physiology of open fractures, as it can lead to tissue ischemia and necrosis. The severity of soft tissue injury can be classified using various systems, such as the Gustilo-Anderson classification system, which categorizes open fractures based

on the extent of soft tissue damage. In addition to soft tissue damage, open fractures can also result in bone damage and disruption of the local immune system. The local immune response can be impaired in open fractures, as the exposure of bone and soft tissue to the environment can lead to bacterial contamination and colonization (8).

Evaluation and classification

The evaluation and classification of open fractures is a fundamental aspect to guide appropriate treatment and reduce the rate of complications. The Gustilo-Anderson classification is one of the most used in clinical practice, as it allows identifying the severity of the injury and guiding therapeutic decision-making. This classification is divided into three categories: type I, type II, and type III (1,9).

Type I refers to open fractures with a wound less than 1 cm in length, without significant soft tissue injuries, and minimal contamination. Type II is characterized by a wound greater than 1 cm, with moderate soft tissue damage and variable contamination. Finally, type III is subdivided into three subtypes (A, B, and C) and refers to open fractures with a wound greater than 10 cm, extensive soft tissue damage, and significant contamination. Subtype IIIA implies moderate soft tissue injury, subtype IIIB is associated with severe soft tissue injury, and subtype IIIC refers to open fractures with associated vascular injuries (1,8).

In a recent study, it was found that the Gustilo-Anderson classification remains a useful tool for evaluating the severity of open fractures and guiding surgical treatment. However, the importance of considering other factors, such as the patient's age and the presence of comorbidities, to predict treatment outcomes has also been highlighted. Additionally, a new classification, the "AO/OTA Classification for Open Fractures," has been proposed, which integrates important aspects of the Gustilo-Anderson classification and provides a more comprehensive guidance for the treatment of open fractures (1,5,7).

Treatment

The treatment of open fractures is a complex process that requires a multidisciplinary approach and is guided by the severity of the injury. The Gustilo-Anderson classification system is commonly used to categorize open fractures and guide treatment decisions. Type I fractures are typically managed with wound irrigation and debridement followed by antibiotic therapy, while type II fractures may require additional surgical interventions such as external fixation or bone grafting. Type III fractures are the most severe and may require complex reconstructive procedures and prolonged hospital stays (1,10).

In type I fractures, the main goal of treatment is to prevent infection and promote wound healing. This is achieved through thorough wound irrigation, debridement, and administration of antibiotics. In some cases, early primary closure of the wound may be considered. Type II fractures may require additional interventions such as external fixation, bone grafting, or fasciotomy, which are performed to reduce the risk of infection, promote bone healing, and preserve soft tissue viability (1,8,10).

In type III fractures, the management is more complex and often requires a staged approach. The initial focus is on reducing the risk of infection and stabilizing the fracture through debridement, irrigation, and fixation. Soft tissue coverage is then provided using local tissue flaps or free tissue transfer. Additional procedures may be required to address associated injuries such as vascular or nerve damage. The overall goal of treatment is to achieve bone union, restore function, and prevent complications such as nonunion and infection (1,10).

Recent advances in the management of open fractures have focused on optimizing timing of surgical intervention, use of antibiotics, and management of associated injuries. Early intervention and appropriate use of antibiotics have been shown to reduce the risk of infection and improve outcomes in patients with open fractures. In addition, the use of advanced imaging modalities such as computed tomography (CT) and magnetic resonance imaging (MRI) has improved the accuracy of diagnosis and treatment planning, particularly in cases of complex fractures or associated injuries (1,11).

The AO/OTA Classification for Open Fractures is a more recent classification system that integrates important aspects of the Gustilo-Anderson classification and provides a more comprehensive guide for the management of open fractures. This classification system takes into account not only the size of the wound, but also the degree of soft tissue damage, fracture complexity, and degree of contamination. The classification is divided into three main groups: type A, type B, and type C, with further subdivisions within each group based on the severity of the injury. The type A fractures involve minimal soft tissue damage and minimal contamination, while the type C fractures involve severe soft tissue damage and contamination. The AO/OTA classification system has been shown to be a reliable predictor of the risk of complications and can help guide the choice of treatment options for open fractures (5,7,12).

Several studies have shown the usefulness of the AO/OTA classification system for guiding the management of open fractures. For example, a study conducted in Japan found that the AO/OTA classification system was more reliable than the Gustilo-Anderson classification system in predicting the risk of infection and nonunion in patients with open fractures. Another study conducted in South Africa found that the AO/OTA classification system was a useful tool for predicting the need for operative intervention and the risk of complications in patients with open fractures. In addition, a study conducted in Turkey found that the AO/OTA classification system was useful for guiding the choice of treatment options and predicting the outcome in patients with open fractures (7,13).

Overall, the AO/OTA Classification for Open Fractures is a more comprehensive classification system that takes into account several important factors for the management of open fractures. This classification system can help guide the choice of treatment options and predict the risk of complications, which can ultimately lead to better outcomes for patients with open fractures. Further studies are needed to validate the usefulness of this classification system in different clinical settings and populations (5,13).

COMPLICATIONS

Open fractures are associated with various complications that can affect the outcome of treatment. Infections, delayed union or nonunion, malunion, and neurovascular damage are some of the most common complications. Infections are a significant concern and can occur in up to 27% of cases, leading to prolonged hospitalization, multiple surgeries, and poor outcomes. Delayed union or nonunion can also occur in up to 20% of cases, leading to persistent pain, functional impairment, and the need for additional surgery. Malunion, which is a result of inadequate reduction or fixation, can cause deformity, joint stiffness, and loss of function. Neurovascular damage can lead to sensory and motor deficits, chronic pain, and poor wound healing (14).

To reduce the risk of complications, appropriate management of open fractures is essential. Early administration of antibiotics, surgical debridement, and wound irrigation are recommended to reduce the risk of infection and improve

outcomes. Proper fixation and reduction are also critical to prevent delayed union or nonunion, malunion, and neurovascular damage. In cases of severe open fractures, early soft tissue coverage may be necessary to reduce the risk of infection and improve healing (15).

In addition to the aforementioned measures, close monitoring and follow-up are necessary to detect and manage complications promptly. Complications such as infections or delayed union/nonunion may require additional surgeries, prolonged immobilization, or physical therapy to improve outcomes (14,15). Therefore, appropriate management and follow-up are crucial to minimize the risk of complications and achieve optimal outcomes in patients with open fractures.

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