



Surgical and Non-Surgical Interventions in Charcot Neuroarthropathy

Manuel Flores*

Facultad de Ciencias Químicas, Universidad de Autónoma de San Luis Potosí, Mexico

Abstract

This review examines both surgical and non-surgical interventions for managing Charcot neuroarthropathy. Non-surgical approaches focus on early diagnosis, immobilization, and offloading to prevent further joint destruction. Strict weight-bearing restrictions, use of custom orthotics, and the application of total contact casts are essential components of conservative treatment, particularly in the acute phase, when the goal is to stabilize the joint and prevent deformity. The role of pharmacological management, including bisphosphonates for bone resorption and anti-inflammatory medications for pain control, is also discussed. For patients with advanced deformities or persistent joint instability, surgical interventions are often required. Surgical options, such as reconstructive procedures, joint fusion, or amputation, are considered based on the extent of damage and the patient's functional needs. The review highlights the importance of a multidisciplinary approach, including input from orthopedic surgeons, podiatrists, and rehabilitation specialists, to optimize patient outcomes. Additionally, post-operative rehabilitation strategies are critical in restoring function, preventing further complications, and improving the quality of life for individuals affected by this challenging condition. Through this comprehensive review, we aim to provide clinicians with evidence-based guidelines for the effective management of Charcot neuroarthropathy, emphasizing both the conservative and surgical treatment options available for different stages of the disease.

Keywords: Charcot neuroarthropathy; Charcot joint disease; Surgical interventions; Non-surgical interventions; Foot and ankle deformity; Peripheral neuropathy

Introduction

Charcot neuroarthropathy (CNA), or Charcot joint disease, is a progressive and potentially debilitating condition that leads to joint destruction, deformity, and loss of function, primarily affecting weight-bearing joints like the foot and ankle [1]. It is most commonly associated with peripheral neuropathy, particularly in individuals with diabetes mellitus, though it can also occur in patients with spinal cord injuries, alcohol abuse, or other forms of neuropathy. The hallmark of Charcot neuroarthropathy is the combination of loss of protective sensation and repetitive trauma, which, when unrecognized or inadequately managed, can lead to severe joint deformities [2], increased morbidity, and, in some cases, amputations.

The disease progresses in stages, beginning with an acute inflammatory phase characterized by swelling, warmth, and redness, followed by joint dislocation, fragmentation, and deformity. Without timely intervention, the joint undergoes irreversible changes, significantly impairing mobility and quality of life. Early detection and appropriate management are crucial in halting or slowing disease progression and preventing further joint destruction [3-5]. Management of Charcot neuroarthropathy involves a combination of non-surgical and surgical strategies, tailored to the stage and severity of the disease. Non-surgical interventions are the cornerstone of treatment, particularly in the early stages, with immobilization and offloading the joint to prevent further damage being essential. The use of total contact casts, custom orthotics, and pharmacological agents such as bisphosphonates for bone resorption play key roles in conservative management.

However, as the disease progresses or in cases of significant deformity, surgical intervention may be necessary. Surgical options range from joint fusion and reconstructive procedures to, in more severe cases, amputation. The decision to pursue surgery is often based on the degree of joint destruction, functional impairment, and the patient's overall health and goals. Given the complexity of

Charcot neuroarthropathy, a multidisciplinary approach is essential for optimizing patient outcomes [6]. This approach typically involves collaboration among orthopedic surgeons, podiatrists, endocrinologists, and rehabilitation specialists to address the medical, surgical, and functional aspects of the disease. This review aims to provide an in-depth overview of both surgical and non-surgical interventions in Charcot neuroarthropathy. By exploring evidence-based management strategies, we seek to improve early diagnosis, guide treatment decisions, and ultimately enhance the quality of life for individuals affected by this challenging condition.

Results and Discussion

The review of surgical and non-surgical interventions in Charcot neuroarthropathy (CNA) revealed several key findings across different stages of the disease, highlighting the effectiveness of both conservative and surgical treatment options [7]. The outcomes depend largely on early detection, appropriate management, and the severity of the condition at presentation. The majority of studies emphasize the importance of early detection for preventing progression and irreversible damage in Charcot neuroarthropathy. In the acute phase, immobilization using methods like total contact casting (TCC), removable walking boots, or below-knee casts is crucial to limit joint movement and prevent further trauma. Early weight-bearing restriction significantly reduces the risk of deformity, with a 95% success rate in preventing joint destruction when immobilization is initiated promptly. The use of custom orthotics and shoes is a common recommendation in non-surgical

*Corresponding author: Manuel Flores, Facultad de Ciencias Químicas, Universidad de Autónoma de San Luis Potosí, Mexico, E-mail: manuel.f@flores.com

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management, aimed at redistributing pressure and protecting the affected joint. Offloading strategies reduce the mechanical stress on the affected foot, which has been shown to prevent deformity progression and preserve joint integrity [8]. Studies suggest that, when combined with immobilization, orthotics can reduce the risk of joint collapse by approximately 30-40%.

Pharmacological treatment, particularly the use of bisphosphonates, has shown promise in reducing bone resorption and preventing further joint collapse. Bisphosphonates, such as alendronate and zoledronic acid, have been found to improve bone mineral density and reduce the inflammatory response in the acute phase of CNA. Several studies have reported that bisphosphonates can reduce the time required for disease stabilization, with some showing improvement in healing time by up to 20-30%. For patients in the early stages of CNA, conservative management is highly effective, with 70-80% of patients experiencing satisfactory outcomes, including stabilization and reduction of symptoms. However, in patients with advanced deformities or extensive joint involvement, non-surgical approaches alone are often insufficient to restore function or prevent long-term complications [9]. Surgical intervention is generally reserved for patients with advanced deformities, persistent joint instability, or those who fail to respond to conservative measures. Common indications for surgery include significant deformity, non-union, or the presence of ulcers or infections that cannot be managed conservatively. The need for surgery is determined by the extent of joint damage, the patient's level of pain, and their functional goals. The most common surgical procedure for Charcot neuroarthropathy, especially in the foot and ankle, is joint fusion. This procedure is particularly effective for preventing further deformity and providing stability. Tarsal joint fusion, including ankle, subtalar, and first metatarsophalangeal joint fusion, is commonly performed in patients with extensive joint collapse or instability. The success rate of joint fusion is high, with 90-95% of patients achieving good to excellent outcomes, including pain relief, improved function, and stability.

However, in patients with advanced deformities or joint instability, surgical intervention becomes necessary. Joint fusion remains the most effective surgical procedure for stabilizing the affected joint and restoring function. While reconstructive surgeries offer functional improvements in cases with less severe joint destruction, amputation is often the last resort for patients with extensive joint collapse or persistent infection. The outcomes of both surgical and non-surgical interventions depend heavily on the stage of the disease at diagnosis, the patient's overall health, and their adherence to post-operative protocols. A multidisciplinary approach that includes both medical and surgical specialists, as well as rehabilitation therapists, plays a crucial role in optimizing outcomes and minimizing complications [10]. Patient education, particularly regarding weight-bearing restrictions, the importance of early intervention, and rehabilitation, is key to improving long-term function and quality of life. Ultimately, a personalized treatment plan, based on the individual patient's needs and the extent of the disease, is essential for managing Charcot neuroarthropathy. With appropriate interventions, the majority of patients can achieve satisfactory functional outcomes and avoid the

most severe consequences of the disease.

Conclusion

Charcot neuroarthropathy (CNA) is a complex, progressive condition that poses significant challenges in both diagnosis and management, particularly for individuals with peripheral neuropathy, such as those with diabetes mellitus. Early detection and prompt intervention are critical in preventing the rapid progression of joint destruction and deformity. Non-surgical interventions, including immobilization, offloading, custom orthotics, and pharmacological treatments such as bisphosphonates, remain the cornerstone of management in the early stages, with high success rates in stabilizing the joint and preventing further complications. For patients with more advanced disease or those who fail to respond to conservative measures, surgical options such as joint fusion, reconstructive procedures, and, in extreme cases, amputation, are effective in restoring function and alleviating pain. While surgical interventions have a high success rate, they come with inherent risks, and the decision to proceed with surgery should be carefully considered in consultation with a multidisciplinary team, including orthopedic surgeons, podiatrists, and rehabilitation specialists.

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Interest of Conflict

None

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