



## RESEARCH ARTICLE

### EVALUATION OF THE TREATMENT OF NON-UNION AND / OR PSEUDOARTHROSIS OF LONG BONES IN THE ORTHOPEDIC SERVICE OF CEMENAV IN A PERIOD FROM JANUARY 2016 TO JANUARY 2019

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#### ABSTRACT

**Introduction:** A pseudoarthrosis is established after a minimum of nine months after the trauma without progressive visible signs of consolidation for three months<sup>1</sup>. The treatment of nonunion of fractures is expensive, with an estimated cost per case between £ 7,000 and £ 79,000 (\$ 10,000 to \$ 114,000) <sup>2</sup>. There is currently no surgical technique that is considered standard for the treatment of this pathology **Objective:** To determine the effectiveness of the mixed stabilization treatment with a central medullary nail + external fixator in the patients of the Naval Medical Center based on the radiological consolidation time. **Method:** Study where the effectiveness of mixed surgical treatment for pseudoarthrosis and / or nonunion was evaluated in 21 patients who met inclusion criteria for the surgical procedure from 2016 to 2019 at the Naval Medical Center of Mexico City. Under informed consent. **Results:** This study included 21 patients who were cared for by the Traumatology and Orthopedics service of the Naval Medical Center, who met the inclusion criteria to be part of this study. The gender distribution in the analyzed patients was predominantly male with n = 17 (81%) and female with n = 4 (19%). The area of injury of the affected limb was n = 12 (57%) for the femur bone and n = 9 (43%) for the tibia bone. Without showing a significant relationship between the affected bone and the healing time. The hypertrophic type was the most common with a frequency of 14 cases (67%), 33% corresponded to the hypotrophic type (n = 7). **Conclusions:** The mixed surgical fixation and stabilization treatment used in this hospital for the management of pseudoarthrosis was adequate since we obtained an effectiveness of 90.47%, thus providing us with adequate safety in its use.

#### INTRODUCTION

Historically, the definition of late union and nonunion are related to the time of union. If a fracture does not heal within a generally adequate period of time, it is first considered late union. Despite the slow and delayed process of fracture healing, it is still possible to perform without surgical intervention. Unlike nonunions, bone healing cannot be expected without surgical intervention. According to the United States Food and Drug Administration (FDA), a pseudoarthrosis establishes itself after a minimum of nine months post-trauma with no visible signs of progressive consolidation for three months<sup>3</sup>. In analyzing the socioeconomic situation of nonunions, the direct and indirect costs of treatment and losses in productivity must be taken into account. Antonova et al. They found in their study an average total cost of care of US \$ 25,556 for nonunions of the tibial shaft compared to US \$ 11,686 for those with union of tibial shaft fractures within 24 months of the fracture. Khunda et al. calculated £ 26,000 / patient for the direct costs of treating tibial nonunion in the UK.<sup>3</sup>

Another study conducted in the UK estimated direct treatment costs between £ 7000 and £ 79,000 per case for the National Health Service (NHS). Indirect costs are the key factor in patients with fracture and nonunion. Hak et al. They obtained an indirect record where the costs will be 67% to 79% in Canada and 82.8% to 93% in European Health Systems for the total costs of treatment.<sup>3</sup> The rate of nonunion varies greatly according to the different anatomical locations of the fracture, with a mean incidence rate of 4.93%. Considered a chronic condition in terms of pain and functional and psychosocial disability. The nonunion of some fractures can reduce the quality of life and even increase the risk of death.<sup>4</sup> The surgical treatment of nonunions continues to represent a challenge for the patient and the surgeon, this associated with significant costs for the health care system.<sup>3</sup> In series reported in the literature about surgical techniques, including plastic and reconstructive surgery techniques that are considered limb-preserving procedures, there are extensive excision of non-viable soft tissues and sequestration, the use of autologous bone grafts and tissue flaps. Advances in the development of orthopedic implants have contributed to achieving adequate stabilization of bone fragments, thus reducing the risk of damage to the blood vessels, the periosteum. Currently the

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implants used to stabilize nonunions are external fixators, bone plates or intramedullary nails.<sup>5</sup>

prone to lower limb fractures due to the high rate of accidents where they are involved.

**MATERIAL AND METHODS**

This study was carried out at the Naval Medical Center in Mexico City, between 2016 and 2019. Through a systematic review of the clinical records of patients with a diagnosis of nonunion and / or pseudoarthrosis, who were subjected to mixed treatment due to failure of the primary treatment of the fracture by the department of Traumatology and Orthopedics. All patients were operated on by the same Orthopedic surgeon, in the pseudoarthrosis module. For convenience: because all patients undergoing mixed stabilization treatment were taken, without taking any statistical criteria.

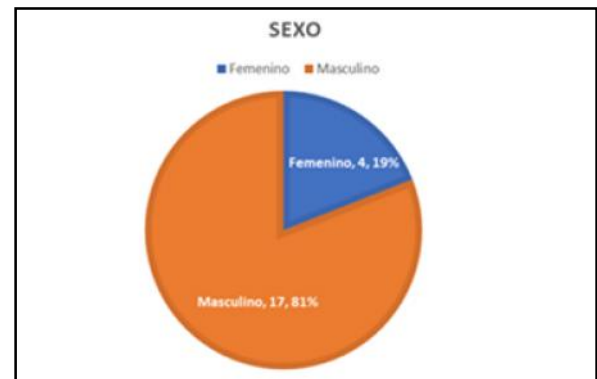


Figure 1. Shows the distribution of the sex of the patients

**INCLUSION CRITERIA**

- ) Patients over 18 years of age.
- ) Patients with radiographically demonstrated skeletal maturity by physis closure
- ) Patients with diaphyseal long bone fractures who have undergone surgery at the Naval Medical Center in the period from January 1, 2016 to December 31, 2019
- ) Patients with or without controlled chronic degenerative diseases me. Active military patients and beneficiaries
- ) Patients with Naval Medical Center registration and signing the informed consent.

The area of injury of the affected limb was n = 12 (57%) for the femur bone and n = 9 (43%) for the tibia bone. Without showing a significant relationship between the affected bone and the healing time. This distribution is represented in figure 2. The most commonly reported fracture site of the affected areas was the middle third with a total frequency of n = 13 (62%), followed by the distal third with n = 6 reported patients (29%) and only 2 patients with injury in the proximal third (2%).

**EXCLUSION CRITERIA**

- ) Patients with a pathology other than a diaphyseal long bone fracture
- ) Patients with psychiatric or organic illness that he cannot decide for himself.
- ) Patients who do not have radiographically demonstrated skeletal maturity
- ) Patients who withdrew or desisted from participating in the study.

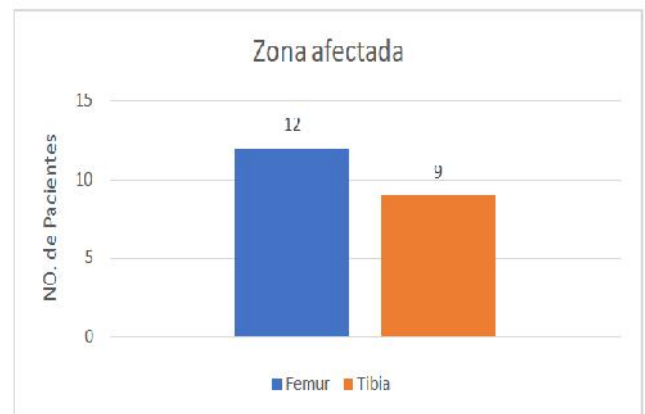


Fig. 2. Distribution of the number of patients and the frequency of lesions found for each case

**DISPOSAL CRITERIA**

- ) Patients who did not attend an outpatient clinic during their evolution
- ) Patients who died during treatment of fractures
- ) Pregnant patients

The most common cause of injury was traffic accidents with 71% (n = 15), the second cause of injury with 19% was falls (n = 4) and finally 10% of the patients analyzed (n = 2) were caused by gunshot wounds as shown in figure 4.

Percentages, frequencies, mean, and standard deviation were performed to describe the demographic variables, and Fisher's Exact tests were performed to search for the association of qualitative variables. In data analysis, the GraphPad Prism v5 program was carried out. Statistical significance was taken at a p value 0.05.

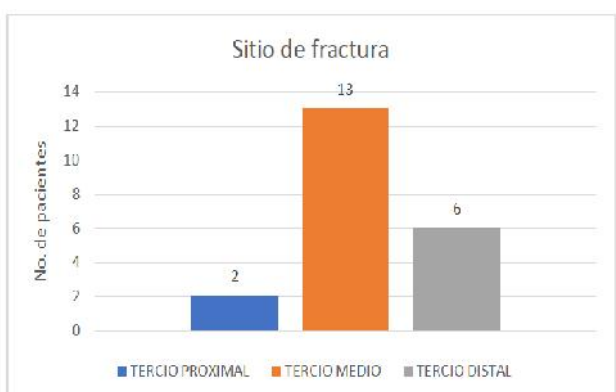


Figure 3. Anatomical sites of the long bone where the

**RESULTS**

This study included 21 patients who were cared for by the Traumatology and Orthopedics service of the Naval Medical Center, who met the inclusion criteria to be part of this study. The gender distribution in the analyzed patients was predominantly male with n = 17 (81%) and female with n = 4 (19%). The distribution of sex, as clearly observed is male, this may be due to the fact that the male sex is predominantly more

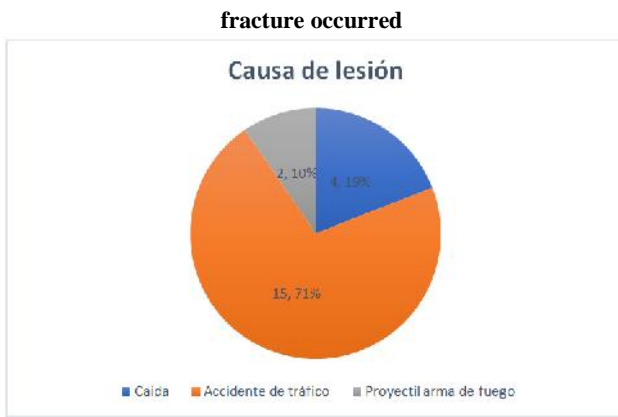


Figure 4. Causes of injury

Traffic accidents were the main cause of injury with 71% of cases, so this may be the cause of the predominance of males in the cases studied.



Fig. 5. Types of pseudoarthrosis

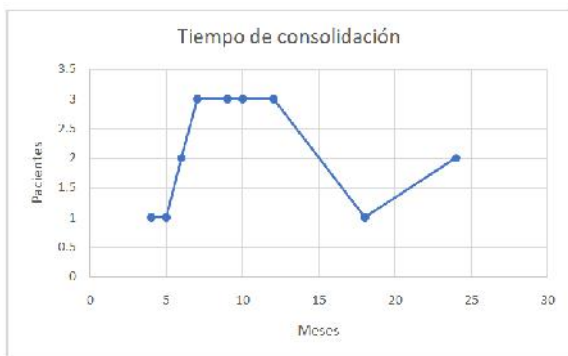


Fig. 6. Consolidation time in months

For the pseudoarthrosis variable, it was subdivided into the classification of hypertrophic or hypotrophic, the former being the most common with 67% of cases. The hypertrophic type was the most common with a frequency of 14 cases (67%), 33% corresponded to the hypotrophic type (n = 7). Consolidation timeline (in months) was traced after surgery, with an average of 10.5 months. The fastest consolidations took 4 to 5 months, the average was 10.5 months, reaching up to 24 months, 2 cases of patients who did not consolidate and reached amputation were also reported.

DISCUSSION

The rates of general nonunion of fractures are estimated between 1.9% and 10%. It is hypothesized that 100,000 fractures progress to nonunion each year in the United States.

A recent study from Scotland found 4,895 cases of nonunion treated in hospitalized patients between 2005 and 2010, averaging 979 per year, with an overall incidence of 18.94 per 100,000 population per year.3 Patient comfort and success rates can be positively influenced by the additional use of internal fixation devices.3 This investigation evaluated the level of success achieved with the external fixation technique complemented with internal fixation with a change of the centromedullary nail and autologous graft, applied to 21 patients, managing to provide a criterion for its use in this surgical procedure in our institution, as well as in the other hospitals of the republic that belong to the Secretary of the Navy, since there is no treatment indicated as standard for this pathology, given its important relevance and frequency.

We obtained an effectiveness of 90.47%, higher than that reported in 2009 by Wu 11 reported a consolidation rate of 89% for 18 aseptic and atrophic supracondylar femoral nonunions with in situ plate and screw fixation treated with implant extraction, debridement, a nail 12 mm diameter retrograde with 1 mm scarification, dynamic locking and autogenous bone graft. Also close to that reported in 2009 by Megas and colleagues who reported a 97% consolidation rate for 30 aseptic nonunions of the femoral shaft (25 atrophic) with an in situ plate treated with implant extraction, debridement, bone graft in cases atrophic and antegrade intramedullary nailing.9

No differences were observed (p> 0.05) in comorbidities since most of the patients were young adults, for which they did not present comorbidities, and no significance was observed regarding the habit of smoking or alcoholism in terms of the time of consolidation. I mean. The distribution of sex, as clearly observed is male, this may be due to the fact that the male sex is predominantly more prone to lower limb fractures due to the high rate of accidents where they are involved. Traffic accidents were the main cause of injury with 71% of cases, so this may be the cause of the predominance of males in the cases studied. The area of injury of the affected limb was n = 12 (57%) for the femur bone and n = 9 (43%) for the tibia bone. Without showing a significant relationship between the affected bone and the healing time. Our average consolidation period of consolidation was 10.5 months. Higher than reported in nail exchange procedures, statically locked (7.3 months) versus dynamically locked (7.9 months) .3

Conclusion

A. The mixed surgical fixation and stabilization treatment used in this hospital for the management of pseudoarthrosis is effective since we obtained an effectiveness of 90.47%, thus providing us with adequate safety in its use. B. Experience in this surgical field must continue to be created in order to define and analyze its indications, results, and complications.

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