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(RESEARCH ARTICLE)

Management controversies of fractures of the Lateral Third of the Clavicle: About 38 patients

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Abstract

Introduction: Clavicle fractures are a common condition, accounting for approximately 2.6 to 5% of all fractures in adults. Among these, fractures of the distal third, although less common than those of the middle third, present specific diagnostic and therapeutic challenges due to their anatomical and biomechanical complexity

Materials and Methods: A retrospective study was conducted in the Department of Orthopedic Trauma Surgery (AILE 4) at Ibn Rochd University Hospital in Casablanca to analyze fractures of the distal third of the clavicle and evaluate diagnostic and therapeutic approaches, as well as their clinical and radiological outcomes, in 38 patients admitted to the department between January 2018 and September 2024.

Results: The mean age was 37 years, with a large male predominance (81.6%).

All patients, or 100%, presented with symptoms typical of upper extremity trauma, including total functional impairment, as well as pain upon the slightest palpation of the distal part of the clavicle and the acromioclavicular joint.

No vascular or nerve injuries were observed in our patients.

The cases were distributed as follows: Type I (11%), Type II with subtypes

IIA (42%) and IIB (39%), and Type III (8%).

In our series, the clavicle fracture was isolated in 77% of cases, whereas in 23% of cases we dealt with patients with multiple trauma.

Surgical treatment was the most common therapeutic approach, accounting for 86% of patients, while orthopedic treatment was used in 14% of cases. Orthopedic immobilization was performed using an elbow-to-body brace in all patients.

The average healing time was 12 weeks.

The results were good or excellent in 90% of cases, fair in 7%, and poor in only 3%.

Discussion: Our study, consistent with the literature, showed generally satisfactory results but also highlighted the importance of appropriate management and rigorous postoperative monitoring to minimize complications. Finally,

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advances in surgical techniques and rehabilitation protocols, combined with a better understanding of biomechanics, continue to improve long-term outcomes for these complex fractures.

Conclusion: Multidisciplinary management combined with informed treatment decisions remains the key to a favorable prognosis, with priority given to restoring function and ensuring patient comfort.

Keywords: Clavicle; Lateral third; Osteosynthesis; Surgery

1. Introduction

Clavicle fractures are a common condition, accounting for approximately 2.6% to 5% of all fractures in adults. Among these, fractures of the distal third, although less common than those of the middle third, present specific diagnostic and therapeutic challenges due to their anatomical and biomechanical complexity. This specific location, close to the acromioclavicular joint and the coracoclavicular ligaments, exposes these fractures to an increased risk of instability and functional complications.

Diagnosis relies on a thorough clinical evaluation and the essential use of medical imaging, particularly standard X-rays, supplemented in some cases by CT scans.

Treatment options, meanwhile, vary depending on the classification of the fractures, their stability, as well as the patient's age and functional needs. Conservative treatment remains an option for stable fractures, but surgical indications have expanded considerably in recent years with the development of innovative techniques and specialized implants, such as anatomical or hook plates, as well as the ENDOBUTTON system.

The management of this type of fracture remains a subject of controversy, pitting authors who advocate conservative treatment against those who prefer surgical intervention, given the risks and complications associated with the latter.

1.1. Hypothesis

Surgical treatment is the treatment of choice despite the short-, medium-, and long-term risks.

The objective of this study is to thoroughly explore fractures of the lateral third of the clavicle by examining the various diagnostic and treatment modalities available, analyzing the clinical and radiological outcomes obtained after treatment, and comparing these results with data from the literature to evaluate the effectiveness of current approaches and identify areas for improvement.

2. Materials and Methods

2.1. Nature, Location, and Period of the Study:

This is a descriptive study. It involved the analysis of a series of 38 patient records of patients admitted to the trauma and orthopedic surgery department (Wing 4) at Ibn Rochd University Hospital and followed up in outpatient clinics for fractures of the outer third of the clavicle. This study covered a 6-year period from early January 2018 to late September 2024.

2.2. Data collection tool:

- The registry of patients hospitalized in the Trauma Department, Wing 4, was used to collect the data
- The documents were formatted and the data entered using Microsoft Word and Excel.
- Data analysis was performed using Jamovi software.
- The literature review was conducted using the following search engines: Google Scholar, PubMed, and EMC.

2.3. Study population

2.3.1. Inclusion criteria

Adult subjects with a fracture of the outer third of the clavicle who underwent orthopedic or surgical treatment and were followed up during outpatient visits with clinical and radiological examinations.

2.3.2. Exclusion criteria

- Incomplete or missing records.
- Patients discharged against medical advice.
- Fractures of the outer third of the clavicle in subjects under 15 years of age.

3. Results

3.1. Epidemiological data:

3.1.1. Gender

- Of our 38 cases:
- 31 cases were male, representing 81.6%.
- 7 cases were female, representing 18.4%.

3.1.2. Age

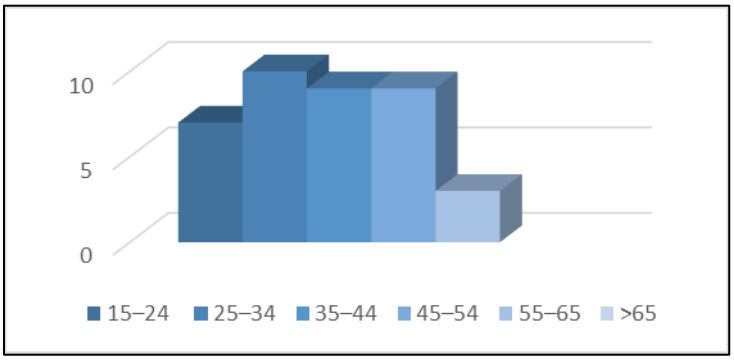

Figure 1 Distribution of cases by age

3.1.3. By affected side:

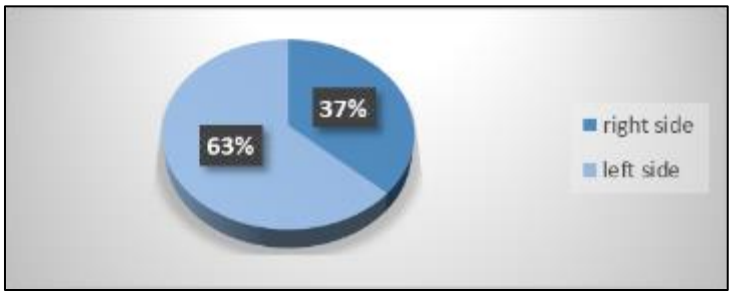

Figure 2 Distribution of fractures by affected side

Analysis of the affected side reveals that in:

- 24 cases, the left side was affected, representing 63.2%.
- 14 cases the right side was affected, representing 36.8%.

3.1.4. By etiology

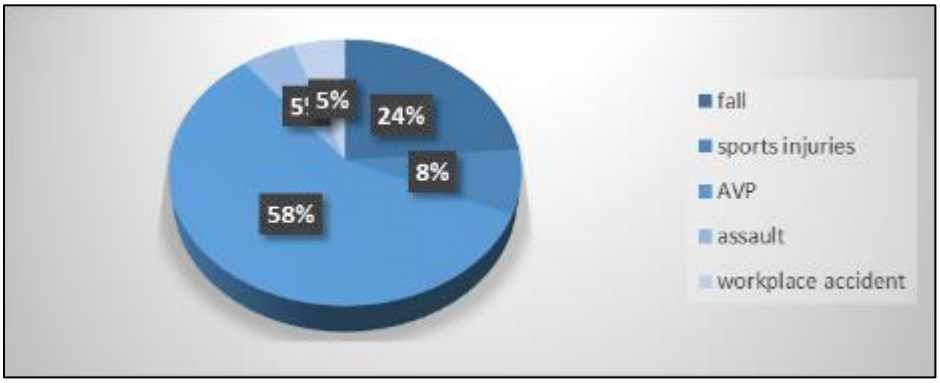

Figure 3 Distribution of cases by etiology

Traffic accidents were the most common cause in our series, accounting for 57.9%, followed by sports injuries and household accidents.

3.2. Clinical data

3.2.1. Functional signs

Shoulder pain, the primary functional sign associated with total functional impairment, was present in all of our patients, representing 100% of our cases.

3.2.2. Physical signs

Table 1 Physical signs presented by our patients

Lesion	Percentage
Trauma-related presentation	100%
Edema	47.3%
Deformity	63.1%
Skin opening	5%
Vascular-nerve injury	0%

3.3. Classification

Table 2 Distribution of cases by fracture type

Classification		No. of cases	Percentage
Type I		10	26.3%
Type II	IIA	13	34.2%
	IIB	12	31.6%
Type III		3	7.9%

3.4. Treatment

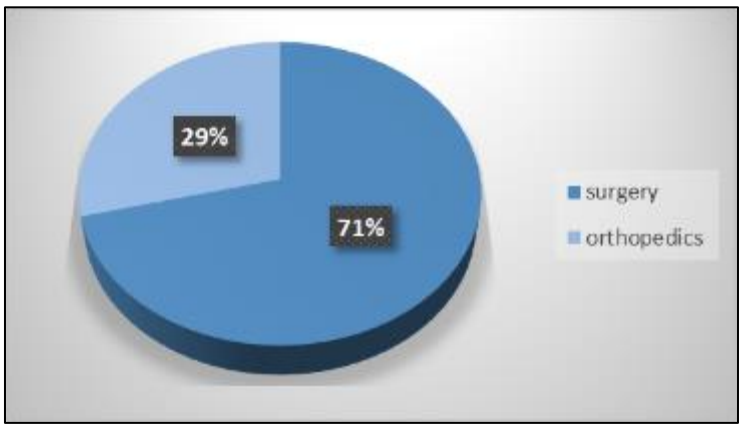

Figure 4 Distribution of Treatment

In our study, surgical treatment was the most common therapeutic approach, accounting for 71.1% of patients, while orthopedic treatment accounted for 28.9% of cases.

3.4.1. Surgical Methods

The available osteosynthesis methods are:

- Screw plate:
  - S-shaped plate
  - Third-party tube plate
  - Hook plate
- Pins:
  - - Intramedullary pinning
  - - Tension pinning

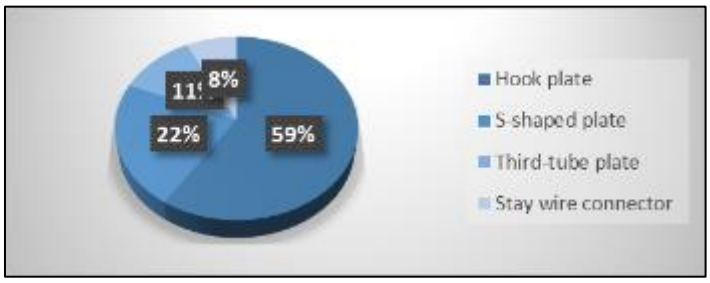

Figure 5 Distribution of osteosynthesis techniques used in our study

3.4.2. Length of hospital stay

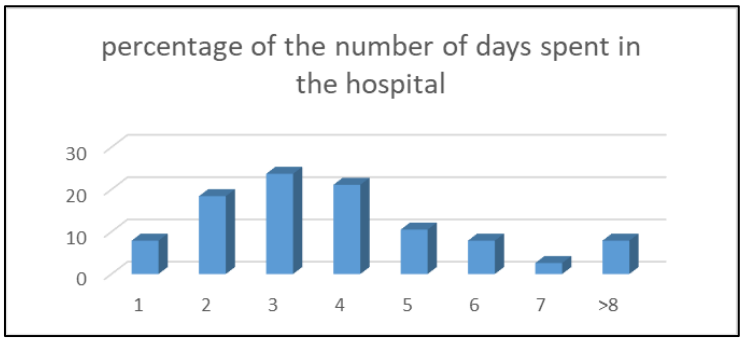

Figure 6 Length of hospital stay in days

We found that the average length of hospital stay in the trauma unit was approximately 4 days.

3.4.3. Postoperative immobilization:

Immobilization using a simple sling or elbow-to-body bandage was the most commonly used method in our series. All of our patients received postoperative immobilization using a simple sling.

3.4.4. Rehabilitation:

All patients underwent a rehabilitation program supervised by a physical therapist, consisting of two sessions per week over a six-week period, including:

- An immobilization phase,
- A phase of restoring joint range of motion,
- A muscle strengthening phase.

3.5. Progress and prognosis:

3.5.1. Immediate Complications:

The immediate postoperative course has generally been uneventful for the majority of our patients. However, certain complications may occur:

Infection (4%):

In our series, we observed:

A single case (4%) of early postoperative superficial infection, resolved with local treatment.

Respiratory:

The close proximity of the clavicle to the lungs behind it exposes them to direct complications, such as pneumothorax or hemopneumothorax.

-No cases of pulmonary complications were reported in our series.

Immediate neurovascular:

A potentially serious complication resulting from stretching or rupture of the roots or secondary trunks of the brachial plexus, or from injury to the subclavian artery or vein in fractures with significant displacement.

No cases of neurological or vascular complications were observed.

Complications related to osteosynthesis materials:

We observed, in a single patient, displacement of the osteosynthesis hardware (hooked plate), leading to a revision surgery performed on the same day.

3.5.2. Late complications

Pseudarthrosis:

It is defined as the failure of a fracture to heal within six to nine months.

In our series, we noted 3 cases of pseudarthrosis, representing 8% of cases:

- 2 cases of pseudarthrosis with a body-mounted elbow brace occurring after 6 months.
- 1 case of pseudarthrosis following an S-shaped screw plate fixation that occurred after 8 months.

Malunion

In the vast majority of cases, they are asymptomatic. When they manifest clinically, they may present as signs of neurovascular compression, discomfort during exertion, chronic pain, muscle weakness, or simply unpleasant sensations in the shoulder.

A single case of malunion was found in a patient treated orthopedically.

Shoulder stiffness:

This primarily affects the elderly and results from various causes, such as prolonged immobilization of the shoulder as part of orthopedic treatment or insufficient rehabilitation following surgery on the clavicle.

In our study, we identified 3 cases of shoulder stiffness.

Complications related to osteosynthesis materials:

No complications related to osteosynthesis hardware were observed in our patients.

3.6. Clinical results:

3.6.1. Functional outcome:

Our results were evaluated using the clinical scoring of both shoulders according to the system described by CONSTANT Components of the Constant score:

Pain:

- 25 patients (83%) reported no pain on examination.
- 2 patients (7%) reported minimal pain.
- 3 patients (10%) reported moderate pain.

The results regarding postoperative pain are summarized in the following diagram:

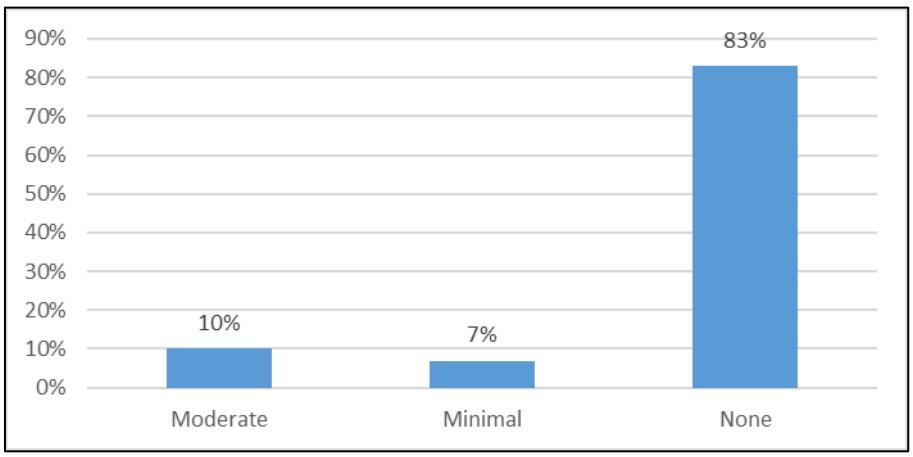

Figure 7 Postoperative shoulder pain scores according to the CONSTANT rating scale

Occupation:

- Occupation:

Only one of the 30 patients had to change professions due to their fracture. (Bricklayer)

- Sports and leisure activities:

Of the 30 patients, only 1 had to stop swimming and another had to stop weight training, representing 6%.

- Sleep disturbances:
- One patient experienced sleep disturbances, representing 3%.
- Hand function:The hand could be easily raised above the head in 27 cases.
- The hand did not extend beyond the head in 2 patients and did not extend beyond the neck in one other.

Active range of motion:

Two patients exhibited limited external rotation.

Internal rotation was reduced in 3 cases: the back of the hand reached the level of D12 in 2 cases, not extending beyond L3 in the other case.

Muscle strength:

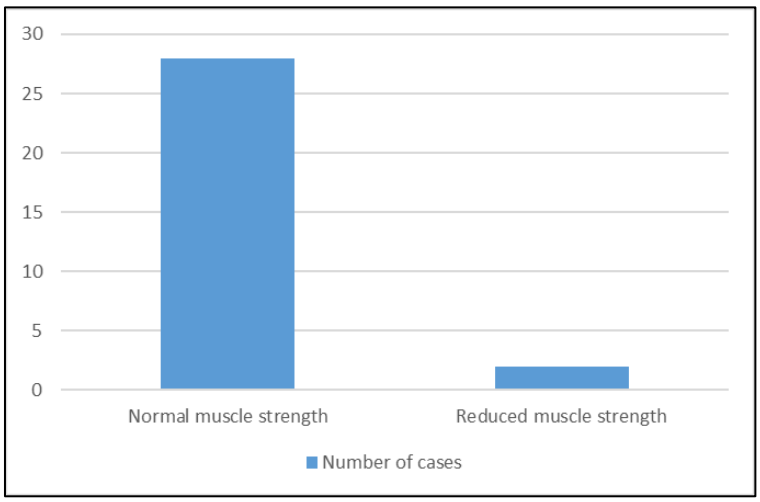

Figure 8 Results of the level of manual activity postoperatively According to the CONSTANT scoring system

3.6.2. Overall objective result

The assessment of the final outcome is based on a comparative analysis of the Constant index between the operated side and the unaffected side, i.e., the difference, which corresponds to what the operated shoulder lacks to be identical to the unaffected shoulder.

Table 3 Objective qualitative assessment of the result according to CONSTANT based on the difference between the CONSTANT index on the operated side and that on the opposite healthy side

Deficit	**Moderate**		**Moderate**	**Severe**
Differential (contralateral CI–operated side CI)	≤10	≤20	≤30	≤30
Result	Excellent	Good	Average	Poor

To simplify this study, we have grouped the excellent and good results under a single criterion.

Table 4 Functional results according to CONSTANT's rating

Functional outcome	**Number of cases**	**Percentage (%)**
Excellent/good	27	90%
Average	2	7%
Poor	1	3%

4. Discussion

4.1. Epidemiology

4.1.1. Gender

The data show a clear male predominance among the authors of studies on fractures of the outer third of the clavicle, with a sex ratio ranging from 1.3 to 5.3. In our series, 82% of the authors are men, with a sex ratio of 4.5, reflecting an underrepresentation of women. This disparity may be explained by greater male exposure to high-risk activities, as well as by cultural and anatomical factors.

Table 5 Comparison of the distribution of cases by gender with the authors**.**

Authors	Men	Women	Sex ratio
Largo et al(1)	84%	16%	5.3
Cho et al (2)	58.1%	41.9%	1.4
Raval et al (3)	56%	44%	1.3
Hickland et al(4)	63.6%	36.4%	1.75
Renger et al (5)	66%	34%	1.95
Webber and Haines (6)	73%	27%	2.7
Our series	82%	18%	4.5

4.1.2. Age

In our series, the mean age of patients is 37 years, similar to the results reported by Cisneros and Reiriz (36 years) and Renger et al. (38.4 years). It is higher than those reported by Hickland (26 years) and Webber and Haines (29.8 years), reflecting younger populations that are likely more prone to sports-related injuries. In contrast, series such as those by Raval (57 years) and Largo (43 years) involve older patients, in whom falls are a common mechanism of injury.

Table 6 Mean age of fractures of the outer third of the clavicle

Authors	Mean age (years)
Largo et al(1)	43
Raval et al (3)	57
Cisneros and Reiriz (7)	36
Renger et al (5)	38.4
Webber and Haines (6)	29.8
Hickland et al (4)	26
Our series	37

4.1.3. Etiology

In the analysis of fractures of the outer third of the clavicle by etiology, significant variations are observed across studies. For example, Renger et al.(5) report a predominance of traffic accidents (43%) and sports-related accidents (41%), while Vaishya et al.(8) note a high rate of traffic accidents (67%). The study by Raval et al.(3) reveals a prevalence of falls (86%), and that by Webber and Haines(6) (73%) follows a similar trend combining road traffic accidents and sports-related accidents.

In our series, road traffic accidents (58%) and falls (24%) are the most common causes. These differences may be attributed to geographical, demographic, or lifestyle factors, highlighting the importance of tailoring prevention and treatment strategies to the predominant etiology.

Table 7 Illustration of the main causes of fractures of the outer third of the clavicle

Authors	Sports injuries	AVP	Work-related accidents	Falls
Renger et al (5)	41%	43%	2%	14%
Vaishya et al (8)	6%	67%	-	27%
Webber and Haines (6)	73%		-	-
Raval et al. (3)	3%	6%	5%	86%
Our series	8%	58%	5%	24%

4.2. Treatment approaches

4.2.1. Orthopedic treatment

Indications

According to the Neer classification(9) , the indication for conservative treatment is therefore limited to Type I and Type III fractures, where the bone fragments remain stable due to the integrity of the coracoclavicular ligaments, with no displacement or only slight displacement.

Methods

According to the study by Kim et al.(12) , conservative treatment of distal clavicle fractures involves immobilization using a sling or a figure-of-eight bandage. Recently, slings have become more commonly used due to the comfort they offer patients. Figure-of-eight bandages are not associated with better outcomes and have several disadvantages.

The review of current concepts by van der Meijden et al(13) shows that non-surgical management of lateral clavicle fractures yields good results in up to 98% of cases of minimally displaced or non-displaced fractures

4.2.2. Surgical treatment:

Indications:

- **Displaced and unstable fractures:**

According to Neer et al.(9) , Type 2B fractures, characterized by a rupture of the coracoclavicular ligaments, result in significant mechanical instability, with a high rate of pseudarthrosis reaching 30% to 45% with conservative treatment. Robinson and Cairns(10) also reported that unstable fractures, types II and III, benefit from surgical fixation to improve union rates.

Rokito et al.(11) and Kim et al.(24) note that the best approach to managing Neer Type II fractures remains controversial. The indication for surgery is therefore based on displacement and instability.

- **Open Fractures**

Open fractures expose the patient to an increased risk of infection and bone loss. The literature, including the work of Kona et al.(14) , recommends open reduction and immediate internal fixation to prevent infectious complications and optimize union.

- **Neurovascular complications**

Studies report that fractures of the distal third associated with neurovascular injuries (brachial plexus or subclavian vessels) require urgent surgical intervention. Bezer et al.(15) emphasize that early fixation reduces the risk of secondary injuries due to fracture instability.

- **Multiple trauma and associated fractures**

In cases of multiple trauma, clavicle fractures combined with rib fractures or acromioclavicular joint dislocation warrant surgical stabilization. Data from the Canadian Orthopaedic Trauma Society (COTS) multicenter study led by Axelrod et al.(16) in 2021 show that this approach improves the patient's overall rehabilitation.

- **General indications**

In our series, 71% of patients underwent surgical treatment, including 25 Type II patients (66%) and 2 Type III patients (5%). This approach is consistent with the literature, which recommends surgery for unstable fractures to prevent pseudarthrosis. However, our rate of surgical treatment is higher than in some studies, where Type II fractures were treated conservatively with good results. This difference may reflect a selection of younger or more active patients, for whom surgery is preferred.

Thus, each case of clavicle fracture must be evaluated individually. The treatment decision must take several criteria into account, while incorporating the patient's needs and preferences.

4.3. Outcome

4.3.1. Orthopedic treatment

Stable fractures (Neer type I and III) with little or no displacement heal favorably with simple immobilization (slings or figure-of-eight bandages) for 2 to 6 weeks.

Studies, notably those by Robinson and Cairns(10) , report a high union rate (approximately 98%) for these fractures. However, complications such as asymptomatic pseudarthrosis (15–22%) or chronic pain related to malunion may occur.

4.3.2. Surgical treatment

For unstable fractures (Neer types II and V), surgical treatment provides reliable mechanical stabilization and rapid union. Techniques include osteosynthesis using an anatomical plate, a hook, or a wire.

According to Flinkkilä et al (17), surgical treatment significantly improves functional outcomes, with a union rate close to 100% and optimal functional scores (Constant-Murley Score often >90). However, the risk of secondary complications (implant displacement, infection) is reported to be between 5 and 15%.

5. Conclusion

Our study, in line with the literature, showed generally satisfactory results but also highlighted the importance of appropriate management and rigorous postoperative monitoring to minimize complications. Finally, advances in surgical techniques and rehabilitation protocols, combined with a better understanding of biomechanics, continue to improve long-term outcomes for these complex fractures.

In conclusion, multidisciplinary management combined with informed therapeutic decision-making remains the key to a favorable prognosis, with priority given to restoring function and ensuring patient comfort.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

"Informed consent was obtained from all individual participants included in the study."

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