



DIAPHYSEAL FRACTURES OF THE CLAVICLE

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ABSTRACT

Introduction: clavicle fractures are common, especially in people under 25 years of age involved in sports, falls from heights or traffic accidents. Traditionally they were treated orthopedically, reserving surgery for exceptional cases. However, recent studies have shown that orthopedic treatment may increase the incidence of complications.

Objective: to detail current information related to diaphyseal clavicle fractures, anatomy, mechanism of action, etiology, epidemiology, classification, evaluation, treatment and complications.

Methodology: a total of 30 articles were analyzed in this review, including review and original articles, as well as clinical cases, of which 17 bibliographies were used because the other articles were not relevant to this study. The sources of information were PubMed, Google Scholar and Cochrane; the terms used to search for information in Spanish, Portuguese and English were: clavicle fractures, shoulder fractures, shoulder trauma, upper limb fractures, clavicular osteosynthesis.

Results: clavicle fractures represent between 2% and 10% of all bone fractures, affecting mainly young active and elderly people due to low energy falls. The most frequent mechanism of trauma is a direct fall on the shoulder, which produces a fracture in 85-94% of cases, with the middle third fracture being the most prevalent (69%). Treatment depends on the type of fracture: non-displaced fractures are managed conservatively with immobilization, while displaced fractures, especially in the distal third, may require surgery. Osteosynthesis with plate and screws is the standard approach for diaphyseal fractures, while intramedullary stabilization with elastic titanium pins shows good results, especially in pediatric patients.

Conclusions: the clavicle is an anatomically vulnerable bone due to its subcutaneous location and the absence of significant muscular protection, which makes it susceptible to fractures due to direct trauma, especially in falls on the shoulder. Clavicle fractures account for a significant proportion of bone fractures, with the middle third being the most affected region in particular. Treatment of clavicle fractures should be tailored to the severity and location of the fracture, with a clear preference for a conservative approach in nondisplaced fractures of the middle third. However, in cases of displaced or complicated fractures, surgery, either by plate osteosynthesis or intramedullary fixation, is recommended to ensure proper alignment and reduce the risk of complications such as malunion and functional limitation of the shoulder.

KEY WORDS: fracture, clavicle, trauma, osteosynthesis.

INTRODUCTION

Clavicle fractures are a prevalent condition, especially in people under 25 years of age who perform sports activities, suffer falls from heights or traffic accidents. Traditionally, these fractures were treated orthopedically, considering surgery only as an exception. However, over the years, some studies and observations have shown that orthopedic treatment can lead to a higher incidence of complications such as nonunion and pseudarthrosis.

Since the 2000s, surgery has gained popularity as a treatment option for clavicle fractures, due to its better results in terms of bone healing and reduction of long-term complications. Plate and screw fixation is the standard treatment, although it has disadvantages such as increased soft tissue invasion and risk of nerve injury. In response, more minimally invasive techniques have been explored, such as intramedullary fixation with titanium elastic nailing and the use of absorbable biodegradable plates. Clavicle fractures are relatively common injuries that

can occur in patients of all ages. Clinical history and physical examination remain the primary means of diagnosing this injury. Plain radiographs are helpful in confirming the diagnosis and providing information on fracture classification, prognosis, and treatment options. The management of clavicle fractures continues to be a challenge for orthopedists, especially considering the expectations of young, active patients, who seek early recovery and return(1-5).

METHODOLOGY

A total of 30 articles were analyzed in this review, including review and original articles, as well as cases and clinical trials, of which 17 bibliographies were used because the information collected was not important enough to be included in this study. The sources of information were Cochrane, PubMed and Google Scholar; the terms used to search for information in Spanish, Portuguese and English were: clavicle fractures, shoulder fractures, shoulder trauma, upper limb fractures, clavicular osteosynthesis.

The choice of bibliography exposes elements related to clavicle diaphyseal fractures; in addition to this factor, anatomy, mechanism of action, etiology, epidemiology, classification, evaluation, treatment and complications are presented.

DEVELOPMENT

Anatomy and mechanism of action.

The clavicle is a key bone in the human anatomy, which ossifies intramembranous from the fifth month of fetal development. It

is the first bone to form and its medial growth plate is the last to close at around 22 to 25 years of age. It has a characteristic “S” shape, with a medial convexity and lateral concavity. At its acromial end, it articulates with the scapula (shoulder blade) through the acromioclavicular and coracoclavicular ligaments, while at its sternal end it articulates with the sternum and is secured to the first rib by various ligaments, being key in the transfer of energy. between the trunk and the arm. This bone is particularly prone to fracture due to its subcutaneous location and lack of significant muscle protection, making it vulnerable to transmitted forces. Clavicle fracture involves misalignment of the bony fragments due to the action of adjacent muscles, such as the sternocleidomastoid (which pulls on the medial fragment) and the pectoralis major (which rotates and pulls on the lateral fragment). When the fracture does not heal properly, it can result in functional complications, such as winged scapula, alterations in the orientation of the glenoid and clavicle, and a limitation in the arc of motion of the shoulder girdle, which affects the functionality of the shoulder and arm. The most common trauma mechanism causing clavicle fractures is a fall or direct blow to the shoulder, which accounts for 85% to 94% of cases. When forces are transmitted through the outstretched arm and hand, without direct impact to the clavicle, the likelihood of fracture decreases considerably (only 2% to 5%). In young individuals, clavicle fractures generally occur due to high-energy trauma, such as those resulting from collision sports or traffic accidents. In contrast, in the elderly population, clavicle fractures usually result from low-energy falls or less intense displacements(2,6,7).

Figure 1. AP radiograph in skeletally mature individual, showing a fracture in the medial region of the left clavicle.



Source: The Authors.

Etiology

In 87% of reported cases, clavicle fracture results from a direct fall onto the lateral shoulder. Less frequently, fractures may result from direct trauma to the clavicle or from a fall on the outstretched hand.

Epidemiology

Clavicle fractures account for 2% to 10% of all fractures. Clavicle fractures affect 1 in 1000 people per year. The middle third of the clavicle is fractured in 69% of cases, the distal third is fractured in 28% of cases, and the proximal third is fractured in 3% of cases. The middle third of the clavicle accounts for 95% of fractures seen in children(8,9).



Classification

The clavicle is a key bone in the anatomy of the upper limb and its fracture, although common, can vary in severity depending on the mechanism of trauma and location of the fracture. The Allman and Neer classification provides a useful guide for the management of these fractures, and treatment should be tailored to the specific characteristics of each case. It is essential to assess and treat potential associated injuries, especially in the context of high-energy trauma, to avoid serious complications. Early rehabilitation and appropriate management of clavicle fractures can significantly improve functional prognosis.

Clavicle fractures are typically described using the Allman classification system, which divides the clavicle into three groups based on location. Fractures of the middle third or diaphysis fractures are in Group I (the most common), fractures of the distal or lateral third are in Group II, and fractures of the proximal or medial third are in Group III(10).

Allman's classification has subsequently been revised by Neer and includes the following:

Type 1 fracture in which there is minimal displacement. These fractures occur just outside the intact coracoclavicular ligament and are treated nonsurgically.

Type 2 fracture occurs when the medial fragment separates from the coracoclavicular complex. The fragment is displaced downward due to traction of the sternocleidomastoid muscle. The distal fragment is displaced cranially. This fracture produces an obvious deformity and has a high rate of pseudarthrosis.

Type 3 fracture is one in which there is no displacement of the fracture, but it extends into the acromioclavicular joint. Again, these fractures are treated nonsurgically. However, late degenerative changes in the acromioclavicular joint may occur, which may require excision of the distal clavicular segment(11).

Evaluation

In patients with clavicle injuries, a standard anteroposterior radiograph should be performed. A second radiograph with 45-degree cephalad tilt helps to better assess clavicle displacement and reduce overlap of the first rib and scapula. Although most fractures are visible with these views, in cases of less common proximal or distal fractures, a CT scan may be necessary.

Treatment/Management

In individuals with clavicle fractures, immediate orthopedic consultation is essential if there is neurovascular compromise, exposed fractures, tented skin, severe angulation, severe displacement, or any laceration near the fracture, indicating urgent surgery. Indications for surgery include displaced distal third type II fractures, shortening greater than 1.5 cm, floating shoulder, polytrauma or cosmetic complications. Once the associated injuries have been evaluated, treatment is based on analgesia, immobilization and follow-up.

In group I fractures of the middle diaphysis of the clavicle, conservative non-surgical treatment is the most common approach. Treatment of these fractures consists of supportive measures or reduction. In individuals with an increased risk of nonunion (due to fracture displacement, shortening of the clavicle, or comminution of the fracture) surgical fixation produces better patient outcomes relative to nonoperative treatment. Surgical fixation is achieved with open reduction with plate fixation or intramedullary fixation.

In group II distal clavicle fractures, patients should be immobilized with a simple sling or a sling and brace. Figure-of-eight bracing should be avoided, as it may increase fracture displacement. Definitive treatment is controversial, with some studies showing better results with surgical fixation, while others show similar results in patients treated non-surgically.

Non-displaced proximal clavicle fractures (group III) are managed conservatively, using a sling for support and comfort. Analgesics are recommended and the focus is on early recovery of range of motion. Displaced proximal fractures are uncommon because of the strong ligamentous support that sustains them. However, in 90% of cases of displaced proximal fractures, severe associated injuries are seen. If signs of neurovascular compromise are present, these fractures should be reduced immediately. In addition, it is essential to perform a detailed evaluation to detect possible injuries(12,13).

Orthopedic treatment: this is the optimal treatment option for non-displaced fractures and commonly consists of immobilization with a sling or an 8-shaped brace applied in the acute phase, maintaining immobilization for two to six weeks, according to the level of comfort. In adults, immobilization may be extended for up to three months. Some studies have shown high rates of symptomatic non-union (51.4%) and reduced shoulder function by Constant test (48.6%) after non-surgical treatment.

Surgical treatment: plate osteosynthesis remains the standard method for the surgical management of diaphyseal clavicle fractures, with high success rates and low complication rates. Several types of plates are available for this procedure: dynamic compression plates (DCP), tubular third shank plates, reconstruction plates, and anatomic clavicle plates, which are molded to the anatomy of the clavicle.

Intramedullary stabilization is the ideal technique from a biomechanical point of view, multiple intramedullary techniques exist, but their functional results appear to be inconsistent. Devices used include Hagie, Rockwood, Knowles, Steinmann, Herbert, Kirschner and the minimally invasive technique-intramedullary elastic nailing-using a titanium intramedullary elastic nail. Although the literature reports significant complications using the Steinmann, Hagie and Rockwood nails, reports regarding the complication profile of intramedullary nailing using the Titanium Elastic Nail (TEN) intramedullary elastic titanium nail appear more promising, reflecting significant improvement in shoulder function and pain reduction. The titanium intramedullary elastic nail has

been successfully used in the fixation of long bone fractures in pediatrics, whose main advantage lies in the fact that it can be

self-locked in the bone and provide three points of fixation within the clavicle in an S-shape(2,14,15).

Figure 2. Fluoroscopic image of the immediate surgical result after osteosynthesis with plate and screws in left clavicle.



Source: The Authors.

Complications

In clavicle fractures, serious complications are rare. Injury to the brachial plexus or subclavian vessels may occur at presentation or during healing and callus formation of the clavicle. Excessive callus formation can lead to compression of the brachial plexus, resulting in peripheral neuropathy.

The most common complication of clavicle fractures is malunion, or when the clavicle fracture heals with angulation, shortening or poor cosmetic appearance. Patients with malunion of clavicle fractures usually have full function and are not clinically significant. Some malunions may cause neurological or functional problems, especially if there is shortening greater than 2 cm. Complications of proximal third clavicle fracture include nonunion and posttraumatic arthritis(16,17).

CONCLUSIONS

The clavicle is an anatomically vulnerable bone due to its subcutaneous location and the absence of significant muscle protection, which makes it susceptible to fractures from direct trauma, especially in falls on the shoulder. Clavicle fractures account for a significant proportion of bone fractures, with the middle third being the most affected region in particular. Treatment of clavicle fractures should be tailored to the severity and location of the fracture, with a clear preference for a conservative approach in nondisplaced fractures of the middle third. However, in cases of displaced or complicated fractures, surgery, either by plate osteosynthesis or intramedullary fixation, is recommended to ensure proper alignment and reduce the risk of complications such as malunion and functional limitation of the shoulder.

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