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CASE REPORT

# Sternal fracture due to low-energy trauma with surgical treatment: a case report

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*sternal fracture; internal fracture fixation; trauma; chest wall reconstruction; bone fractures* (source: MeSH-NLM).

## ABSTRACT

Sternal fractures are rare and typically associated with high-energy trauma. This report describes the case of a 25-year-old male who presented with neck pain and swelling following a motorcycle accident. Computed tomography revealed an oblique fracture of the sternal manubrium with minimal displacement. Due to difficulties in pain management, surgical intervention was performed, involving fracture fixation with plates and screws. The procedure was successful and uneventful, with adequate postoperative pain control and early discharge. Although conservative management is the standard approach for sternal fractures, surgical intervention may be necessary to stabilize the fracture and improve respiratory mechanics, thereby preventing complications such as pseudoarthrosis. In this case, early surgery enabled a rapid and effective recovery. Current evidence supports plate and screw osteosynthesis as a safe and effective option in selected cases with poor pain control and displaced fractures.

# Fractura de esternón por traumatismo de baja energía con tratamiento quirúrgico: reporte de caso

***Palabras clave:***
*fractura de esternón; fijación interna de fracturas; traumatismo; reconstrucción de la pared torácica; fracturas óseas* (fuente: DeCs-BIREME).

## RESUMEN

Las fracturas esternales son raras y suelen asociarse a traumas de alta energía. Presentamos el caso de un paciente masculino de 25 años que, tras una caída en motocicleta, desarrolló dolor y edema en el cuello. La tomografía reveló una fractura oblicua del manubrio esternal con desplazamiento mínimo. Debido a la dificultad en el manejo del dolor, se optó por una intervención quirúrgica con fijación de la fractura mediante placas y tornillos. El procedimiento fue exitoso, sin complicaciones, con buen control del dolor posoperatorio y alta temprana. Aunque el tratamiento conservador es el enfoque habitual para las fracturas esternales, la intervención quirúrgica puede ser necesaria para estabilizar la fractura y mejorar la mecánica respiratoria, evitando complicaciones como la pseudoartrosis. En este caso, la cirugía temprana permitió una recuperación rápida y efectiva. La evidencia actual respalda la osteosíntesis con placas y tornillos como una opción segura y eficaz en casos seleccionados con mal control del dolor y fracturas desplazadas.

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## INTRODUCTION

Sternal fractures are uncommon, with few cases described in the medical literature, particularly regarding their clinical characteristics and surgical approaches. These fractures are generally associated with high-energy trauma that directly impacts the anterior chest wall. In addition, forced flexion and extension movements may displace the sternomanubrial joint and potentially cause spinal injuries. It is rare to encounter a sternal fracture without accompanying lesions, as they are typically related to high-energy trauma (defined as an impact at speeds equal to or greater than 40 km/h), which often increases the risk of severe complications [1-4]. Sternal fractures account for less than 0.5 % of all fractures and between 3 % and 8 % of closed-trauma cases. These injuries frequently result from falls from heights greater than three meters or from indirect trauma caused by compression and flexion of the torso [4]. Traumatic sternal fractures are mainly transverse fractures of the sternal body, whereas fractures of the manubrium and xiphoid process are less common.

The relevance of this case lies in the need to raise awareness within the medical community, particularly among specialists in traumatology, thoracic surgery, and intensive care, about the importance of early diagnosis and timely management. Although their incidence is low, delayed treatment of these fractures can lead to serious complications, making appropriate intervention crucial to improving clinical outcomes in affected patients [5-7]. We present the case of a young man with no significant medical history who sustained a low-energy injury after falling from a motorcycle.

## CASE PRESENTATION

A 25-year-old male presented to the Emergency Department after falling from a motorcycle from his own height at very low speed. He landed on his right side, sustaining blunt trauma to the right shoulder and subsequently developing neck pain and swelling, accompanied by resting dyspnea and diaphoresis. On arrival, the initial evaluation identified soft-tissue edema in the anterior region of the neck, area I, on the right side, extending toward the sternomanubrial joint (see Figure 1).

The remainder of the physical examination, conducted following the ABCDE trauma protocol (see Figure 2), revealed no significant abnormalities. Analgesic management was provided between interventions. Given the clinical findings and the possibility of vascular injury within the thorax, a CT angiography of the neck was requested. The scan showed increased soft-tissue volume in the anterior aspect of the lower neck, corresponding to a hematoma extending toward the sternal and clavicular portions of the right sternocleidomastoid muscle, with no evidence of active bleeding or cervical vascular injury. No vascular structures were compressed by the hematoma. A fracture of the sternal manubrium was also identified, with an oblique trajectory involving both cortices, displaying minimal displacement while maintaining articular congruence with the clavicles. The airway, digestive tract, and pleural cavities were unremarkable.

Based on these findings, the patient was evaluated by thoracic surgery. Owing to the difficulty in achieving adequate pain control, the surgical team

**Figure 1.** Patient's thorax showing soft-tissue edema in the anterior region of the neck, extending toward the sternomanubrial joint.

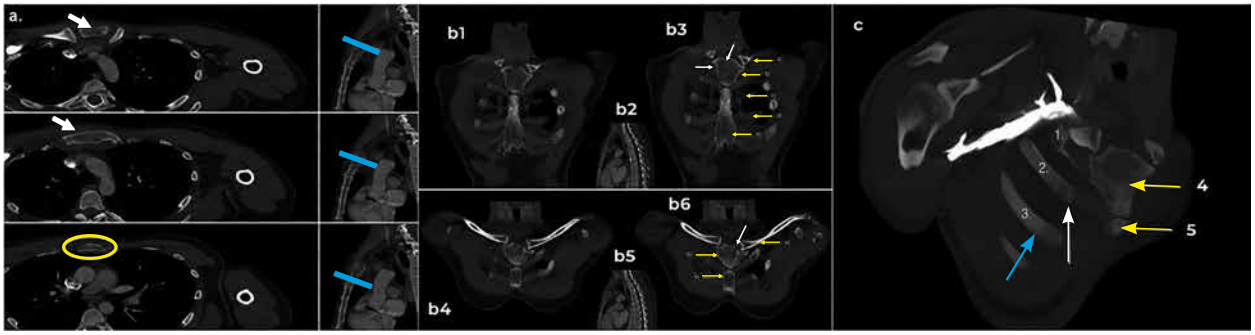


**Figure 2.** CT reconstructions of the thorax (projections: a) oblique axial; b) oblique coronal; and c) oblique coronal of the thorax).

**Description:* a) Oblique axial projection of the thorax: the oblique fracture line in the sternal manubrium, extending toward the most cephalic part of the structure, is indicated by a white arrow. The blue lines denote the level at which the sagittal reconstructions of the oblique axial images are obtained, aiding spatial localization. b) Oblique coronal projection of the thorax: b1) sternal manubrium; b2) reference showing the location of the reconstruction within the sternum on the sagittal image; b3) anatomical reference structures: (a) proximal epiphysis of the left clavicle, (b) sternal manubrium, (c) neurovascular bundle of the internal thoracic artery and vein, (d) cartilaginous portion of the left third costal arch toward the costosternal junction, (e) sternal body. White arrows indicate the fracture line of the sternal manubrium. c) Oblique coronal projection of the thorax: reconstruction directed to display the right rib cage with the right costosternal joint. Visible structures include: (1) first costal arch, (2) second costal arch, (3) third costal arch, (4) sternal manubrium, (5) sternal body. The white arrow marks the fracture of the second costal arch, where a double hyperdense line is observed (compare with the normal third costal arch, green arrow). The sternal fracture shows approximately 50% overlap.

recommended operative management, consisting of fixation of the sternal fracture using Johnson & Johnson sternal plates and fixation of the rib fracture with the StraCos® system. For the procedure, a longitudinal incision was made along the midline of the sternum; the pectoralis major muscles were retracted, and the sternum was identified and stripped of its periosteum. A complex fracture of the manubrium and the sternomanubrial junction was then exposed. Two plates were placed transversely across the sternal manubrium, and two additional plates were positioned to stabilize the manubrium and sternal body, following measurement of the bicortical length. A total of three Johnson & Johnson plates were used, with two unicortical screws on each side of the fracture—except for the superior fracture, where one screw was applied on one side and two on the other. Hemostasis was confirmed (see Figure 3).

Subsequently, the right second rib was dissected through the same approach, identified as the only fracture site, and stabilized with a six-segment clip. Hemostasis was again confirmed, and the absence of air leakage from the pleura was ensured. The incision was then closed in layers, approximating the pectoralis major muscles, subcutaneous tissue, and skin using 3-0 Prolene. The procedure was completed without complications. The patient achieved adequate pain control one day after surgery. Follow-up radiographs showed proper positioning of the osteosynthesis material without alterations, and no pathological findings were observed in the remaining evaluated structures. Given this favorable clinical course, early discharge was possible.

The development of this case was carried out with the patient's authorization for the dissemination of

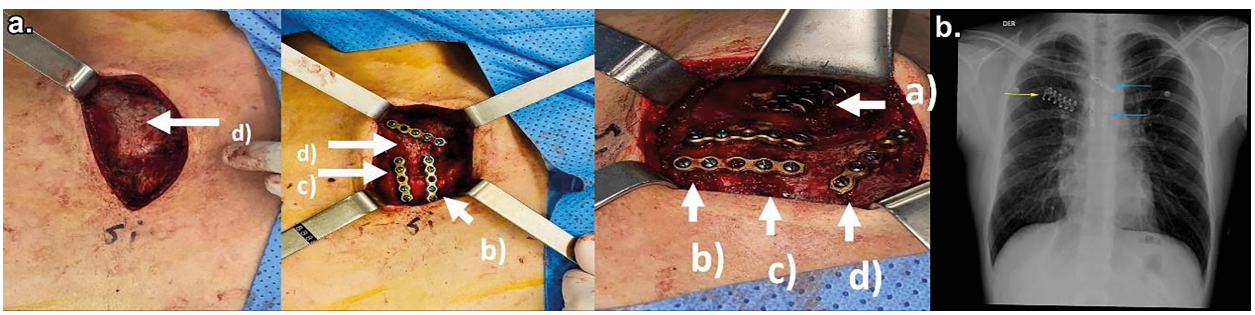


**Figure 3.** Surgical approach for osteosynthesis of the sternum and rib with postoperative radiograph.

**Description:* a) Second rib with osteosynthesis hardware; b) proximal sternal body fixed with osteosynthesis hardware; c) sternomanubrial joint; d) sternal manubrium; e) posteroanterior radiograph showing osteosynthesis hardware projected over the topography of the sternum and right anterior second rib. No pleural effusion, consolidations, or pneumothorax-related complications are observed. The yellow arrow indicates the second rib with osteosynthesis hardware. Blue arrows indicate the osteosynthesis material in the sternal manubrium and in the fixation between the manubrium and the sternal body.

clinical, paraclinical, and imaging data derived from his medical record, in accordance with the principles of beneficence, nonmaleficence, and justice. Informed consent was duly obtained from the patient, respecting confidentiality and privacy and ensuring anonymity.

## DISCUSSION

Although conservative management is the standard approach for most sternal fractures, surgical treatment may be necessary in selected cases as a means to stabilize and control the injury. The use of plate-and-screw osteosynthesis allows restoration of sternal anatomy and stabilization of the anterior thoracic wall, providing comfort and structural support that facilitate early rehabilitation. This approach may also reduce complications related to poor pain control or impaired respiratory mechanics resulting from the injury, as well as long-term issues such as pseudoarthrosis, which is often associated with chronic and disabling pain.

Although low-kinetic, low-energy sternal fractures are gaining recognition, no methodologically rigorous studies have yet been published to establish strong evidence-based recommendations for their management. Nevertheless, it is well established that most of these fractures tend to be isolated injuries and are treated conservatively. A systematic review by Klei et al. included 16 studies describing the effects of surgical management in 191 individuals. All patients achieved complete sternal healing, and 98 % reported pain relief. Only 2 % experienced treatment-related complications, findings that support the growing relevance of surgical intervention in these injuries.

A non-surgical strategy to realign the sternum involves orthopedic maneuvers such as thoracic hyperextension; however, several additional techniques exist, including the use of figure-of-eight periosteal wires or plate fixation. Thoracic hyperextension was once part of the preferred conservative approach for most sternal fractures, even severe or displaced ones. Current practice, however, increasingly favors open reduction with internal fixation using titanium plates and screws for most displaced sternal fractures, a management strategy similar to that used in the patient described here.

Finally, within a multidisciplinary and comprehensive trauma approach, it is essential to rule out cardiac injuries that may compromise the patient's safety. Structural and electrical cardiac assessment through electrocardiography, echocardiography, and even cardiac enzyme measurement (such as troponins) is appropriate and recommended to detect findings suggestive of myocardial contusion. If results are normal, medical discharge can typically be considered within 24 hours after surgical recovery. This approach was applied in our patient.

This report presents limitations inherent to its descriptive nature as a single case, which prevents generalization of the findings to broader populations. No long-term clinical follow-up was conducted to assess potential complications such as pseudoarthrosis or persistent chronic pain. Furthermore, there was no objective measurement of pain or postoperative quality of life, elements that would have enriched the evaluation of clinical outcomes.

### Conclusion

Sternal fractures resulting from low-energy trauma require a comprehensive diagnostic approach rooted in the principles of trauma care, with the aim of ruling out potentially life-threatening injuries. Although ultrasound may be useful during the initial assessment, computed tomography remains the reference standard for confirming the presence and extent of the fracture. Early surgical fixation should be considered in cases of displaced sternal fractures or inadequate pain control—even in the context of low-energy trauma—always within a multidisciplinary evaluation framework.

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## Authorship contribution

**JSS-T, CAC-G, MB-G, SGB-M, JFG-P, LAB-C:** Conceptualization; Writing – original draft; Writing – review & editing; Approval of the final manuscript.

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## Conflict of interest statement

The authors declare no conflicts of interest.