Open Reduction and Internal Fixation as Management of a Complex Scapular Fracture in a Polytraumatized Child: Case Report

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ABSTRACT
Scapular fractures in children are rare and typically result from high-energy trauma. Conservative treatment is usually the preferred approach, and surgical intervention is uncommon. In adults, surgery has demonstrated better short-term functional outcomes, but its benefits in the pediatric population remain unclear. Determining which pediatric patients may benefit from osteosynthesis is challenging due to the lack of available evidence. However, the presence of complications and certain imaging measurements may help guide management. The objective of this report is to describe the case of a child who underwent surgical treatment for a complex scapular fracture and to highlight the usefulness of the glenopolar angle as a criterion for decision-making in these patients. Alterations in the glenopolar angle and other radiographic parameters may be useful in identifying patients who could benefit from surgical management, as well as in predicting complications and postoperative outcomes. Nevertheless, further studies are needed to validate these findings over the long term and to better establish their diagnostic and prognostic value.
Keywords: Scapula; pediatrics; bone fractures; open reduction; surgical management.
Level of Evidence: V

Reducción abierta y fijación interna como manejo de una fractura compleja de escápula en una niña con politraumatismos. Reporte de un caso

RESUMEN
Las fracturas de escápula son raras en los niños y se producen por mecanismos de alta energía. El tratamiento de elección es conservador y la cirugía es poco frecuente. Se ha comprobado que, con la cirugía, se logra un mejor resultado funcional a corto plazo en los adultos, pero se desconoce qué ocurre en los niños. Es difícil definir qué pacientes se beneficiarán con la osteosíntesis, pues no hay bibliografía al respecto. Sin embargo, la presencia de complicaciones y algunas mediciones en los estudios por imágenes pueden ser útiles para definir un mejor manejo. El objetivo de esta presentación es comunicar el caso de una niña operada por una fractura de escápula y mostrar la utilidad del ángulo glenopolar como criterio para definir el manejo en estos pacientes. El tratamiento quirúrgico para estas fracturas ha logrado mejores resultados a corto plazo. La alteración del ángulo glenopolar y otros criterios podrían ser útiles para definir el beneficio de la cirugía, las complicaciones y los resultados posoperatorios, pero se necesitan estudios que permitan validar estos resultados a largo plazo, su rendimiento diagnóstico y el pronóstico.
Palabras clave: Escápula; pediatría; fracturas óseas; reducción abierta; manejo quirúrgico.
Nivel de Evidencia: V

INTRODUCTION

Scapular fractures are uncommon in children; therefore, clinical experience in treating them is limited, and the literature consists mostly of case reports, unlike in adults. Most of these fractures result from high-energy mechanisms, particularly traffic accidents, polytrauma, seizures, and high-energy falls.[1-3] Multiple fracture patterns have been described due to their association with closed thoracic trauma. The most frequently affected site is the coracoid process, followed by fractures of the body (mainly the infraspinous portion), the acromion, and the glenoid.[1-5]

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However, the main challenge lies in management, as conservative treatment with immobilization has traditionally been the approach of choice,[6-8] and cases requiring surgery have been rare.[2] In the few surgically treated cases reported, arbitrarily defined criteria, such as instability,[9-11] medial displacement of the glenoid surface >10 mm, intra-articular involvement, comminution, and floating shoulder,[13] have been extrapolated from adult parameters to guide treatment.[14,15] Currently, it remains unclear in which scenarios surgical management provides long-term benefits, especially considering the differences in the immature pediatric skeleton and the lack of dedicated research in pediatric traumatology.[1]

According to published cases, surgically treated patients show a lower incidence of complications, shorter hospital stays,[16] better short-term functional outcomes, and shorter follow-up periods than those treated conservatively.[17,18] Therefore, despite the limited and largely expert-opinion-based indications, the available evidence encourages considering operative management in selected cases.

We report the case of a girl with a displaced extra-articular fracture of the scapular body with marked compromise of the glenopolar angle, who underwent surgery due to persistent significant functional limitation in the context of multiple trauma (triplanar distal tibial fracture, Torode and Zieg type III pelvic fracture, and closed thoracoabdominal trauma).

The aim of this case report is to highlight the usefulness of the glenopolar angle and fracture displacement as criteria for identifying pediatric patients who may benefit from surgery, given the lack of consensus in this population and the implications for short-term postoperative outcomes.

The patient and her legal guardian provided informed consent for publication of this case.

CLINICAL CASE

An 11-year-old girl with no significant medical history presented with multiple trauma following a traffic accident. She sustained several associated injuries: grade 2 friction burns involving 12% of her body surface area; a triplanar fracture of the right ankle; a type III pelvic fracture according to the Torode and Zieg classification (opening of the left sacroiliac joint and widening of the pubic symphysis); and a complex displaced fracture of the right scapular body. She also suffered severe traumatic brain injury and closed thoracoabdominal trauma, which required a prolonged hospital stay to manage her injuries and critical condition.

On physical examination at admission, her general condition was poor, with a brief loss of consciousness lasting several minutes, somnolence, edema in the proximal third of the arm, and a 0.5-cm wound on the left shoulder with abrasions, ecchymosis, and tenderness on palpation. No signs of distal neurovascular injury were noted. Shoulder flexion was limited to 50°, while internal rotation was fully preserved.

Radiographs (Figure 1) revealed a displaced fracture of the right scapular body with two fragments.

Figure 1. Anteroposterior, lateral, and axillary shoulder radiographs obtained at admission. A displaced fracture of the scapular body is observed, with two fragments, mild comminution, angulation, and loss of continuity of the lateral border, without articular involvement.

A computed tomography scan with three-dimensional reconstruction (Figure 2) showed a markedly compromised glenopolar angle measuring 20.88°. Comminution of the scapular body was also identified, along with displacement of the lateral wall with a 45° inclination and medialization.

Figure 2. Computed tomography of the scapula with three-dimensional reconstruction. **A.** Measurement of the glenopolar angle. **B**. Measurement of the body inclination angle.

A consultation was requested with shoulder surgery and pediatric orthopedic specialists, who agreed that the patient would benefit from surgical fixation due to the high risk of instability, the possibility of correcting the deformity, and the expectation of improved functional recovery using compression and locking plates.

Surgical Technique

General anesthesia was administered, and the patient was placed in the left lateral decubitus position. A longitudinal incision was made along the lateral border of the scapula, dissecting through the infraspinatus and teres minor muscles. Intraoperatively, multifragmentary involvement of the glenoid at the superior and posterior rim was identified (Figure 3).

Figure 3. Images illustrating the planning and minimally invasive incision (Brodsky approach) used for fixation of the extra-articular scapular body fracture affecting the lateral border. The suprascapular neurovascular bundle is visible coursing through the spinoglenoid notch.

The fragments were mobilized by releasing the abundant bone callus with signs of consolidation, in order to improve fragment mobility at the fracture site and restore the length of the scapular lateral border. Reduction was achieved using reduction forceps, with provisional fixation using Kirschner wires to align the superior and inferior fragments. Together, these steps facilitated correction of the lateral wall angle, which was definitively fixed using a pre-contoured plate proximally and cortical screws along the lateral border (Figure 4).

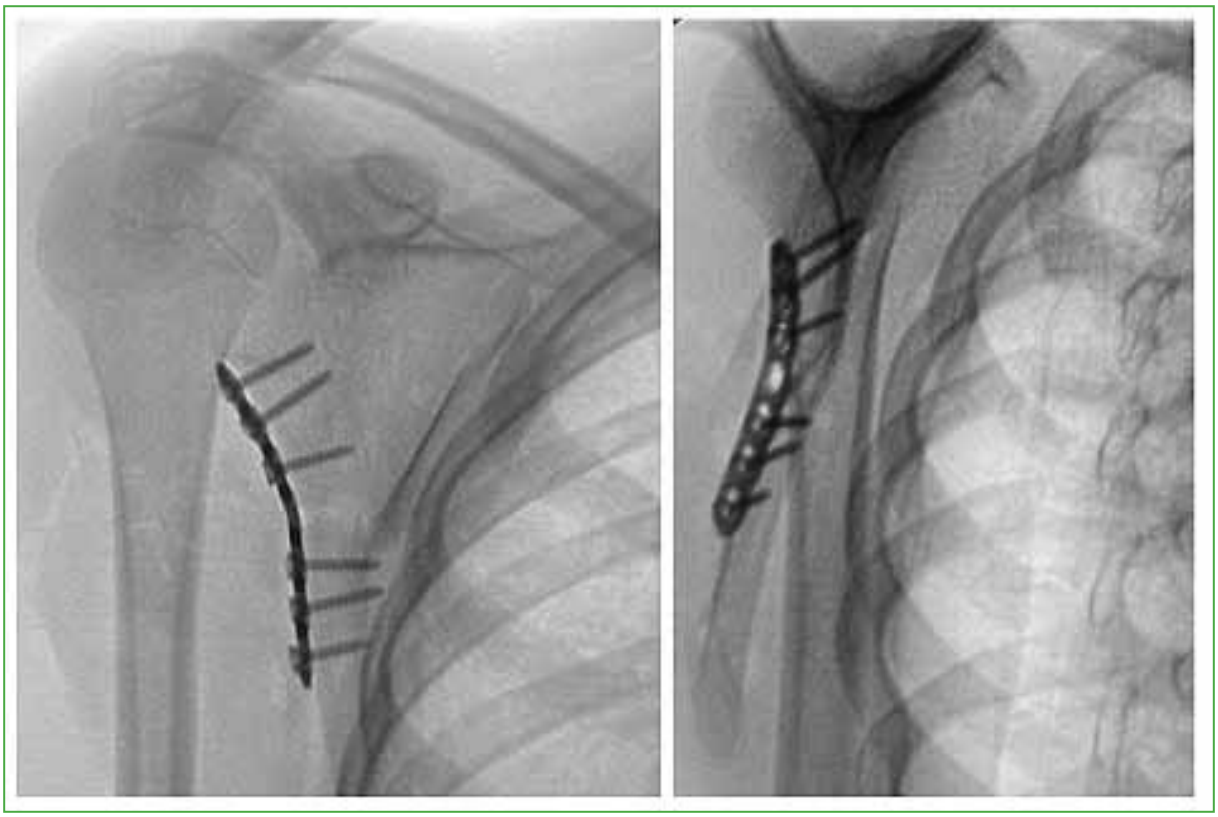

Figure 4. Intraoperative fluoroscopic images guiding the procedure. The lateral wall deformity was corrected by improving fragment alignment with a straight, pre-molded 7-hole compression plate positioned proximally and secured with three proximal and three distal 2.4-mm cortical screws.

Alignment, reduction, and implant positioning were confirmed using intraoperative fluoroscopy. Adequate screw angulation was achieved, with no intra-articular placement. The wound was closed in layers, and shoulder mobility was assessed immediately. Both passive and assisted active ranges of motion showed marked improvement. The patient continued to use an arm sling until postoperative follow-up.

Postoperative radiographs demonstrated satisfactory alignment, with anatomic reduction and appropriate positioning of the osteosynthesis hardware. The scapular body was restored along its lateral border, improving stability at the fracture site with the pre-contoured plate in place. Improved glenohumeral alignment was noted, including restoration and increase of the glenopolar angle, correction of the inclination of the distal fracture segment, and proper alignment of the scapular body relative to the preoperative lateral radiograph (Figure 5).

Figure 5. **A**. Lateral shoulder radiograph. Adequate positioning of the osteosynthesis material, restoring the inclination and length of the lateral border of the scapular body. **B**. Anteroposterior postoperative shoulder radiograph. Significant correction of the glenopolar angle, reaching nearly 30°, close to normal reference values.

Due to the patient's social circumstances, the first follow-up visit occurred at 3 months. Shoulder mobility was adequate, with clear improvement in both passive-assisted and active ranges of motion, and complete resolution of prior functional limitation. Radiographs showed fracture consolidation without complications, and postoperative appearance was satisfactory. Given these findings, follow-up was concluded (Figure 6).

Figure 6. A. Clinical postoperative images. Symmetrical right shoulder with acceptable scarring and full functional capacity, without limitation in abduction, adduction, elevation, external rotation, or internal rotation, with ranges of motion comparable to the contralateral side. **B.** Anteroposterior and lateral scapular radiographs. Adequate positioning of the hardware, with no signs of loosening or instability; fracture site aligned and progressing toward consolidation.

DISCUSSION

The available literature on the management of scapular fractures in pediatric patients is scarce. Most publications consist of isolated case reports describing children treated conservatively, which generally document improvement in functional limitation but longer recovery times and a higher risk of complications.[6]

Several authors have proposed absolute criteria for surgical management, including open fractures, comminution, neurovascular injuries, scapulothoracic dissociation, failure of conservative treatment, and fracture-pattern–related deformities such as glenohumeral instability with glenoid malrotation. In our case, alteration of the gleno-

polar angle, the inclination angle, and displacement at the fracture site were considered indicators of instability, in association with complete functional limitation. However, the use of these criteria has only been described in adults.

The glenopolar angle was originally introduced as a radiographic prognostic criterion in patients with floating shoulder.[19] It is defined as the angle formed between a line connecting the superior and inferior poles of the glenoid and a line connecting the superior glenoid pole to the most inferior point of the scapular inferior angle. Although its application has not been described in the pediatric population, the measurement is reproducible and has been widely used in adults to determine which patients benefit from osteosynthesis.[19,20] Therefore, it is relevant to consider whether this variable may also be useful in children and to assess its value in predicting postoperative outcomes. Previous studies have suggested that lower glenopolar angle values are associated with worse rehabilitation outcomes. This implies that, at least for scapular body fractures, the glenopolar angle could serve as an objective parameter to determine whether a patient is more likely to benefit from conservative treatment or surgery. From a biomechanical standpoint, it correlates with the degree of glenohumeral instability,[13] one of the most commonly cited predictors of the need for surgical management in children. It could also help stratify patients into good- or poor-prognosis groups based on postoperative correction of this angle, given its association with improved functional outcomes, shorter hospital stays, and other clinical variables.

A major limitation in the use of the glenopolar angle is its substantial interobserver variability, largely due to anteroposterior rotational differences during shoulder radiography acquisition.[19] This underscores the need for a standardized imaging configuration that ensures proper orientation of the scapular body to achieve accurate and reproducible measurements. Three-dimensional computed tomography would therefore be the ideal tool for preoperative assessment when corrective surgery is being considered for displaced fractures.[12,15,18]

CONCLUSIONS

This clinical case highlights the challenges involved in managing scapular fractures in pediatric patients. Surgical intervention, using an approach adapted to the specific anatomical, physiological, and biomechanical considerations of this age group, proved effective in achieving favorable outcomes. However, the rarity and distinctive characteristics of scapular body fractures in children contribute to the current lack of clear criteria defining when surgery is truly beneficial. Although the available literature is limited, it consistently suggests that surgical management may offer considerable advantages, particularly by enabling faster functional recovery, as demonstrated in this case. Moreover, many elements of the approach, surgical technique, and decision-making process described in the literature rely heavily on the surgeon's expertise and clinical judgment. This underscores the inherent complexity of these injuries, as optimal treatment requires careful preoperative planning and individualized strategies tailored to each patient.

Finally, alterations in measurable parameters (such as inferior fragment displacement, medial border inclination, and the glenopolar angle) may serve as objective indicators of which fractures are most likely to benefit from surgical fixation, and how correction of these parameters may predict postoperative outcomes. Long-term follow-up studies of similar pediatric cases are needed to validate these observations and to determine the practical utility of these radiographic measures in guiding clinical decision-making regarding the management of scapular body fractures in children.

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