Surgical indications for scapula fractures: Case series.

Hugo Ernesto Villarroel Rovere [1] ID *, María Dolores Delgado Zambrano [1] ID, Andrés Huerta Gil [1] ID, Cesar Morán Vargas [1] ID.

1. Traumatology and Orthopedics Service, Alcívar Hospital, Guayaquil, Ecuador.

Abstract

Introduction: Scapula fractures are considered relatively uncommon and are usually treated conservatively. However, in complex or displaced cases, surgical intervention may be necessary. A series of complex cases requiring surgery is presented.

Methods: A retrospective observational study was conducted in 5 patients with scapula fractures treated at Alcívar Hospital between August 2018 and April 2024. All five patients underwent surgery. X-rays and CT scans were performed, and the Cole criteria were applied to determine the indication for surgery. The functional outcomes were assessed via the DASH score.

Results: The incidence of surgically treated scapula fractures was approximately 0.885 cases per 100 person-years. Patients who underwent surgery had satisfactory functional outcomes in the short- and medium-term follow-up.

Discussion: The results are consistent with the literature, where surgical intervention is reserved for complex or displaced fractures. Postoperative functional assessment was favorable, supporting the effectiveness of appropriate surgical selection.

Conclusions: The incidence of surgically treated scapula fractures is low, and postoperative functional outcomes are satisfactory, making it beneficial for young patients with high functional demands. A treatment protocol based on clinical and radiological criteria has been developed.

Keywords:

Scapula fracture, trauma, treatment protocol, functional outcomes.

Abbreviations

SSSC: superior suspensory complex of the shoulder.
GPA: angle glenopolar.

Additional information

No supplementary materials are declared.

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Not applicable.

Authors' contributions

Hugo Ernesto Villarroel Rovere: Conceptualization, research, writing – original draft, resources, software, supervision.

María Dolores Delgado Zambrano: Conceptualization, research, writing—original draft, resources, software, supervision.

Andrés Huerta Gil: Methodology, Data curation, Formal analysis, Funding acquisition, Project management, Validation, Visualization, Writing – review and editing.

Cesar Morán Vargas: Conceptualization, Research, Writing – original draft.

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Availability of data and materials

The datasets used and analyzed during the present study are available from the corresponding author upon reasonable request.

Introduction

Owing to their rarity, scapular fractures, especially those of the scapular body, have been treated conservatively. Surgical intervention was reserved solely for glenoid fractures involving the articular surface. However, owing to a better understanding of shoulder biomechanics, greater emphasis has been placed on the anatomical and functional restoration of all scapular fractures, including those of the body, to establish specific criteria for surgical decision-making.

Scapula fractures are rare, representing 0.7% of all fractures and between 3% and 5% of fractures affecting the shoulder girdle [1]. Most cases are caused by violent trauma, so they are associated with other injuries in 90% of cases. Among these cases, 50% are in the ipsilateral limb, 80% are thoracic trauma, 48% are head trauma, and 26% are in the spine [2].

There is controversy regarding the surgical indications for treating these fractures. Most patients are treated conservatively, achieving good clinical results with little dysfunction, partly because they are usually slightly displaced and the shoulder can compensate for mobility [2]. Furthermore, the scapula is a bone surrounded by many muscles that provide a large amount of vascularization, so it is rare for them to evolve into pseudoarthrosis [3].

The scapula is a dynamic stabilizer for the humerus and the shoulder girdle. Numerous studies have demonstrated the poor outcomes associated with conservative treatment in cases of highly displaced scapular fractures [4 - 10], whereas surgical treatment has shown better results for this type of fracture [11- 14]. Consequently, when determining the treatment approach for a scapula fracture, it is essential to evaluate the displacement of the fragments to decide between conservative or surgical methods.

A thorough radiological and CT study is essential to establish the surgical indication. The radiological projections should include anteroposterior (AP), axillary, and lateral views of the scapula. The CT scan should encompass 3D reconstruction.

Imaging studies are used to determine whether treatment will be conservative or surgical. The criteria published by Cole et al. [2] are the most appropriate for deciding between conservative and surgical treatment for scapula fractures. This study aimed to document a case series of patients with scapula fractures who required surgery.

Materials and methods

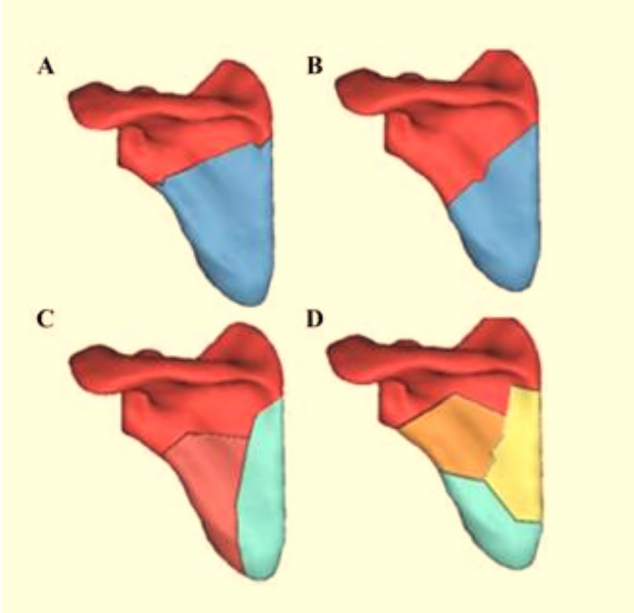
This observational, retrospective study was conducted in the Traumatology and Orthopedics Department of Alcívar Hospital. The study included cases over 6 years, from August 2018 to July 2024. During this time, 36 patients with scapula fractures were treated, 5 of whom underwent surgery. These patients underwent the following:

1. AP and axial radiographs of the scapula.
2. 3D reconstruction of a CT image. 3. Classification of the injuries.
4. Imaging measurements were made using Cole's criteria to determine the surgical indications for the fracture.
5. A minimum follow-up of 6 months was conducted, and the final functional results of the patients who underwent surgery were assessed.

Classification used

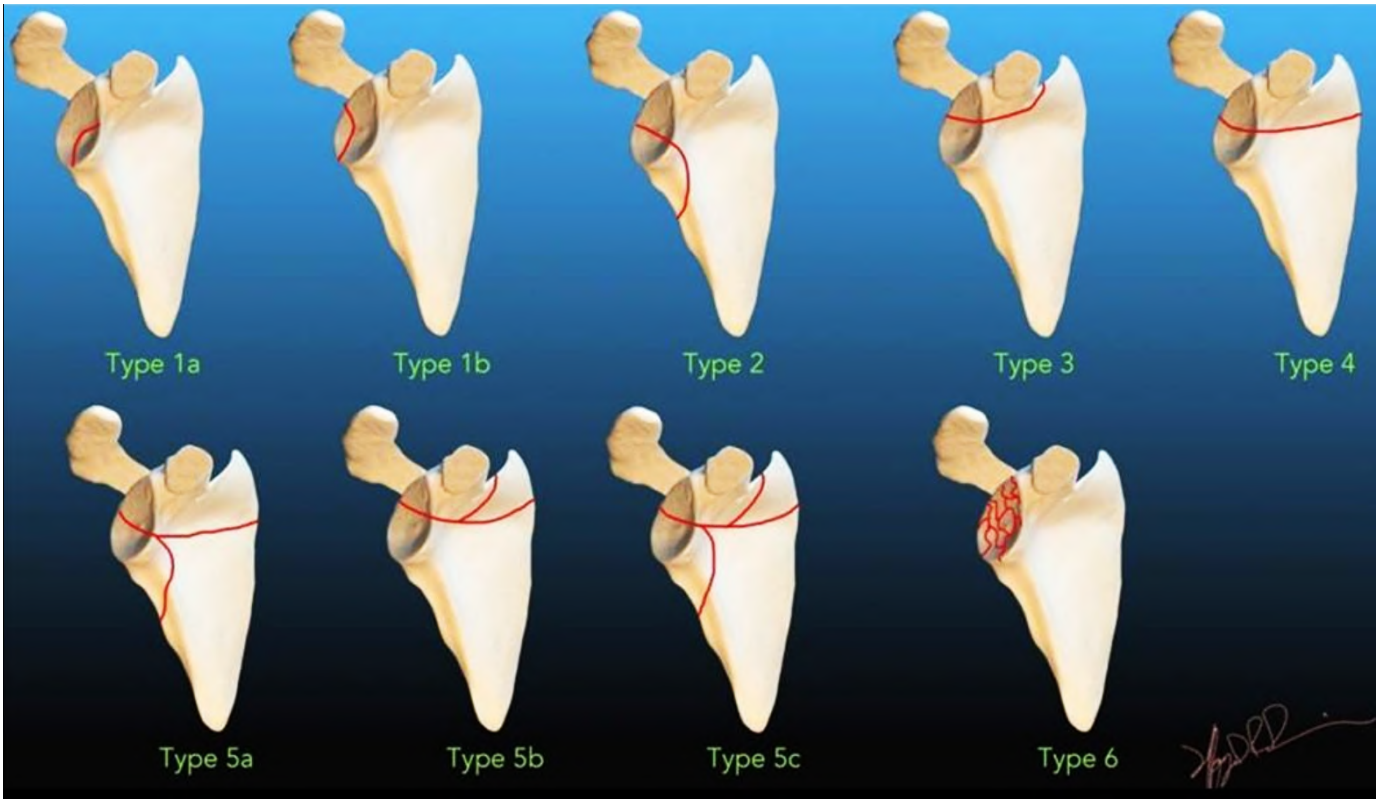
To classify the lesions, the descriptions of Bartonicek [15- 27] (Figure 1), Ideberg [28] (Figure 2), and Khun [29] (Figure 3) were used.

Figure 1. Bartonicek classification .



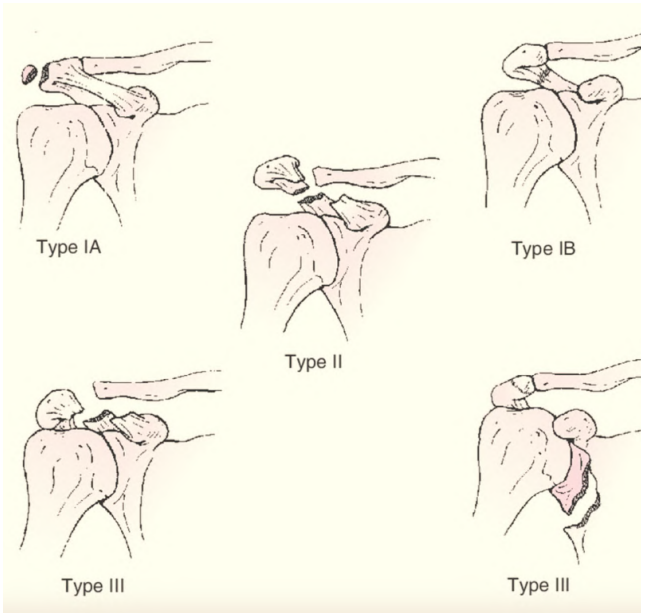
Bartonicek classification A) Two fragments – high transverse fracture, B) Two fragments – low transverse fracture. C) Three fragments, and D) Comminuted fracture.

Figure 2. Ideberg classification .



Ideberg classification (glenoid fractures): Type 1a Anterior border, Type 1b Posterior border, Type 2 Transverse to the lateral margin, Type 3 Transverse to the superior margin, Type 4 Transverse to the medial margin, Type 5a Transverse lateromedial , Type 5b Transverse superomedial , Type 5c Transverse superomediolateral , Type 6 Comminuted impaction .

Figure 3. Kuhn classification.

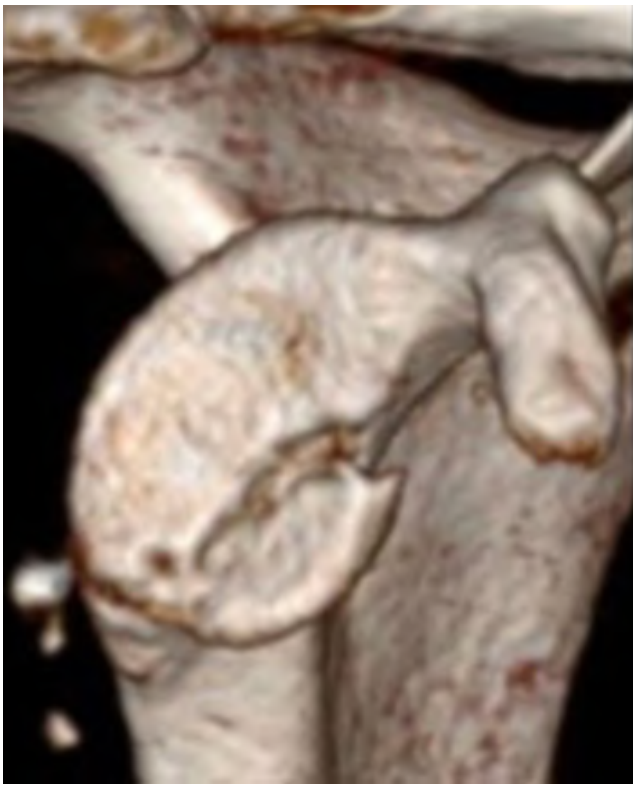


Kuhn classification of acromion fractures. Type I Nondisplaced: avulsion fractures and true Ib fractures. Type II Displaced without reduction of the subacromial space. Type III Displaced with reduction of the subacromial space. This reduction may be due to inferior displacement of the acromion or in association with a superiorly displaced glenoid neck fracture.

B. Surgical indications in scapula fractures: Cole criteria [2] and other authors [9, 11, 13, 15-19].

B.1. Joint fractures with displacements greater than or equal to 4 mm were observed (Figure 4). For other authors, such as Kavanagh et al. [15], a displacement greater than or equal to 2 mm was used, and for Mayo et al. [11], a displacement greater than or equal to 5 mm was used.

Figure 4. Scapula joint fracture.



Scapula joint fracture with 4 mm displacement .

B.2. The mediolateral displacement was equal to or > 20 mm (Figure 5). This measurement determines the medial displacement of the glenoid fragment relative to the rest of the scapula. It can be measured in the AP projection or via 3D reconstruction in its posteroanterior view. For Herrera et al. [16] > 15 mm and for Jones et al. 17 to 25 mm.

B.3. Angular deformity greater than or equal to 45° (Figure 6). It measures the angulation of the scapular fragment attached to the glenoid bone concerning the rest of the scapular body in a lateral view. Others indicate that it is more than 25° [16].

B. 4. If medialization and angular deformities are combined, surgical treatment is indicated if they are equal to or greater than 15 mm and 30°, respectively.

B. 5. An angle glenopolar (GPA) angle of less than or equal to 22° was used (Figure 7). To obtain this angle, in the AP projection, a line is drawn between the inferior pole and the superior pole of the glenoid and another line between the superior pole of the glenoid and the inferior part of the angle of the body of the scapula; the angle formed by the intersection of these lines is the glenopolar. Typical values range between 30° and 45° [13]. Bozkurt et al. [9] indicated surgery with angles less than or equal to 20°, and Kim et al. [18] stated surgery with angles less than or equal to 30°.

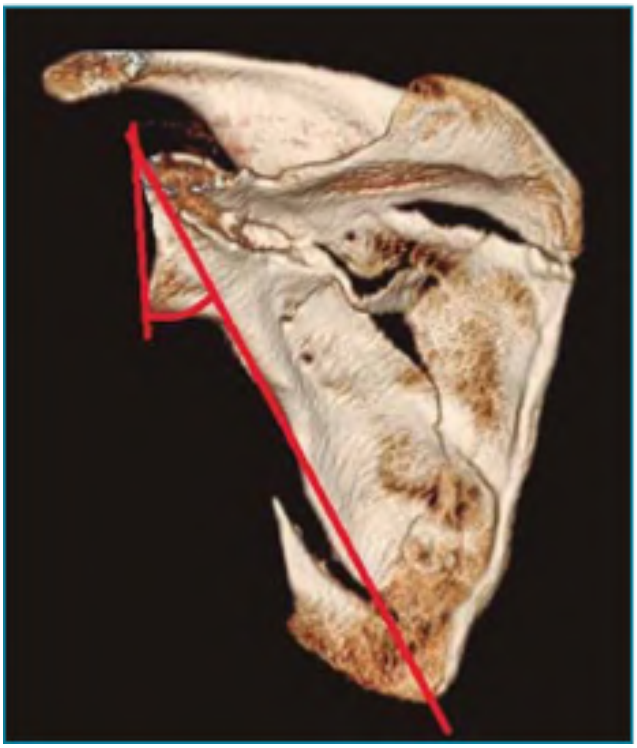
Figure 5. Measurement of medialization in scapula fractures.

Measurement of medialization in scapula fractures . In this case, medialization was less than 20 mm.

Figure 6. Angular deformity .

Scapula fracture . Measures the angulation of the glenoid bone relative to the body.

Figure 7. Glenopolar Angle .



Scapula fracture . Measures the angulation of the glenoid bone relative to the body.

B. 6. A double-displaced lesion of the superior suspensory complex of the shoulder (SSSC), the bone-ligamentous ring described by Goss [19] (Figure 8), is formed by the following anatomical structures:

- Glenoids.
- Coronoid process.
- Coracoclavicular ligaments.
- Clavicle.
- Acromioclavicular joint.
- Coracoacromial ligament.
- Acromion.

Surgical treatment is indicated if the displacement of 2 or more of these structures is greater than 1 cm.

B.7. Other indications include isolated and displaced fractures of the coracoid process or acromion greater than 10 mm, painful pseudoarthrosis, or concomitant fractures of the scapula, one of which does not require surgical treatment, but surgery on another that does need to be performed (Figure 9). Table 1.

The scale used to assess functional outcomes was the DASH [20].

Figure 8. Superior Suspensory Complex of the Shoulder .

Superior Suspensory Complex of the Shoulder (CSSH).

Figure 9. Displaced glenoid fracture and acromion fracture .

Displaced glenoid fracture and acromion fracture. Glenoid fracture is indicated Surgically , the acromion is minimally displaced and its treatment is conservative, but the intervention of the glenoid is used to perform osteosynthesis of the acromion.

Table 1. Surgical indications for scapula fractures, Coe's criterio [2] and other authors [9, 11, 13, 15-19].

Joint fractures	> 2 - 4 mm
Medialization	> 15 - 20 mm
Angular deformity	> 25 - 450
Medialization + deformity	> 15 mm and 300
Glenopolar Angle (GPA)	< 220 - 300
Displacement of 2 or more elements of the superior suspensory complex of the shoulder.	>10 mm
Isolated fractures of the acromion and coronoid process.	>10 mm

Demonstration case and surgical technique used

Medical records

This patient is a 46-year-old male who was involved in a traffic accident. He was hit while riding as a passenger on a motorcycle and suffered a blow to his right side, causing pain, edema, and functional impairment of the right shoulder. The images show a Bartonicek type D comminuted scapula fracture. Measurements and analysis according to Cole's criteria revealed the following surgical criteria (Figure 10: A, B, C, and D):

1. A medialization greater than 15 mm
2. The glenopolar angle is 24 degrees.

Treatment

An extended posterior Judet approach was used for the surgical procedure, taking care not to injure the supraspinatus nerve; the fractures were reduced, and a 3.5 mm angled and contoured reconstruction plate was placed on the lateral and medial edges. A 2.7 mm mini-fragment T-plate was also used in the inferior part of the glenoid neck (Figure 11).

Figure 10. Physical examination.

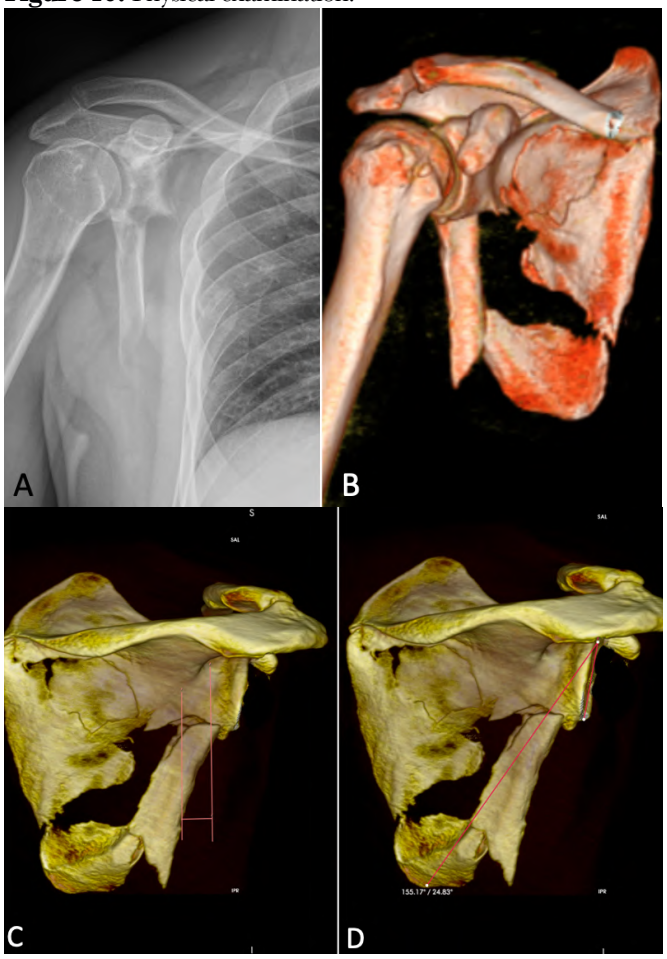
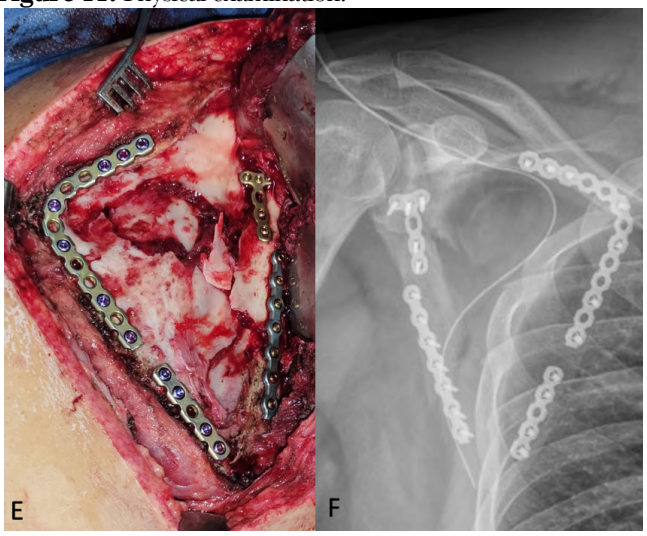


Figure 10. 46-year-old patient, suffers a traffic accident, A. The X-ray shows a scapula fracture, but without further details B. The 3D Tomography shows a comminuted fracture of the body of the scapula type D of the Bartonicek classification , C. Taking measurements in the CT with 3D reconstruction there is Medialization > 15 mm, D. Measuring the Glenopolar Angle is 240. For all these reasons, this scapula fracture has a surgical indication.

Results

1. The incidence of scapula fractures at Alcívar Hospital was 0.8%.
2. The following information was obtained from the five patients who underwent surgery within these 6 years, which is detailed in Table 2.

Figure 11. Physical examination.



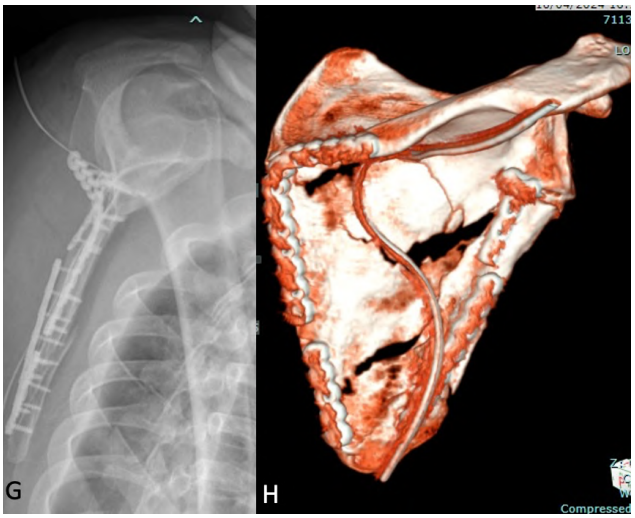


Figure 11. E. Extended Judet posterior approach , F and G Fracture reduction and fixation with 3.5 mm moldable reconstruction plates, at the level of the glenoid neck a 2.7 mm mini T-plate, all made of titanium, was placed, H. Postoperative 3D CT.

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Table 2. Cases operated on for scapula fractures.

	Case # 1	**Case # 2**	**Case # 3**	**Case # 4**	**Case # 5**
Date	August 17, 2018	March 19, 2020	October 26, 2022	September 12, 2023	April 9, 2024
Age	26	27	28	37	46
Sex	Man	Man	Man	Man	Man
Cause	Traffic Accident-Motorcycle	Traffic Accident-Motorcycle	Traffic Accident-Motorcycle	Traffic Accident-Motorcycle	Traffic Accident-Motorcycle
Occupation	Police	Dealer	Military	Laborer	Police
Functional demand	High	High	High	High	High
Associated injuries	Severe injury to right thigh with loss of skin, muscle and tendon.	1. Head trauma 2. Grade 2 liver trauma and kidney trauma – nephrectomy. 3. Fx . Clavicle.	Fracture of the external third of the clavicle.	No associated injury	No associated injury
Fracture classification	Idebert Type 5c	1.Bartonicek Type C 2.Khun type III acromion base fracture associated with scapula neck fracture	Idebert Type 4	Khun type III acromion base fracture with decreased subacromial space	Bartonicek Type D
Surgical indication (Cole)	1.Fx . Displaced joint >4 mm 2.Lateral displacement >15 mm 3.Angular deformity >25 degrees 4.Double CSSH injury Glenoid and coronoid process	1.Angular deformity of the scapula body > 30 degrees 2.Double CSSH injury: Base of acromion and clavicle > 10 mm displacement	1. Displaced joint fracture > 2 mm 2. Double CSSH lesion Glenoid with coronoid process and fx . Clavicle	Double CSSH injury: acromion and coracoacromial ligament Decreased subacromial space due to deltoid action	1.Medialization > 15 mm 2.Glenopolar angle < 30 ^{0}
Approach	1. Brodsky Posterolateral Approach 2. Superior Approach	Judet 's Expanded Posterior Approach	Deltopectoral approach , extended toward the clavicle	Posterior approach to the scapula on the spine and acromion	Judet 's expanded posterior approach
Implant used	1. Molded reconstruction plate and mini titanium body plate 2. 4 mm cannulated screws in glenoid	1.3.5 mm reconstruction plate 2.2 mm titanium miniplates at the level of the glenoid neck and base of the spine	1.Three 4 mm cannulated screws 2.Miniplate in FX . Clavicle	1. Reconstruction plate 3.5 upper edge 2. 2 mm mini-fragment plate on lower edge	1.Angled and moldable 3.5 reconstruction plate, also used 2 cuts from the lowe jaw plate 2.Mini-fragment T-plate
Complications	No	No	No	No	No
DASH 3 months	8	8	9	10	8
DASH 6 months	11	10	11	11	11
DASH 12 months	11	10	11	11	-

Discussion

Scapular fractures are relatively rare injuries, accounting for only 3–5% of all fractures involving the shoulder joint and less than 1% of all fractures overall, 50% of which affect the body of the scapula [24]. Anavian et al. reported having operated on 1 to 2 cases per year between 2002 and 2009 [13], consistent with our findings. In our hospital, the incidence of scapular fractures is 0.8%, and patients who undergo surgery for scapular fractures have an average of 1 fracture per year.

These fractures are usually the result of high-energy trauma, so they are associated with multiple injuries, such as rib fractures in 52.9%, spine fractures in 29.1%, lung injuries in 47.1%, head trauma in 39.1%, clavicle fractures in 25.2%, and brachial plexus injuries in 13% of patients [1]. All our patients experienced high-energy trauma; when they were hit by a car while riding a motorcycle, 3 of our patients had associated injuries that required urgent damage control care and deferred scapular osteosynthesis.

Although most out-of-joint fractures can be treated nonoperatively, surgical intervention should be considered for fractures that are significantly displaced. Nordqvist and Peterson [5] studied 37 displaced glenoid neck fractures treated nonoperatively and reported that at a 10- to 20-year follow-up, 32% of patients had fair to poor functional outcomes. Ada and Millar [4] reported that 16 patients with out-of-joint fractures were treated conservatively, where 50% experienced chronic night pain, 40% showed weakness in abduction, and 20% had a decreased range of motion [21]. Various studies have also concluded that glenoid neck fractures with malalignment and a GP angle of < 20 are associated with a less favorable outcome [22].

Conservatively treated, poorly healed scapular fractures can sometimes alter the mechanics and bony anatomy of their respective muscle attachments [23], resulting in scapular dyskinesia, which results in the scapula not moving in its usual patterns, notably when flexing the shoulder and raising the arm overhead. Following malunion, some form of functional loss inevitably occurs, including reduced mobility, strength, endurance, or response time of the shoulder girdle, especially in patients with high physical demands [1]. Similarly, unstable or highly displaced fractures of the glenoid neck and fractures within the joint can cause shoulder imbalance, instability, chronic pain, weakness, stiffness, deformity, and early development of osteoarthritis. Research on nonoperative treatment has rarely clearly identified levels of displacement and fracture patterns, complicating the interpretation that patients might benefit most from surgical fixation [2].

In 2013, Cole mentioned that the surgical indication for scapular fractures is usually reserved for displaced, unstable fractures or those that compromise joint function 1, establishing applicable criteria to determine when a scapular fracture should be operated on and to avoid scapular dyskinesia [2]. Since 2018, at Alcívar Hospital, we have used these criteria to determine which scapular fractures require surgical intervention; five scapular fractures that fell under Cole's criteria have been treated for over 6 years.

Noort et al. [7] also reinforced the importance of surgical management when the superior suspensory complex of the shoulder is double disrupted. An essential aspect of our study was correctly classifying the injury and analyzing whether the CSSH was involved via appropriate imaging studies; of all five patients, four presented with the disruption described above.

The approach that is usually performed is the one described by Judet et al. [25], since it allows for observing the lower border of the glenoid, the entire extension of the body, the spine, and the acromion. Nevertheless, there is a risk of injury to the supraspinatus nerve and the circumflex scapular artery. The Brodsky approach [26] can also be used when the fracture is in the internal border of the scapula. If we have an articular fracture of the glenoid, we can use a superior approach as an extension of the deltopectoral approach. We have had the opportunity to use all the approaches described without having any paralytic nerve complications, especially Judet's approach, where we must respect the safety limits. We placed the fixation plates on the edge of the scapula for better fixation with the screws, and we generally used 3.5 mm locked reconstruction plates. We also used 4 mm cannulated screws and 2 mm titanium miniplates, which are also commonly used in hand and maxillofacial surgery.

Tatro et al. [14] reported practically complete functional recovery in patients appropriately selected for surgery. However, the literature also suggests that long-term functional success may be influenced by the type of fracture and postoperative management (Schandelmaier et al. [12]). In the present study, with a minimum follow-up of 6 months, the mean DASH score was 10 out of 11 points. Strength testing revealed no significant differences between injured and uninjured shoulders for any movement, whereas the range of external rotation and abduction decreased slightly in 1 of the five patients. All five operated patients returned to their original occupation and did not need to change occupations for reasons related to shoulder injury. Prospective and longitudinal studies should address long-term follow-up and consider pathological fractures [31- 35].

Conclusions

Although several scientific papers have been published in the last decade on the surgical treatment of scapula fractures and their excellent functional results, there is still no complete consensus regarding the limits of displacement and angulation that allow for surgical indications. Advances in imaging techniques will enable us to accurately measure displacement and deformity in a fracture and help us plan surgery more safely.

References

1. Cole PA, Freeman G, Dubin JR. Scapula fractures. Curr Rev Musculoskelet Med. 2013 Mar;6(1):79-87. doi: 10.1007/s12178-012-9151-x. PMID: 23341034; PMCID: PMC3702760.

2. Cole PA, Gauger EM, Schroder LK. Management of scapular fractures. J Am Acad Orthop Surg. 2012 Mar;20(3):130-41. doi: 10.5435/JAAOS-20-03-130. PMID: 22382285.

3. Cole PA, Dubin JR, Freeman G. Operative techniques in the management of scapular fractures. Orthop Clin North Am. 2013 Jul;44(3):331-43, viii. doi: 10.1016/j.ocl.2013.04.001. Epub 2013 May 25. PMID: 23827836.

4. Ada JR, Miller ME. Scapular fractures. Analysis of 113 cases. Clin Orthop Relat Res. 1991 Aug;(269):174-80. PMID: 1864036.

5. Nordqvist A, Petersson C. Fracture of the body, neck, or spine of the scapula. A long-term follow-up study. Clin Orthop Relat Res. 1992 Oct;(283):139-44. PMID: 1395237.

6. Romero J, Schai P, Imhoff AB. Scapular neck fracture--the influence of permanent malalignment of the glenoid neck on clinical outcome. Arch Orthop Trauma Surg. 2001 Jun;121(6):313-6. doi: 10.1007/s004020000224. PMID: 11482461.

7. van Noort A, te Slaa RL, Marti RK, van der Werken C. The floating shoulder. A multicenter study. J Bone Joint Surg Br. 2001 Aug;83(6):795-8. doi: 10.1302/0301-620x.83b6.10806. PMID: 11521916.

8. Cole PA, Talbot M, Schroder LK, Anavian J. Extra-articular malunions of the scapula: a comparison of functional outcome before and after reconstruction. J Orthop Trauma. 2011 Nov;25(11):649-56. doi: 10.1097/BOT.0b013e31820af67f. PMID: 21697740.

9. Bozkurt M, Can F, Kirdemir V, Erden Z, Demirkale I, Başbozkurt M. Conservative treatment of scapular neck fracture: the effect of stability and glenopolar angle on clinical outcome. Injury. 2005 Oct;36(10):1176-81. doi: 10.1016/j.injury.2004.09.013. Epub 2005 Jul 27. PMID: 16054146.

10. Pace AM, Stuart R, Brownlow H. Outcome of glenoid neck fractures. J Shoulder Elbow Surg. 2005 Nov-Dec;14(6):585-90. doi: 10.1016/j.jse.2005.03.004. PMID: 16337524.

11. Mayo KA, Benirschke SK, Mast JW. Displaced fractures of the glenoid fossa. The results of open reduction and internal fixation. Clin Orthop Relat Res. 1998 Feb;(347):122-30. PMID: 9520882.

12. Schandelmaier P, Blauth M, Schneider C, Krettek C. Fractures of the glenoid treated by operation. A 5- to 23-year follow-up of 22 cases. J Bone Joint Surg Br. 2002 Mar;84(2):173-7. doi: 10.1302/0301-620x.84b2.12357. PMID: 11922356.

13. Anavian J, Gauger EM, Schroder LK, Wijdicks CA, Cole PA. Surgical and functional outcomes after operative management of complex and displaced intra-articular glenoid fractures. J Bone Joint Surg Am. 2012 Apr 4;94(7):645-53. doi: 10.2106/JBJS.J.00896. PMID: 22488621.

14. Tatro JM, Gilbertson JA, Schroder LK, Cole PA. Five to Ten-Year Outcomes of Operatively Treated Scapular Fractures. J Bone Joint Surg Am. 2018 May 16;100(10):871-878. doi: 10.2106/JBJS.17.00673. PMID: 29762283.

15. Kavanagh BF, Bradway JK, Cofield RH. Open reduction and internal fixation of displaced intra-articular fractures of the glenoid fossa. J Bone Joint Surg Am. 1993 Apr;75(4):479-84. doi: 10.2106/00004623-199304000-00001. PMID: 8478375.

16. Herrera DA, Anavian J, Tarkin IS, Armitage BA, Schroder LK, Cole PA. Delayed operative management of fractures of the scapula. J Bone Joint Surg Br. 2009 May;91(5):619-26. doi: 10.1302/0301-620X.91B5.22158. PMID: 19407296.

17. Jones CB, Cornelius JP, Sietsema DL, Ringler JR, Endres TJ. Modified Judet approach and minifragment fixation of scapular body and glenoid neck fractures. J Orthop Trauma. 2009 Sep;23(8):558-64. doi: 10.1097/BOT.0b013e3181a18216. PMID: 19704270.

18. Kim KC, Rhee KJ, Shin HD, Yang JY. Can the glenopolar angle be used to predict outcome and treatment of the floating shoulder? J Trauma. 2008 Jan;64(1):174-8. doi: 10.1097/01.ta.0000240982.99842.b9. PMID: 18188118.

19. Goss TP. Double disruptions of the superior shoulder suspensory complex. J Orthop Trauma. 1993;7(2):99-106. doi: 10.1097/00005131-199304000-00001. PMID: 8459301.

20. Hudak PL, Amadio PC, Bombardier C. Development of an upper extremity outcome measure: the DASH (disabilities of the arm, shoulder and hand) [corrected]. Upper Extremity Collaborative Group (UECG). Am J Ind Med. 1996 Jun;29(6):602-8.

doi: 10.1002/(SICI)1097-0274(199606)29:6<602::AID-AJIM4>3.0.CO;2-L. Erratum in: Am J Ind Med 1996 Sep;30(3):372. PMID: 8773720.

21. Bartoníček J, Tuček M, Klika D. Inferior glenoid fossa fractures: patho-anatomy and results of operative treatment. Int Orthop. 2017; 41(9): 1741-8. doi: 10.1007/s00264-017-3511-5.

22. Schroder LK, Gauger EM, Gilbertson JA, Cole PA. Functional Outcomes After Operative Management of Extra-Articular Glenoid Neck and Scapular Body Fractures. J Bone Joint Surg Am. 2016 Oct 5;98(19):1623-1630. doi: 10.2106/JBJS.15.01224. PMID: 27707848.

23. Gumina S, Carbone S, Postacchini F. Scapular dyskinesis and SICK scapula syndrome in patients with chronic type III acromioclavicular dislocation. Arthroscopy. 2009 Jan;25(1):40-5. doi: 10.1016/j.arthro.2008.08.019. Epub 2008 Oct 10. PMID: 19111217.

24. Ao R, Yu B, Zhu Y, Jiang X, Shi J, Zhou J. Single lateral versus medial and lateral plates for treating displaced scapular body fractures: a retrospective comparative study. J Shoulder Elbow Surg. 2018 Feb;27(2):231-236. doi: 10.1016/j.jse.2017.07.028. Epub 2017 Sep 28. PMID: 28964674.

25. Judet R. Traitement chirurgical des fractures de l'omoplate [surgical treatment of scapular fractures]. Acta Orthop Belg. 1964;30:673-8. French. PMID: 14291980.

26. Brodsky JW, Tullos HS, Gartsman GM. Simplified posterior approach to the shoulder joint. A technical note. J Bone Joint Surg Am. 1987 Jun;69(5):773-4. PMID: 3597479.

27. Tuček M, Bartoníček J, Novotný P, Voldřich M. Bilateral scapular fractures in adults. Int Orthop. 2013 Apr;37(4):659-65. doi: 10.1007/s00264-013-1778-8. Epub 2013 Feb 24. PMID: 23436152; PMCID: PMC3609996.

28. Ideberg R, Grevsten S, Larsson S. Epidemiology of scapular fractures. Incidence and classification of 338 fractures. Acta Orthop Scand. 1995 Oct;66(5):395-7. doi: 10.3109/17453679508995571. PMID: 7484114.

29. Kuhn JE, Blasier RB, Carpenter JE. Fractures of the acromion process: a proposed classification system. J Orthop Trauma. 1994;8(1):6-13. doi: 10.1097/00005131-199402000-00002. PMID: 8169698.

30. Alemán-Iñiguez J, Mora-Bravo F, Bravo-Aguilar C. Rare brown tumor location in chronic renal failure. Pediatric case report and literature current. Revista Portuguesa de Endocrinología, Diabetes e Metabolismo 2016;11(2):220-227. Doi: 10.1016/j.rpedm.2016.04.001.

31. Duran J, Gil M, Trinidad P. Phosphorus kinetics in patients with chronic renal failure on hemodialysis. REV SEN;10(2):56-63. Doi: 10.56867/13.

32. Rico-Fontalvo J, Daza-Arnedo R, Montejo-Hernandez J, Cardona-Blanco M, Rodriguez-Yanez T Reflections on chronic kidney disease with obesity-associated(CKD-WO): from an old causal relationship to an approach based on phenotyping. REV SEN 2022;10(2):137-9. Doi: 10.56867/37.

33. Alemán-Iñiguez JM, Alemán-Iñiguez PJ, Mora-Bravo F. Lumbalgia atípica por plasmocitoma óseo solitario coexistente con absceso de psoas: dos entidades distintas en una misma localización. Comunicación del primer caso. Rev Hematol Mex 2014; 15(3):129-136. Doi: re143f.

34. Mora-Bravo F, Muñoz J. Impaired Reconversion of Bone Marrow in Nuclear Magnetic Resonance in Patients with Chronic Renal Disease. Curr Med Imaging. 2021;17(10):1256-1261. doi: 10.2174/1573405616999201118140832. PMID: 33213332.

35. Vernaza C, Pazmino L. Intra- and extraindividual biological variability of total calcium, urea, and creatinine in predialysis and postdialysis adult patients with chronic renal failure. Revista De La Sociedad Ecuatoriana De Nefrología, Diálisis y Trasplante 2022;10(1):13-20. Doi: 10.56867/8.

Statements

Ethics committee approval and consent to participate

This method is not required for clinical cases.

Consent to publication

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Conflicts of interest

The authors have no conflicts of interest.

Authors' information

Hugo Ernesto Villarroel Rovere, specialist in traumatology and orthopedics from the University of Guayaquil (Guayaquil, 2004). Doctor of Medicine and Surgery from the University of Guayaquil. a. Orthopedic Physician-Traumatologist, team member and director of the postgraduate program in Orthopedics and Traumatology, Alcívar Hospital, Guayaquil, Ecuador.
Email: villarroelr@hotmail.com
ORCID https://orcid.org/0000-0002-0847-0344

María Dolores Delgado Zambrano, PhD in Medicine and Surgery from the Eloy Alfaro Lay University of Manabí (Manabí, 2008). She is a specialist in Traumatology and Orthopedics from the University of Guayaquil (Ecuador, 2016). She also has a specialty in pediatric orthopedic medicine from the National Autonomous University of Mexico (Mexico, 2017). She is also an attending physician in the Orthopedic Department of Alcívar Hospital.
Email: dramarydelgado@yahoo.es
ORCID https://orcid.org/0009-0002-4491-291X

Andrés Huerta Gil, MD, PhD, University of Guayaquil (Guayaquil, 2022). Occupational Health Specialist specializing in Occupational Health from the Pontifical Catholic University of Ecuador (2023). Postgraduate in Traumatology and Orthopedics. Alcívar Hospital.
Email: doctor.huerta@outlook.com
ORCID https://orcid.org/0000-0003-0425-2005

Cesar Morán Vargas, MD, PhD, University of Guayaquil (2020). Postgraduate in Traumatology and Orthopedics. Alcívar Hospital.
Email: smpla5@hotmail.com
ORCID https://orcid.org/0000-0002-5035-0418

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Correspondence: Hugo Ernesto Villarroel Rovere. Email: villarroelr@hotmail.com
Address: Alcívar Hospital, Foundation Building, 1st Floor, Trauma Center. Guayaquil, Guayas, Ecuador.
Telephone: [593] 3720100 Ext 3401.