



ELSEVIER

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Trauma Case Reports

journal homepage: www.elsevier.com/locate/tcr

Case Report

A rare rotated, medially displaced fracture-dislocation of the medial clavicle – Case report and review of the literature

Mohamed Fawzy Ali Afifi, Sören Waldmann, Alessandro Pisano^{*}

Praxisklinik Rennbahn AG, Muttenz, BL, Switzerland

ARTICLE INFO

Keywords:

Shoulder
 Medial clavicle
 Sterno-clavicular joint
 Upper limb
 Open reduction internal fixation
 Sports traumatology

ABSTRACT

Clavicle fractures combined with sternoclavicular joint dislocations are very rare injuries that need to be addressed quickly and treated effectively due to the altered biomechanics of the shoulder girdle as well as to the potential damages to the surrounding “noble” anatomical structures.

A diagnostic and therapeutic algorithm for such injuries has not yet been established. Computer Tomography with 3D reconstruction should be the diagnostic gold standard. In case of a highly displaced fracture and/or dislocation in an active patient, surgical treatment is advised in order to obtain proper bone and joint healing with satisfactory functional outcomes as well as to protect the surrounding anatomical structures from potential damages.

We present the case of an 18-year-old male, skeletally mature patient, who had a fall while snowboarding. Subsequently he was diagnosed with a very uncommon combination of a displaced medial clavicle fracture and complete posterior Sterno-Clavicular dislocation with 111° rotation of the sternoclavicular fragment. We opted for surgery, decided to use “off-label” a 2.5 V-plate Ulna plate long (Medartis®) and to associate this procedure with a Sterno-Clavicular arthrodesis with tape-augmentation to stabilize the SC joint; this treatment strategy resulted in a good clinical outcome without any remaining instability and satisfactory ROM.

We collected this case to describe this seldom combination, to show our treatment strategy and to advocate the creation of a standardized diagnostic and therapeutic algorithm. X-rays, Computer Tomography images and intraoperative photos are presented.

Introduction

Clavicle fractures are relatively common and represent between 2.6 and 10 % of all fractures. The two most frequent situations that lead to such injuries are **sports participation and vehicle crashes**. Among all clavicle fractures, medial-end fractures represent between 2 and 11,9 % [1,2,3].

Sterno-Clavicular (S–C) dislocations are even rarer, representing about 1 % of all kinds of traumatic dislocations and 3 % of all traumatic shoulder girdle lesions [4,5]. Like clavicle fractures, traumas occurring during sports activities and road traffic accidents are the two main causes of traumatic SC joint injuries.

Regarding the degree of the dislocation, according to the Allman grading they have been classified in grade I (Sternoclavicular Sprain), grade II (Sternoclavicular Subluxation) and grade III (Sternoclavicular Dissociation with total disruption of both

^{*} Corresponding author.

E-mail address: pisano.md@gmail.com (A. Pisano).

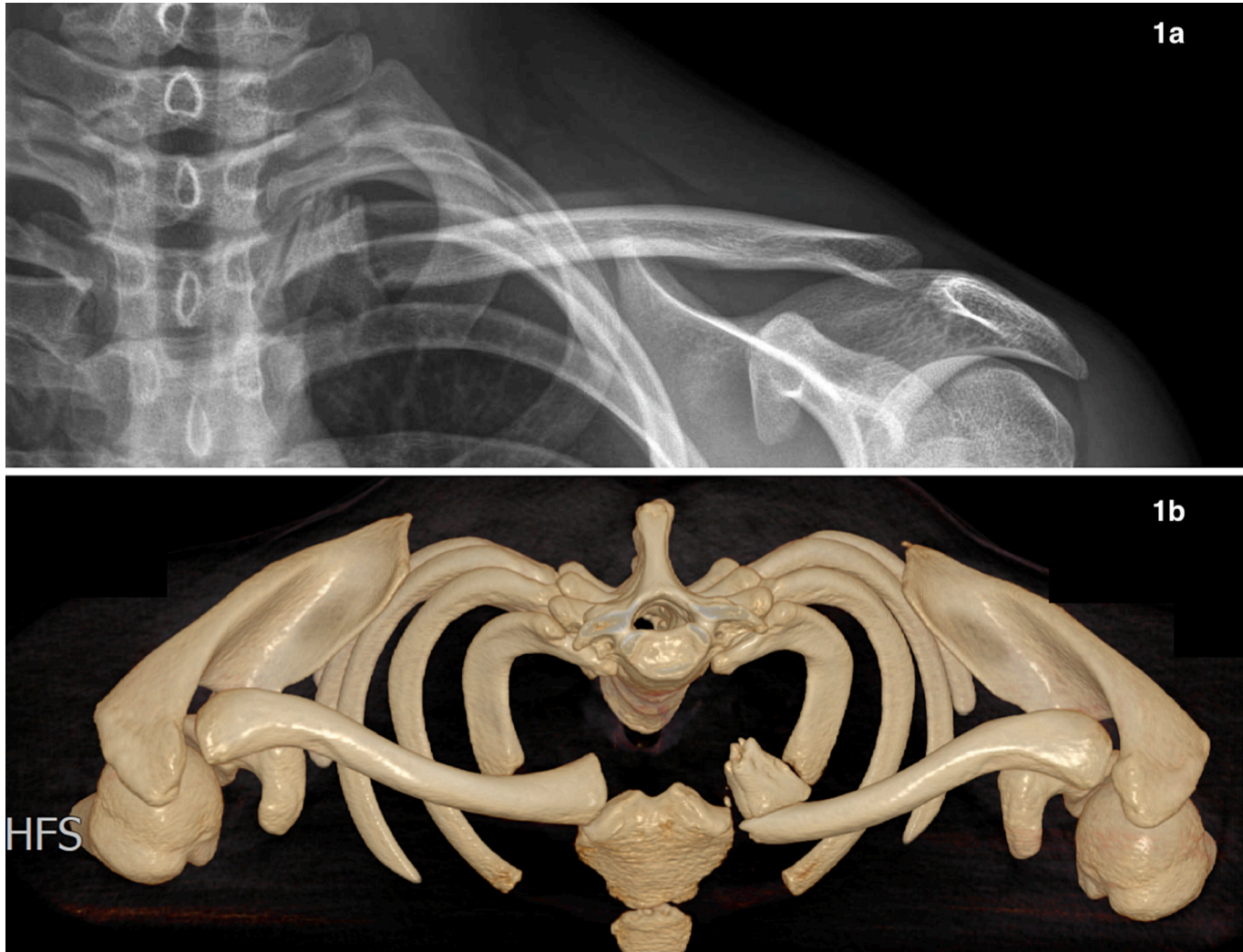


Fig. 1. 1a: X-Rays in standard A-P View showing the fracture-dislocation of the medial clavicle. 1b: 3D reconstruction of a CT scan showing the rotation and displacement of the medial clavicle fragment as well as the complete disruption of the S-C joint.

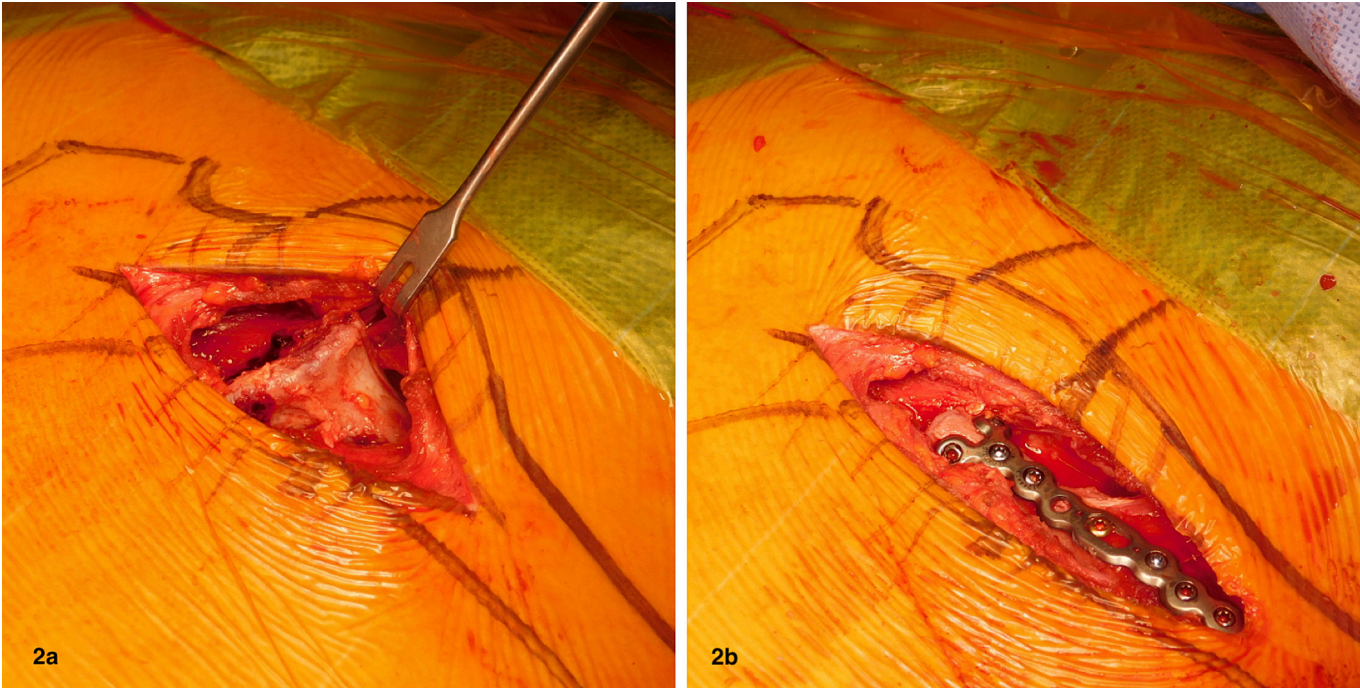


Fig. 2. Medial clavicle fragment before (2a) and after (2b) open reduction and internal fixation with the 2.5 V-Plate Ulna Plate Long (Medartis).

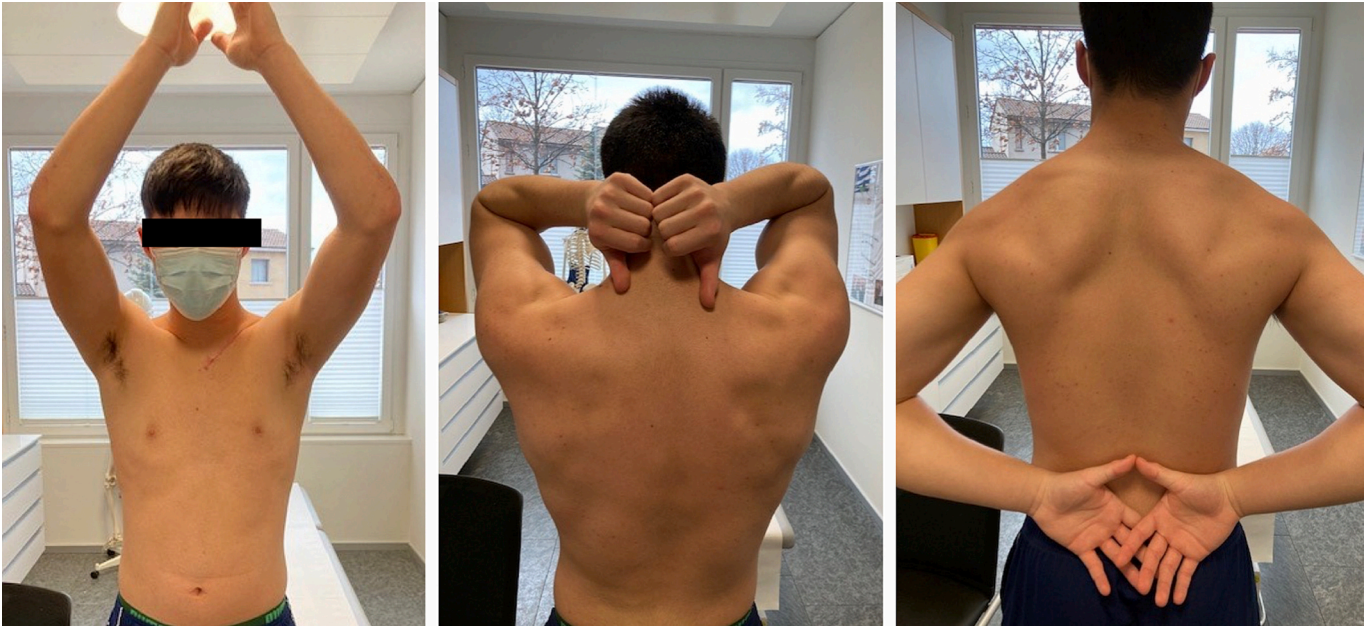


Fig. 3. Shoulder mobility 6 weeks after the procedure.

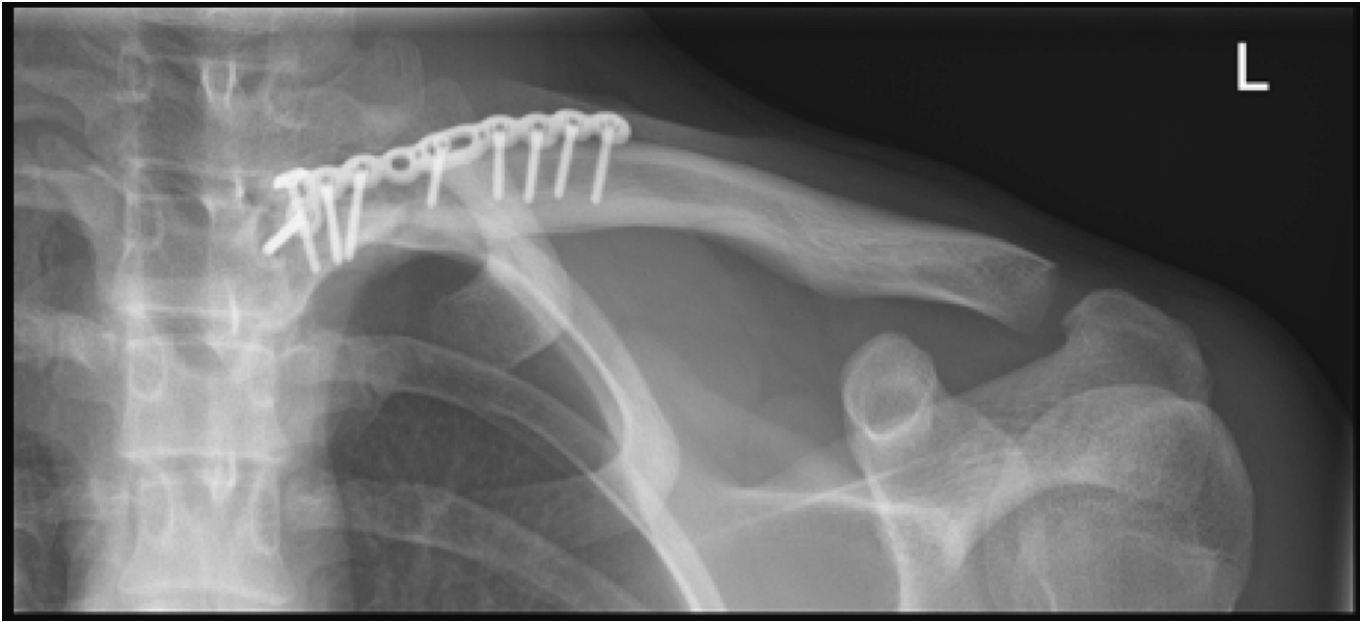


Fig. 4. A-P Clavicle X-Rays at the 3 months control.

sternoclavicular and costoclavicular ligaments) [6]. **Grade III** SC joint dislocations can also be classified into **anterior** and **posterior** dislocations in relation to the displacement of the medial end of the clavicle with respect to the sternum: the anterior type seems to be much more common than the posterior (9 to 20 times), which is rarer but potentially more dangerous because of the injury risk to the adjacent structures (esophagus, trachea, blood vessels, lungs), that can result in serious complications [7]. In a systematic review with meta-analysis from 2019, Sernandez and Riehl highlighted the possibility of symptoms such as dyspnea, hoarseness, dysphagia and venous congestion through compression of the dislocated medial clavicle in patients with posterior SC joint dislocation [5]: in such cases, a surgical treatment is strongly advocated.

With regard to the imaging, SC dislocations bring an additional difficulty, being hard to visualize on traditional X-rays: although many projections are described in the orthopedic literature, those carry a potential for misdiagnosis or non-diagnosis, that's why Computer Tomography (CT) is considered the gold standard for the diagnosis of this kind of lesion [8].

Due to the uncommonness of these injuries as well as their anatomical complexity, an ideal, standardized diagnostic and treatment algorithm still lacks. In the present manuscript we report a displaced medial clavicular fracture, associated with a complete sternoclavicular joint dissociation with 111° rotation of the sternoclavicular fragment, and its management. We obtained verbal and written informed consent from the patient for the publication of the anonymized data in this article.

Clinical case: presentation, procedure and post-operative care

An 18-year-old skeletally mature male had a fall while snowboarding, thereafter he presented himself immediately to the local hospital. **His complains were chest and low neck pain.** On the examination no open injuries, dyspnea, dysphagia, or numbness on the left arm were reported. Standard X-rays with Antero-Posterior clavicle view were performed (Fig. 1a) and he was advised for a conservative treatment.

Nevertheless, he complained about lower neck and chest pain and because of that he came to our clinic for a second opinion. He was seen by one of our shoulder specialists, a CT scan with 3-D reconstruction was made (Fig. 1b) and he was diagnosed with a very uncommon combination of a displaced medial clavicle fracture and complete posterior sterno-clavicular dislocation with 111 degrees of rotation of the sterno-clavicular fragment.

We opted for a surgical strategy, combining an Open Reduction and Internal Fixation of the medial clavicle (using “off-label” a 2.5 V-plate Ulna Plate Long®, Medartis) with a figure-of-8 tape-augmentation arthrodesis of the SC-joint with a PDS Band® (Ethicon).

We performed the procedure under general anesthesia and in supine position. Incision over the fracture site allowed direct visualization of the injury (Fig. 2a). Due to the rupture of the disc, this was fully removed. The open reduction was successfully attempted with high care of the underlying important structures. The internal fixation was done by using of the 2.5 V-plate Ulna plate long from Medartis®. **We decided to use “off-label” this model of ulnar plate (Fig. 2b) for the fixation for several reasons:** it has a total of 10 holes (9 rounded and one oblong for variable plate positioning), rounded edges and a smooth surface for soft tissue protection, K-wire holes for temporary fixation of the plate and an anatomically pre-contoured plate design. Given all these features, **we were able to adapt the plate to the peculiar anatomy of the fracture.** The fracture was occupied medially and laterally with 4 angle-stable screws each side. **The S-C joint was fixed with a trans-osseous Tape-augmentation using a PDS Band (Ethicon®) in a figure-of-8-sling around the plate and sternum.** Adequate stability was achieved. The anatomical reduction, the correct position of the plate and the stability of the construct were confirmed intraoperatively with the use of fluoroscopy.

Post-operatively, the patient's arm was placed in a shoulder sling, and he was advised to perform physiotherapy 2–3 times a week under the following instructions: for 6 weeks following surgery, flexion and abduction of the arm allowed until 80°, free internal and external rotation, no weight lifting with the left arm.

Follow-up visits took place after 2 weeks, 4 weeks, 6 weeks, 3 months, 5 months and 7 months. After 6 weeks, he showed no clinical or radiographic signs of fracture displacement and satisfactory active range of motion (Fig. 3), therefore free shoulder range of motion was allowed, as well as lifting of weights not heavier than 5 kg and return to soccer training sessions without contact.

3 months after surgery he continued to show clinical and functional progress as well as radiographic signs of complete fracture healing (Fig. 4) and he was cleared to return to full training and competition.

At the 5 months control, satisfying and successful healing and functional recovery were assessed, and the patient was instructed to present itself just in case of need.

He came back 2 months later having developed neck contractures; therefore, physical therapy was prescribed.

During the entire follow up our patient developed no major complications. All post-surgical radiographic assessments (at 2 weeks, 6 weeks and 3 months) showed a complication-free radiological healing process as well.

Discussion, review of the literature and conclusion

Sterno-clavicular dislocations combined with clavicle fractures are in the adult population extremely rare and potentially dangerous as well as underdiagnosed injuries that need to be addressed precisely and quickly.

Regarding the treatment options for displaced medial clavicle fractures, there are currently no clear indications whether these should be treated conservatively or surgically. A recent systematic review (15 studies, with a total of 135 patients) analyzed the outcomes of conservative versus surgical treatment. In the non-operative group (5 studies, 39 patients, mean follow-up of 27 months) there were 5 symptomatic non-unions, 2 malunions and 2 delayed unions. In the surgical group (11 studies, 96 patients, mean follow-up 23 months) there were no reported non-unions, but 27 % of the operated patients required hardware removal [9].

For the treatment of isolated S—C joint dislocations there is either currently neither an official consensus nor widely accepted

Table 1
Combined clavicle fractures and S—C dislocations: review of the literature.

Year of publication and authors	Number of patients	Demographics	Diagnosis	Situational pattern and/or injury mechanism	Diagnostic methodology	Treatment strategy	Follow up
1978 – Kanoksikarin S. and Wearne W. M. [11]	1	Male, 19 y.o.	RIGHT SHOULDER - Combination of: medial-end of the clavicle single-fragment fracture and complete S—C dislocation with posterior-superior dislocation of the clavicle fragment.	Sport (football, direct contact with an opponent)	X-Rays	Clavicle Fracture: stabilization with K-Wire. S-C dislocation: suture of the joint capsule.	14 months: no symptoms and full recovery as well as full return to sport activities.
1989 - Thomas C. B. Jr. and Friedman R. J. [12]	1	Male, 28 y.o.	RIGHT SHOULDER -Combination of: medial-end of the clavicle single-fragment fracture and complete S—C dislocation with anterior dislocation of the clavicle fragment. In association: partial brachial plexus palsy involving C5, C6 and C7; pulmonary contusion; right third rib fracture; closed head injury.	Motor vehicle accident (he was the unrestrained driver in a truck that overturned)	X-Rays	Clavicle Fracture: ORIF with a 3.5-mm ASIF/AO plate. S-C dislocation: spontaneous reposition after the ORIF of the medial clavicle.	12 months: radiological healing and clinically stable reduction of the fracture; partial resolution of the brachial plexus palsy.
2012 – Khalid et al. [13]	1	Male, 17 y.o.	LEFT SHOULDER -Combination of: vertically displaced fracture of the medial-end of the clavicle with anterior dislocation of the sternoclavicular joint	Motor vehicle accident (no further details given)	X- Rays, then CT scan with 3-D reconstruction (which confirmed the anterior and vertical displacement of the of the floating clavicular fragment)	Clavicle Fracture: ORIF with 6-hole dynamic compression plate. S—C joint dislocation: removal of the SC disc and joint fusion (arthrodesis) with transarticular suture (with no.5 Ethibond).	6 months: radiological healing and no clinical signs of S—C instability.
2019 – Wang et al. [14]	1	Woman, 28 y.o.	BILATERAL INJURY RIGHT SHOULDER: Middle-third clavicle fracture and posterior S—C joint dislocation LEFT SHOULDER: Middle-third clavicle fracture and anterior S—C joint dislocation Other injuries: comminuted fracture of pelvis, hemopneumothorax, multiple rib fractures, bilateral lung contusion.	Motor vehicle accident (the patient was hit by a truck while driving a motorcycle)	Full-body CT with 3-D reconstruction of the whole skeleton	Clavicle Fracture: ORIF. S—C joint dislocation: fixation with Kirschner wires.	2 months: radiological healing and alignment confirmed with CT scan and 3-D reconstruction

guidelines; however, in most patients and especially in case of young, active patients, posterior dislocations should be treated surgically due to the potential for damage to the surrounding noble structures [10]. In such clinical scenarios, simultaneous presence of a cardiothoracic surgeon during the procedure is often strongly advised [7].

The treatment strategy we chose for our patient takes into account all the above-mentioned anatomical and clinical aspects.

Throughout the course of the orthopedic literature, only a small number of cases like ours involving skeletally mature patients are described (See Table 1) [11,12,13,14]. In three of them a unilateral S—C joint dislocation was associated to an ipsilateral medial-end clavicle fracture [11,12,13]. In the fourth case the injury was bilateral and involved the two S—C joints and the middle third of the clavicle on both sides, instead of the medial end [14].

Regarding the injury mechanism, in three out of four cases these injuries occurred in the context of road traffic accidents [12,13,14] but in one case (as well as ours) the injury happened in a sports-related contest [11]. In all these four cases, a surgical treatment was chosen, due to the high degree of displacement and instability.

With our patient, we showed that it is possible to treat successfully and achieve good mid-term results with the combination of an ORIF (using “off-label” an ulna plate to reduce and stabilize the medial-end clavicle fracture) with a “figure-of-eight” tape augmentation to stabilize the S—C joint.

We also agree with the conclusion of Khalid et al. [13] on the need to collect similar cases reported in the literature, to create a larger collection of cases in order to establish a diagnostic and treatment algorithm for this kind of injury. Especially regarding the imaging, according to our experience a CT scan with 3-D reconstruction should be the gold standard.

Sources of funding

None.

Ethical approval

This case series got ethical approval from our institution.

Consent

Written informed consent was obtained from the patient for publication of this article and accompanying images.

Declaration of Generative AI and AI-assisted technologies in the writing process:

All authors disclose no use of generative AI and AI-assisted technologies in the writing process.

CRedit authorship contribution statement

Mohamed Fawzy Ali Afifi: Conceptualization; Investigation; Writing - original draft; Writing – review and editing.

Sören Waldmann: Conceptualization; Project administration; Supervision; Validation.

Alessandro Pisano: Conceptualization; Investigation; Writing - original draft; Writing – review and editing.

All authors reviewed the manuscript and approved its final version.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

We state that all research data are available.

References

- [1] Kwek E. Chapter “Clavicle” in Buckley, Moran C.G., Apivatthakakul T. AO Principles of Fracture Management – 3rd Edition. Stuttgart (Germany): Georg Thieme Verlag and New York (New York, USA): Thieme, (2017) 573–586.
- [2] A. Klonz, T. Hockertz, H. Reilmann, Klavikulafrakturen, Unfallchirurg 104 (2001) 70–81 (Article in German).
- [3] F. Postacchini, Epidemiology of clavicle fractures, J. Shoulder Elb. Surg. 11 (2002) 452–456.
- [4] S. Boesmueller, M. Wech, T.M. Tiefenboeck, et al., et al., Incidence, characteristics, and long-term follow-up of sternoclavicular injuries: an epidemiologic analysis of 92 cases, J. Trauma Acute Care Surg. 80 (2015) 289–295.
- [5] H. Sernandez, J. Riehl, Sternoclavicular joint dislocation: a systematic review and Meta-analysis, J. Orthop. Trauma 33 (2019) e251–e255.
- [6] F.L. Allman Jr., Fractures and ligamentous injuries of the clavicle and its articulation, J. Bone Joint Surg. Am. 49 (1967) 774–784.
- [7] P.A. O’Connor, L. Nölke, A. O’Donnell, et al., Retrosternal dislocation of the clavicle associated with a traumatic pneumothorax, Interact. Cardiovasc. Thorac. Surg. 2 (2003) 9–11.
- [8] R. Cope, Dislocations of the sternoclavicular joint, Skelet. Radiol. 22 (1993) 223–228.

- [9] L.X. Kang, H.J. Faulkner, W.H. Howard, et al., Displaced medial clavicle fractures: a systematic review of outcomes after nonoperative and operative management, *JSES Int.* 7 (2023) 79–85.
- [10] D.J. Morell, D.S. Thyagarajan, Sternoclavicular joint dislocation and its management: a review of the literature, *World J. Orthop.* 7 (2016) 244–250.
- [11] S. Kanoksikarin, W.M. Wearne, Fracture and retrosternal dislocation of the clavicle, *Aust NZ J. Surg.* 48 (1978) 95–96.
- [12] C.B. Thomas Jr., R.J. Friedman, Ipsilateral sternoclavicular dislocation and clavicle fracture, *J. Orthop. Trauma* 3 (1989) 355–357.
- [13] N. Khalid, A. Elbeshbeshy, K.A. Alsaleh, et al., Anterior sternoclavicular dislocation associated with clavicular fracture: a case report and review of the literature, *Eur. J. Orthop. Surg. Traumatol.* 23 (2012) 179–182.
- [14] H. Wang, C. Wang, J. Ruan, et al., Asymmetrical bilateral sternoclavicular joint dislocation combined with bilateral clavicular fracture, a case report, *Medicine* 98 (2019) 28.