OPEN Case Report

Open Scapulothoracic Dissociation

Yan Rong Chen, MD
Bo Xu, MD
Teng Fei Yu, MD
Ya Ni Lu, MD
Xue Zhen Liang, MD
Chuan Qiang Liu, MD
Ming Xi Wang, MD
Bin Zhou, MD

ABSTRACT

Scapulothoracic dissociation is a rare and serious type of trauma caused by musculoskeletal, vascular, and brachial plexus injuries owing to lateral displacement of the scapula with a strong blunt external force. Here, we describe the treatment of an open scapulothoracic dissociation patient and summarize the findings.

VIDEO 1

From the The Affiliated Hospital of Shandong University of Traditional Chinese Medicine (Dr. Chen, Dr. Liu, Dr. Wang, and Dr. Zhou), and the The First Clinical Medical School, Shandong University of Traditional Chinese Medicine, Shandong, China (Dr. Xu, Dr. Yu, Dr. Lu, and Dr. Liang).

Correspondence to Dr. Zhou: zhouspine@126.com

Supported by Shandong Famous Traditional Chinese Medicine Expert Inheritance Studio (M.X. Wang).

None of the following authors or any immediate family member has received anything of value from or has stock or stock options held in a commercial company or institution related directly or indirectly to the subject of this article: Dr. Chen, Dr. Xu, Dr. Yu, Dr. Lu, Dr. Liang, Dr. Liu, Dr. Wang, and Dr. Zhou

Authors' contributions: All authors made a significant contribution to the work reported and agreed to be accountable for all aspects of the work. C.Y.R., Z.B., Y.T.F., and L.Y.N. did the whole surgery. L.X.Z., X.B., performed the vascular anastomosis, W.M.X., and L.C.Q. gave guidance on treatment options.

JAAOS Glob Res Rev 2025;9: e24.00050

DOI: 10.5435/JAAOSGlobal-D-24-00050

Scapulothoracic dissociation (STD) is a rare and devastating injury that results from high impact trauma. Originally described by Oreck et al[1] in 1984, this injury is defined as a traumatic disruption of scapulothoracic articulation with lateral displacement of the scapula and intact skin. Open STD (OSTD) can be limb- and life-threatening and includes musculoskeletal, vascular, and brachial plexus injuries.[2-4] Here, we present the case of a 32-year-old man who was diagnosed with OSTD and underwent forequarter amputation as lifesaving treatment.

Case Report

A 32-year-old man with no notable medical history was injured in a woodworking accident when he rolled into a machine. The injury consisted of an open fracture of the left upper limb, and the patient was immediately transported to a nearby primary hospital. The patient was a right-handed carpenter. Upon arrival to our hospital, he was admitted to the emergency department at 22:05 on January 6, 2022, nearly 12 hours after the injury had occurred. On admission, the man was conscious and cooperative, with a body temperature of 36.5°C, pulse of 89 beats per minute, respiratory rate 20 breaths per minute, and blood pressure of 90/50 mm Hg. The patient's SpO_2 was 100% with a mask providing 15 L/min oxygen. Multiple wounds were appreciable on physical examination: two penetrating wounds to the right maxillofacial region, a large (15 × 45 cm) wound to the left shoulder and forearm, and two wounds to the patient's chest (10 × 8 and 15 × 10 cm). The three wounds were covered by a thin layer of skin. Open glenohumeral joint and elbow dislocations were also observed (Figure 1). The left upper limb could not be moved, and the left radial artery pulse could not be detected. Sensation was absent in his left arm. When the residual pectoralis major muscle, pectoralis minor muscle, and anterior portion of the deltoid were inverted caudally, a stump of the subclavian artery was found 3 cm peripheral to the clavicle, and the site was occluded by a thrombus (Video). The distal amputated end of the brachial plexus was identified in the upper limb, with approximately 10 cm of length lost. No abnormalities were found

Figure 1

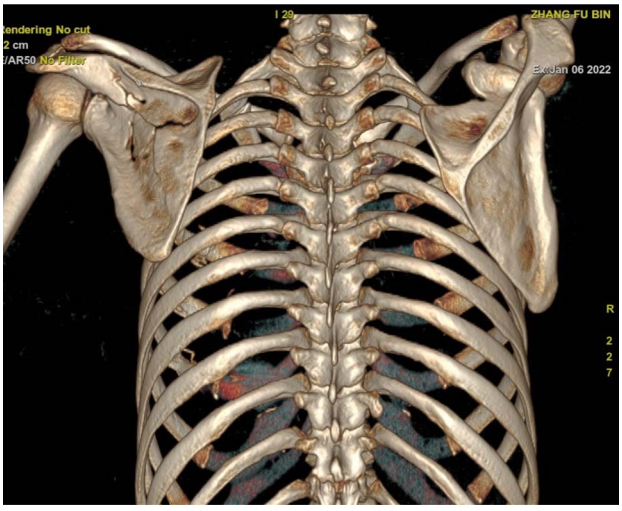
Image showing preoperative findings of the wound. **A**, Wound on the right side of the face. **B**, Anterior view of the left upper limb and walls of the chest. **C**, Interior view of the left upper limb. **D**, Outside view of the left upper limb.

in liver or kidney function tests or coagulation tests. The laboratory findings revealed a white blood cell count of 13.73×10^9/L, a hemoglobin concentration of 75 g/L, platelet count of 275×10^9/L, and an international normalized ratio (INR) of 1.20. The patient reported no notable medical history.

With active fluid resuscitation and 4-unit red blood cell transfusion, 3-dimensional CT was taken. CT revealed a left hemothorax and multiple fractures: left clavicle, ribs (1 to 7), left scapula, spinous processes fractures (C7-T4), humeral head, glenoid, and epitrochlear (Figure 2). To minimize movement of the patient, we did not perform a chest radiograph, and digital subtraction angiogram could not be done at our hospital at night. When conducting a CT scan of the lung, it is customary for the CT operator to instruct the subject to assume a supine position with their face upward and raise both arms above their head to optimize visualization of the lungs. However, because of trauma, the patient was unable to raise his left arm, preventing us from comparing the distance between the spinous processes and inner edge of the scapula on both sides. The CT scan revealed translation and rotation of the left scapula and displaced fractures of the spinous processes. This patient was diagnosed with traumatic OSTD with a mangled extremity severity score (MESS)[5] of 16 points and type 4 Zelle classification.[6]

We did not perform emergency amputation of the left upper limb because the patient and his family strongly objected to an incipient amputation. After detailed communication with the patient and his family, we performed emergency surgery and explained to the patient that the procedure was to provide the patient and his family the time necessary to process his injury and give consent for the necessary amputation procedure.

Figure 2



Postinjury CT findings showing that the right limb was raised, resulting in the right shoulder blade rotating outside owing to restrictions in the CT machine, and the bilateral contrast was not clear.

Therefore, we performed emergent débridement, glenohumeral stabilization with 2 Kirschner wires (2.5 mm in diameter), and long-section vascular bridging anastomosis with a 10-cm autograft great saphenous vein. To repair the skin, a full-thickness skin graft from the wound was used and covered with negative pressure dressing. Our colleague who was an oral surgeon performed maxillofacial repair, and a thoracic surgeon performed thoracic drainage. At 6 days postsurgery, partial necrosis of the pectoralis major and upper-arm muscles was observed, and serious infection was found at the axilla; the wound exhibited a notable amount of purulent drainage, and the patient developed a fever of 39°C. In addition, the patient's white blood cells, polymorphonuclear leukocyte percent, C-reactive protein, and erythrocyte sedimentation rate were elevated. A forequarter amputation was subsequently performed, removing the scapula, necrotic muscle, and a portion of the clavicle. The residual wounds were covered with healthy skin from the shoulder. After revision surgery, no complications occurred, and the patient was discharged 1 month postoperatively. Two years after the surgery, the wound was in good condition (Figure 3). However, the patient still reported of phantom limb pain, with a visual analog scale score of 10. He quit his job as a carpenter. He does not use a prosthetic limb in daily life. Self-rating anxiety scale (SAS) was used for psychological status SAS and self-rating depression scale (SDS), both of which include 20 items, The total score is 100, with higher scores indicating heavier negative psychology. SAS $\geq$ 50 and SDS $\geq$ 53 indicate anxiety and depression.[7] The patient was administered with both questionnaires, revealing indications of mild anxiety and depression with SAS 56 and SDS 58.

Discussion

STD was confirmed, on the basis of medical history as well as clinical and radiographic findings. The diagnosis of STD can be delayed in some patients with multiple traumas. Multiple review articles have addressed the anatomy of scapulothoracic articulation and the spectrum, imaging evaluation, differential diagnosis, and management of STDs for both closed and open STD.[2,4,8-10]

Johansen proposed the MESS as an early phase and objective means to evaluate the use of amputation in patients with lower-limb trauma.[10] MESS is widely used in the clinic, especially for patients who need limb salvage or amputation. Skeletal/soft-tissue injury, limb ischemia, shock, and patient age are factors affecting the MESS, and scores of seven or higher are associated with a high likelihood of requiring amputation.[5] Two main classification systems have been proposed for STD. Damschen et al[1] first proposed a logical system in 1997 to improve clinical decision making regarding diagnosis and management. This was modified in 2004 by Zelle et al[6] in a study on long-term functional outcomes following STD, which differentiated between patients with complete and incomplete brachial plexus avulsion. In this case, the MESS was 16 points and complete brachial plexus avulsion was observed; therefore, the Zell classification was diagnosed as type 4. The logical classification described by Damschen comprised three categories, encompassing injuries to muscles, blood vessels, and nerves; however, it did not further differentiate between complete or partial brachial plexus nerve injuries. The modifications suggested by Zell et al divided nerve damage into complete brachial plexus injury and partial brachial plexus injury. Zell found that, in his study, all patients with a complete brachial plexus avulsion either had had an amputation or had poor shoulder function at the time of follow-up. Therefore, these authors proposed that the degree of brachial plexus injury should play a major role in the description of the severity of a STD.[6] In this case, per the Damschen and Zell classification recommendations, this patient would have been indicated for an amputation as an index surgery. However, the patient and his family were initially unwilling to proceed with amputation, and thus, the patient did not undergo definitive surgical

Figure 3

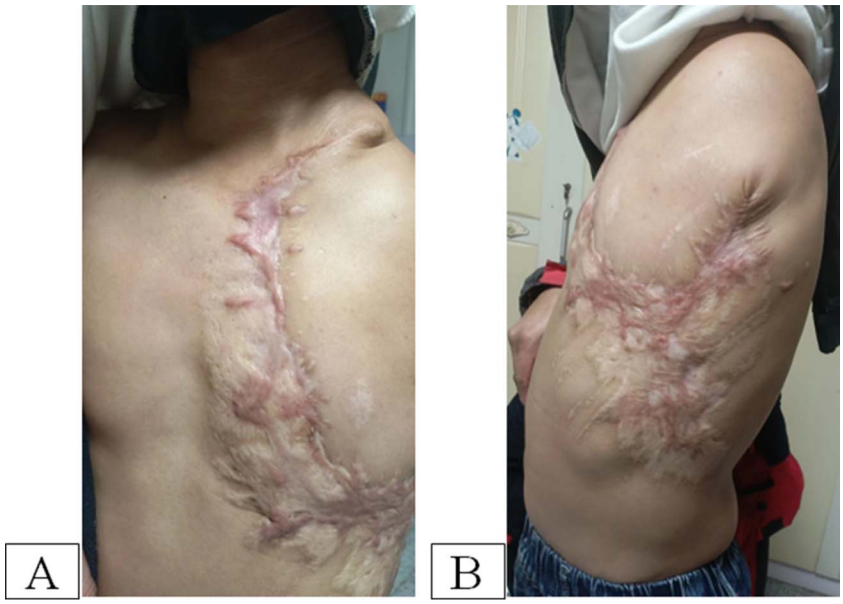


Image showing external observation 2 years after the injury. **A**, Anterior view and (**B**) lateral view.

treatment of his injury until 6 days after his injury, when he became septic secondary to infection of his mangled and devitalized residual limb. When the patient's life risk, infection risk, later functional recovery, and medical costs are taken into account, amputation is a relatively better treatment for the patient and his family overall.

In cases of OSTD, amputation of the impaired limb is considered beneficial because the condition is life-threatening and may leave a nonfunctional upper limb, especially in Zelle type 4 patients with complete brachial plexus avulsion. Forequarter amputation was previously selected as a surgical procedure for bony and soft-tissue sarcomas that occurred in the proximal upper arm and from the thorax to the shoulder.[4,11-13] In this case, we also performed forequarter amputation, and apart from phantom pain, the patient achieved good results. Approximately 70% of individuals worldwide will encounter a traumatic event during their lifetime,[14] yet only a small proportion (5.6%) will develop posttraumatic stress disorder (PTSD).[15] The effect of PTSD on patients extends beyond personal suffering, affecting families and work performance. Consequently, it is imperative to prioritize the prevention and treatment of PTSD.

Conclusion

We treated an OSTD patient with severe musculoskeletal and neurovascular injury through forequarter amputation. Properly evaluating the condition of the upper limbs, life-threatening complications, and the MESS score/Zelle type are important options to consider for of limb salvage or amputation.

Acknowledgments

The case was reported retrospectively with the patient's permission. Written informed consent was obtained from all subjects before the study.

References

1. Oreck SL, Burgess A, Levine AM: Traumatic lateral displacement of the scapula: A radiographic sign of neurovascular disruption. *J Bone Joint Surg Am* 1984;66:758-763.

2. Stepanovic ZL, Milisavljevic SS, Prodanovic NS, Stahel PF; With expert commentary by: Open scapulothoracic dissociation. *J Trauma Acute Care Surg* 2015;79:698-700.

3. Goldstein LJ, Watson JM: Traumatic scapulothoracic dissociation: Case report and literature review. *J Trauma* 2000;48:533-535.

4. Heiman EM, Jankowski JM, Yoon RS, Feldman JJ: Scapulothoracic dissociation: A review of an orthopedic emergency. *Orthop Clin North Am* 2022;53:77-81.

5. Helfet DL, Howey T, Sanders R, Johansen K: Limb salvage versus amputation. Preliminary results of the Mangled Extremity Severity Score. *Clin Orthop Relat Res* 1990;256:80-86.

6. Zelle BA, Pape HC, Gerich TG, Garapati R, Ceylan B, Krettek C: Functional outcome following scapulothoracic dissociation. *J Bone Joint Surg Am* 2004;86:2-8.

7. Dunstan DA, Scott N: Norms for Zung's Self-rating Anxiety Scale. *BMC Psychiatry* 2020;20:90.

8. Kani KK, Chew FS: Scapulothoracic dissociation. *Br J Radiol* 2019;92: 20190090.

9. Choo AM, Schottel PC, Burgess AR: Scapulothoracic dissociation: Evaluation and management. *J Am Acad Orthop Surg* 2017;25:339-347.

10. Anbarasan A, Mohamad NH, Mariapan S: Open traumatic scapulothoracic dissociation: Case report of a rare injury. *Trauma Case Rep* 2018;18:42-45.

11. Rickelt J, Hoekstra H, van Coevorden F, de Vreeze R, Verhoef C, van Geel AN: Forequarter amputation for malignancy. *Br J Surg* 2009;96: 792-798.

12. Yulian ED, Pandelaki J, Kodrat E, Wibisana IGNG: Forequarter amputation post transarterial chemoembolization and radiation in synovial sarcoma: A case report. *Int J Surg Case Rep* 2021;81:105824.

13. Kuroiwa T, Kawano Y, Maeda A, et al: A case of open scapulothoracic dissociation with forequarter amputation. *JSES Int* 2021;5:846-849.

14. Kessler RC, Aguilar-Gaxiola S, Alonso J, et al: Trauma and PTSD in the WHO World Mental Health Surveys. *Eur J Psychotraumatol* 2017;8:1353383.

15. Koenen KC, Ratanatharathorn A, Ng L, et al: Posttraumatic stress disorder in the World Mental Health Surveys. *Psychol Med* 2017;47: 2260-2274.