Technical Note

Obere Extremität 2022 · 17:38–40
https://doi.org/10.1007/s11678-021-00637-w
Received: 4 November 2020
Accepted: 9 March 2021
Published online: 21 April 2021

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Arthroscopic treatment of a multifragmentary glenoid fracture

Video online

The online version of this article (https://doi.org/10.1007/s11678-021-00637-w) contains the video: "Arthroscopic treatment of a multifragmentary glenoid fracture". You will find the video at the end of the article as "Supplementary material." Video by courtesy of A. Wafaisade, B. Bouillon, M. Balke und P. Kappel, Department of Trauma and Orthopedic Surgery, University of Witten/Herdecke, Cologne-Merheim Medical Center and Sports Clinic Cologne, Germany; all rights reserved 2021.

Background

Glenoid fractures can lead to persistent glenohumeral instability and posttraumatic osteoarthritis. Generally, surgery is indicated for displaced fractures, in particular those with an articular step greater than 5 mm [1]. Traditionally, these procedures have been performed using extensive arthrotomy, which is associated with higher risks for intraoperative and postoperative complications [2]. Thus, several arthroscopic techniques have been developed to address two-part fractures (anterior rim, posterior rim, or transverse; [3, 4]). However, these techniques remain technically challenging, even more so in cases of multifragmentary glenoid fractures, i.e., more than two articular fragments. Accordingly, in the classification of glenoid fractures by Ideberg, any injury pattern involving three or more fragments of the articular surface are all summarized as Type "6" [1]. The recent classification of the "Arbeitsgemeinschaft für Osteosynthesefragen" (AO) offers a more detailed subclassification.

Therefore, the aim of this article is to describe a technique for a completely arthroscopic fixation of a three-fragment, y-shaped glenoid fracture (AO14F2.1 or Ideberg "6") in a 25-year-old polytrauma patient (**Fig. 1a**) applying modifications of recently described arthroscopic techniques for two-part glenoid fractures [3, 4].

Surgical technique

The patient is placed in the beach-chair position. Using a standard posterior portal for visualization, severe displacement of the fragments is appreciated. Both the anterior portal and the anterosuperior portal are established. Hematoma is removed using a shaver. The rotator interval capsule is released, in particular visualizing the inferior and the lateral aspect of the coracoid, with partial release of the coracoacromial ligament. In the present case, since a pulley lesion with a ruptured superior glenohumeral ligament was detected, arthroscopic tenotomy with suprapectoral tenodesis was performed. The arthroscope is then introduced through the anterosuperior portal, remaining there for the rest of the procedure.

Posterior fragment

Several instruments (e.g., elevator, probe) are used via the anterior portal for fracture reduction of the posterior fragment.

Subsequently, a glenoid guide (Smith&Nephew [London, UK]) is introduced into the posterior portal with its anterior hook end, and is advanced anteriorly parallel to the glenoid. The guide is rotated to capture the anterior edge of the glenoid at the 8-o'clock position under the hook, with the guide parallel and flush to the glenoid surface.

Posteriorly, two bullets are then placed over the glenoid guide through an accessory posteromedial skin incision. Each bullet can be advanced until it has firm contact with the posterior fragment, thus supporting fracture reduction. A 1.4-mm K-wire is placed through each bullet. Both K-wires are advanced under power, just until reaching the anterior cortex of the scapular neck to avoid penetration of the anterior neurovascular structures. Each K-wire will be 5 mm below the cortical edge of the glenoid surface, parallel to one another and 10 mm apart. At this stage, the bullets and the glenoid guide can be removed posteriorly. In the present case, the upper K-wire exited just above the posterior fragment and was therefore removed again. C-arm fluoroscopy is used to verify the appropriate trajectory. Thus, only the lower K-wire is used to introduce a partially threaded, self-drilling cannulated screw with a 4.0-mm diameter (ASNIS III, Stryker [Kalamazoo, MI, USA]) from the posteromedial skin incision. In this step, compres-

This work was awarded the DVSE Alwin Jäger Video Prize for 2020.

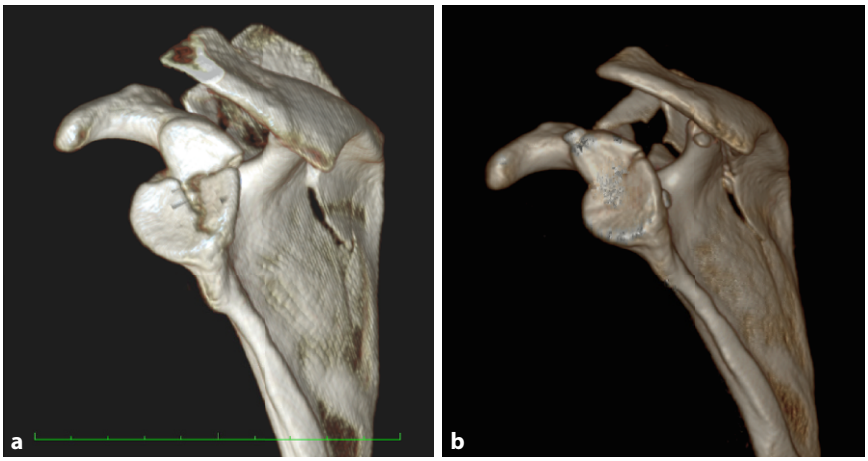

Fig. 1 ▲ **a** Preoperative computed tomography of the left shoulder with three-dimensional reconstruction and subtraction of the humerus showing posterolateral view of the glenoid with a three-part articular fracture (AO 14F2.1). **b** En-face view of the glenoid on computed tomography image of the left shoulder with three-dimensional reconstruction and subtraction of the humerus obtained 2 days postoperatively

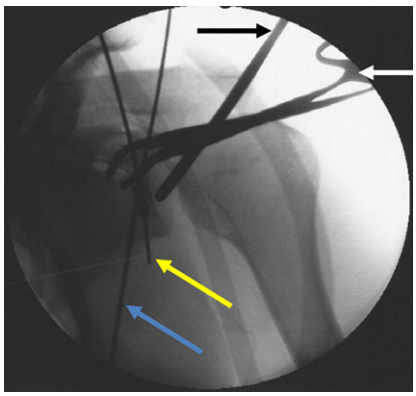

Fig. 2 ▲ Intraoperative anteroposterior fluoroscopy of the left shoulder after placement of the second, cranial K-wire from a high anteromedial portal (*blue arrow*). The *yellow arrow* marks the posterior K-wire with the inserted cannulated screw already fixing the posterior fragment. Also shown are the reduction clamp in the anterior portal grasping the coracoid (*white arrow*) and the trocar of the arthroscope (*black arrow*), which is left in the anterosuperior portal during fluoroscopy

sion with closure of the intra-articular gap can be seen.

Cranial fragment

With the arthroscope still in the anterosuperior portal, the opening in the rotator interval makes alternating and free visualization of both the glenohumeral joint and the coracoid possible. A serrated reduction clamp ("lobster claw") is placed through the anterior portal to grasp the coracoid firmly. Since the fracture pattern displays a continuous coracoglenoid unit (as in Ideberg Type 3 fractures), the extracorporeal manipulation of the clamp allows for precise reduction of the cranial glenoid fragment.

Further soft tissue was removed from the lateral aspect of the coracoid base to define the starting point of the cranial screw. Therefore, a high anteromedial portal just anterior to the lateral clavicle was established. From this portal, a K-wire was introduced. After visualization with fluoroscopy (**Fig. 2**), a cannulated screw was inserted. However, this step had to be repeated from a starting point slightly more medial and posterior because the first screw showed displacement of the posterior fragment. Finally, after removal of both K-wires, stable fixation is confirmed with a probe.

Postoperative three-dimensional computed tomography shows optimal fracture reduction for the posterior fragment and a satisfactory reduction of the cranial fragment with a 1- to 2-mm gap of its posterior aspect (**Fig. 1b**). Nine months after surgery, the patient presented with a Subjective Shoulder Value of 90 and a Constant Score of 92.

Discussion

Multifragmentary glenoid fractures are very rare. In the case presented here, surgery was indicated because the three articular fragments showed substantial displacement. However, as traditionally performed, open surgery would have necessitated combined anterior and posterior arthrotomy with a substantial soft tissue trauma [1, 2].

To our knowledge, only one case report by Gigante et al. described a similar fracture pattern treated arthroscopically: A distinct reposition technique was not further explained, and fixation was achieved with two percutaneous K-wires, which were removed after 6 weeks [5].

Therefore, we aimed to present a detailed, sufficient, and reproducible all-arthroscopic procedure for treatment of multifragmentary, y-shaped glenoid fractures:

First, with the arthroscope in the anterosuperior portal, free and alternating visualization of both the glenoid and the coracoid is possible.

Originally, the glenoid guide was designed for implantation of a button–suture construct, but allowed for safe placement of the posterior screw in the present case [4]. Also, the posterior bullets aided in fracture reduction.

Furthermore, the reduction clamp grasping the coracoid through the anterior portal enables easy reduction of the cranial glenoid fragment with extracorporal manipulation [3].

Finally, since the cranial screw was introduced from the lateral aspect of the coracoid base, a Neviaser portal was not necessary, thus minimizing the risk of penetration of the supraspinatus or of suprascapular nerve injury.

Practical conclusion

- **Multifragmentary glenoid fractures are very rare.**
- **An all-arthroscopic procedure with anatomic reduction and stable screw fixation can be performed for y-shaped fracture patterns (AO14F2.1).**
- **Novel modifications of recently described arthroscopic techniques**

for simple glenoid fractures are applicable, minimizing the potential risks associated with open surgery.

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Funding. Open Access funding enabled and organized by Projekt DEAL.

Declarations

Conflict of interest. The authors report the following potential conflicts of interest or sources of funding: A. Wafaisade is a consultant for Stryker; received travel costs from Arthrex and DePuy-Synthes, and is a consultant for and received travel costs from Smith & Nephew. M. Balke is a consultant for Smith & Nephew and ConMed. B. Bouillon and P. Kappel declare that they have no competing interests.

For this article no studies with human participants or animals were performed by any of the authors. All studies performed were in accordance with the ethical standards indicated in each case.

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