CASE REPORT

Proximal humerus head-splitting fracture associated with single-part anterior dislocation

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SUMMARY

Fractures that split the humeral head are extremely rare, and usually, the split part is posteriorly dislocated. However, in our case, the split part was anteriorly dislocated and trapped between the anterior glenoid and the subscapularis muscle. In this case, the acquisition of preoperative CT results was vital to plan the exposure and reduction strategies. Open anatomic reduction and internal fixation should be considered as the first treatment of choice in young active adults.

BACKGROUND

Head-splitting and impression fractures are usually the result of a severe impaction of the humeral head into the glenoid, with or without dislocation.^{1–3}

To the best of our knowledge, there have been few published cases of proximal humerus head-splitting fracture associated with anterior dislocation of the split part, as described in this case (trapped between the anterior glenoid and the subscapularis).

CASE PRESENTATION

A 40-year-old truck driver fell down directly onto his shoulder and, 30 min later, arrived at our clinic presenting with a severe pain and swelling in his right shoulder. A physical examination revealed a mass on the anterior aspect of his shoulder. In addition, the range of shoulder motion was limited and painful. The neurovascular structures were intact. All preoperative preparations were performed as quickly as possible, and the patient was prepared for surgery. The surgery was performed that same day, only 6 h following admission.

The head-splitting pattern was clear on radiographs, and CT revealed that the split part was anteriorly dislocated.

INVESTIGATIONS

The patient had neither active nor passive movement in his right shoulder. An anterior bump was detected on the anterior side of the shoulder. The neurovascular structures were intact.

The head-splitting pattern was clear on radiographs, and CT revealed that the split part was anteriorly dislocated (figure 1A, B).

DIFFERENTIAL DIAGNOSIS

The differential diagnosis included anterior dislocation of the shoulder and head-split fracture of the humeral head to the posterior side. These

diagnoses were all eliminated by imaging studies, including X-rays and CT.

TREATMENT

One of the most important strategies that can influence a treatment plan is eliminating a posterior fracture-dislocation prior to surgery. This strategy is important because the surgeon cannot make the proper incision if the dislocated side cannot be identified. For posterior head-splitting fracture-dislocations, an additional posterior approach will occasionally be necessary for difficult reductions.

The subscapularis and anterior capsule were released from the lesser tuberosity through a standard deltopectoral incision. Then, an osteochondral fragment carrying approximately 65% of the articular surface was found firmly entrapped between the anterior glenoid rim and the subscapularis. We observed that the fragment retained its capsular attachments and that there was arterial back bleeding. It could be categorised as type 1 using Robinson's criteria.

Dislodging this fragment was quite difficult. Anatomical reduction was achieved with fixation using two k-wires and three 4 mm AO cancellous screws (figure 1C).

OUTCOME AND FOLLOW-UP

At the 3-month follow-up, X-rays showed stable fixation with good evidence of healing (figure 2A).

At the end of the third month, the patient could return to his truck-driving job. At the 15-month follow-up, scintigraphy revealed late revascularisation (figure 2B).

After the 15-month follow-up, the patient had no shoulder pain, and he had good functionality in his right shoulder, with 120–125° of lateral abduction and 130° of forward elevation. In addition, he showed internal rotation of his shoulder and hand against the lumbosacral region. At 15 months post-surgery, the constant shoulder score was –76 (figure 2C–E).

DISCUSSION

There have been few previously published case reports and clinical series^{4–7} that focused on head split fractures with posterior dislocation.

A systematic search of the PubMed database was performed. The following research criteria were applied: (1) papers written in English, (2) papers examining anterior fracture dislocation of the humeral head in adults and (3) cases involving head-splitting fractures. Of 87 articles, only 2 fulfilled the inclusion criteria. Other papers involved paediatric

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Figure 1 (A and B) The head-splitting pattern was clear on the radiographs, and CT revealed that the split part was anteriorly dislocated. (C) Anatomical reduction was achieved with fixation using 2 k-wires and 4 mm AO cancellous screws.

Figure 2 (A) After a 3-month follow-up, we obtained X-rays that showed stable fixation and good bone healing. (B) After a 15-month follow-up, we used scintigraphy to detect the vascularity of the humeral head. We observed that the head was still in the late revascularisation phase. (C–E) After a 15-month follow-up, the patient had no shoulder pain and had moderate functionality of his right shoulder with 120° of lateral abduction and 130° of forward elevation, with internal rotation of the shoulder and the patient's hand against the lumbosacral region. At 15 months postsurgery, the Constant shoulder score was –76.

cases, three-part or four-part fractures, posterior fracture-dislocations and other issues. Two articles (refs. 8 and 4) documented an anterior dislocation humeral head-splitting fracture, as in our case.

Silver *et al*⁸ reported one case of a two-part anterior fracture-dislocation of the humeral head. The article focused on reduction techniques. The authors could not report on the follow-up scores because the patient was lost to follow-up.

Robinson *et al*⁴ presented a large patient cohort (58 patients) with anterior fracture-dislocations of the humeral head. The authors subclassified the injury pattern into type I and type II. In subgroup type II (35 patients), the humeral head was not engaged on the anterior glenoid rim, and there was no osteochondral fracture of the humeral head. They classified all fractures as Neer types III–IV, and this group was mostly composed of valgus-impacted fractures. However, in the type I subgroup (23 patients), 21 patients had three-part fractures (Neer type III), 1 patient had a four-part fracture (Neer type IV) and only one patient had a two-part fracture, as in our case, which highlights the rarity of our case.

Chesser *et al*⁷ reported eight cases of head-splitting fracture-dislocations of the humeral head. We closely examined their cases and realised that their cases seemed to be classified as posterior fracture-dislocations rather than anterior fracture-dislocations.

Chesser *et al*⁷ used the superior subacromial approach, which was popularised by Stableforth and Sarangi,⁹ to treat a posterior fracture-dislocation of the humeral head.

Compared with the cohort of Chesser *et al*⁷ our patient had the same constant score as one of their patients.

Humeral head-splitting fracture-dislocations are associated with avascular necrosis. Regarding avascular necrosis, there were excellent studies that could guide us in predicting the prognosis of our patient and deciding the treatment strategy.

Robinson *et al*⁴ subclassified the injuries into types I and II.

Type I was defined as a humeral head that retained its capsular attachments, was ≥ 2 cm in length and had arterial bleeding.

Type II injuries were characterised as the head being significantly detached from capsular attachment, being < 2 cm in length and having no demonstrable⁴ arterial bleeding.

Type II injuries are prone to avascular necrosis.

The authors cited Hertel *et al*¹⁰ and emphasised the importance of the presence of an extra-articular posteromedial bone spike (a triangular metaphyseal fragment attached to the inferomedial fragment) attached to the humeral head, which is an indicator of a good prognosis of perfusion of the humeral head after a complex proximal fracture.^{4 11}

Our case also had an extra-articular posteromedial bone spike and could be subclassified as type I, which can be associated with a good prognosis.

Schai *et al*,¹² Collopy and Skirving,⁵ Swamy and Schemitsch¹³ reported humeral head fractures (Neer type III–IV, posterior fracture dislocation). They emphasised the rich vascularity of the humeral head and the healing potential.

Swamy and Schemitsch¹³ observed that open reduction and internal fixation of the fragment with Herbert screws offered ideal fixation, without evidence of avascular necrosis.¹³

Their case had no posteromedial metaphyseal spike in which the fracture line was actually above the line of the anatomic neck, in contrast to our case.

In this case, they concluded that even if there was disruption of all vessels and no soft tissue remained intact (the injury could be categorised as type 1 using the Robinson criteria⁴), the rich vascularity of the proximal humerus offered the potential for

vascularisation of the head fragment after stable internal fixation.¹³

Lee and Hansen,¹⁴ Gerber *et al*,¹⁵ Kofoed,¹⁶ published articles that focused on post-traumatic avascular necrosis. From our point of view, in particular, the article by Lee and Hansen¹⁴ shows histological findings (in their case, the resected head was sent for histopathological examination during the prosthetic replacement surgery) in the humeral head that demonstrated extensive revascularisation capacity, even though the head was dislocated and separated from the humerus.

Lee and Hansen,¹⁴ demonstrated revascularisation with capillary ingrowth sequenced with new bone formation (eg, creeping substitution, a phase described in the remodelling phase during the fracture healing process that presents revascularisation with capillary ingrowth followed by new bone formation).

The humeral head is surrounded by rich vascular tissue. The humeral head fragment has a wider fracture surface relative to the thickness of the head. Thus, there is less mechanical stress applied to the humeral head as it heals.¹⁴

Regarding the treatment decision-making process, a literature scan revealed the lack of information about the treatment of humeral head-splitting fractures. Hawkins *et al*¹⁷ recommended haemiarthroplasty mostly for impression-type fractures if the defect encompasses more than 45% of the articular surface, as observed on the axillary view. Some authors also recommended haemiarthroplasty for these fractures because of the possible hazard of avascular necrosis and articular surface traumatic degeneration.¹⁸ However, an analysis¹⁹ of haemiarthroplasty for proximal humeral fractures in patients younger than 50 years old revealed poor results.

From our perspective, open anatomic reduction and internal fixation should be considered as the first line of treatment in such cases. Haemiarthroplasty can be a salvage option in cases of avascular necrosis or degenerative arthritis complications caused by the failure of an initial open reduction and internal fixation procedure.

Learning points

- ▶ Having an extra-articular posteromedial bone spike was associated with a good prognosis.
- ▶ The humeral head is surrounded by rich vascular tissue. The humeral head fragment has a wider fracture surface relative to the thickness of the head. There is less mechanical stress applied to the humeral head as it heals.
- ▶ Even if the articular fragment is denuded from capsular attachments, the rich vascularity of the proximal humerus offers the potential for the revascularisation of the head fragment after stable internal fixation.
- ▶ This case report may help support the study by Lee and Hansen¹⁴ with particular support provided by the late revascularisation phase on scintigraphy in our case (ie, the creeping substitution phase).
- ▶ Open reduction and internal fixation within 24 h should be considered as the preferred treatment method if the patient is younger than 50 years old.
- ▶ Haemiarthroplasty can be a salvage option in cases of avascular necrosis or degenerative arthritis complications caused by an initial open reduction and internal fixation failure.

We preferred open reduction and internal fixation in our case because of the patient's age and life expectancy.

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