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Case report

# Locked 90°-double plating of scapular spine fracture after reverse shoulder arthroplasty with union and good outcome despite plate adjacent acromion fracture

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## SUMMARY

We report the case of a 74-year-old woman who sustained a scapular spine (SS) fracture after a fall 4 weeks after reverse shoulder arthroplasty (RSA). Open reduction and internal fixation (ORIF) with locked 90°-double plating resulted in union of the SS fracture with a good outcome (subjective shoulder value: 80%; Constant score 67; 1 year) despite of an adjacent lateral acromion fracture 3 weeks after ORIF. This is the second description in the literature of a successful double plate ORIF with union of an SS fracture after RSA. SS fractures are known to lead to poor RSA outcomes with a high mal-union rate and non-union rate. We describe the positioning of the plates and technical steps for successful ORIF to avoid complications, discuss the aftercare and report the outcome.

## BACKGROUND

Scapular fractures occur in 1%–4% of patients after reverse shoulder arthroplasty (RSA) and are often associated with poor outcomes if the fracture is located in the region of the scapula spine (SS). For anterior and lateral acromion fractures, non-operative treatment often results in satisfactory outcomes. Several authors have described failure of non-operative treatment of SS fractures as well as failure of open reduction and internal fixation (ORIF). To date there is only one case description of a successful double plate ORIF with union after an SS fracture in the literature. The operative technique and plate positioning has not yet been described well. This is the second report of a locked 90°-double plating with union in this fracture location. The patient had excellent abduction force, no pain with a good outcome 1 year after ORIF despite of the adjacent acromion fracture.

## CASE PRESENTATION

A 74-year-old right-hand dominant woman underwent left RSA for primary OA with concerns of cuff integrity. Her RSA was planned with a 3D software (Blueprint/Wright). The surgery was carried out according to the preoperative plan without perioperative complications (Reversed II metaglene 25 mm; glenosphere 36 mm eccentric +2 mm; ascend flex 1B; tray eccentric +1.5 mm, height +0 mm; inlay technique; insert 36, height +6 mm;

global lateralisation of –2 mm and distalisation of 39 mm according to the preoperative plan).

Four weeks after surgery, the patient was brought to the emergency department and admitted overnight after a fall on ice at the train station. Radiographs (figure 1A,B) and a CT scan (figure 1C) confirmed a displaced lateral SS fracture at the base of acromion<sup>1</sup> in a type 1 fusiform shaped SS<sup>2</sup> as seen on the radiograph (figure 1B) and as confirmed on CT scan.

## DIFFERENTIAL DIAGNOSIS

Acromion and scapular spine fractures after RSA can be classified in acute traumatic fractures as in this case and chronic fatigue fractures due to chronic tension overload after RSA. These fractures, especially the latter, can be associated with osteoporosis. The patient did not have fragility fractures in the past but was assessed with a full bone profile and bone absorptiometry scan 8 years prior, diagnosed with mild osteoporosis and treated with calcium supplementation, vitamin D and bisphosphonates which were discontinued 3 years prior to the fracture after a secondary assessment in 2015. There was no clinical, radiological and surgical evidence of an osteoporotic fatigue fracture or an atypical bisphosphonate-related fracture. The location of the initial lateral SS fracture, in this case, corresponds well to the acromion base as previously described.<sup>1</sup> Its cause was recorded to be traumatic after a fall and direct impact with shoulder abrasions only 4 weeks after an uneventful RSA. The second lateral, plate adjacent fracture may have been caused by lateral screw crowding (too many lateral screws) and may be an erroneous drilling attempt leading to a stress riser. The initial rehabilitation approach with immediate unlimited active-assisted exercises may have also lead to increased stress contributing to the second fracture.

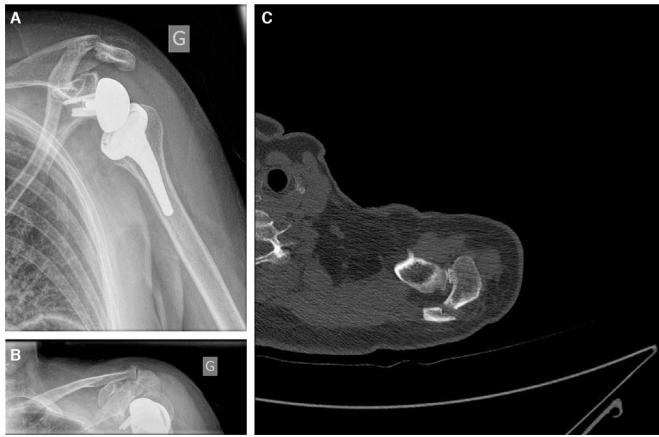
## TREATMENT

ORIF was undertaken 1 week later (figure 2A,B). The patient was positioned 80° sitting and tilted 25° to the opposite side on a shoulder operating table with the scapula draped free on the left side. The left arm was placed in an armholder for shoulder surgery. A posterior longitudinal mediolateral incision along the SS was used and the fracture



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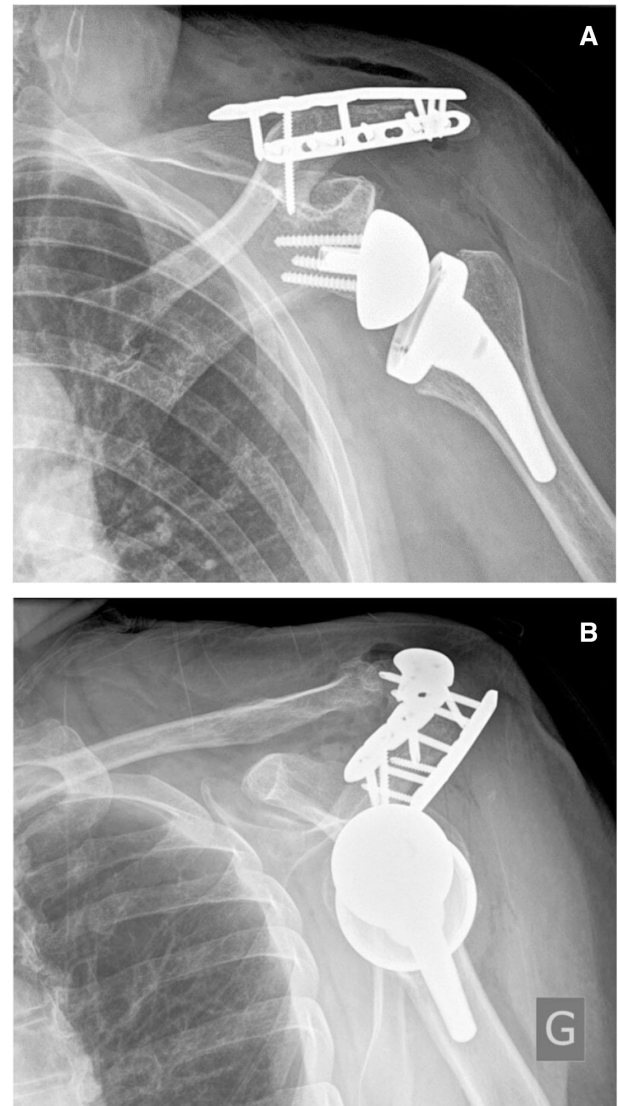


**Figure 1** (A) AP plain film radiography of the shoulder showing displaced lateral scapular spine fracture at the base of acromion. (B) Plain film radiography, scapula spine view of the shoulder showing displaced lateral scapular spine fracture at the base of acromion. (C) Axial CT scan view of the shoulder showing displaced lateral scapular spine fracture at the base of acromion.

identified without stripping the bone unnecessarily. Anatomic reduction of the fracture was easy without tension with the arm placed in 90° of abduction within the armholder. A 3.5/2.7 mm lateral clavicular plate (Synthes/LCP) was bent to the shape of the acromion and SS. The SS fracture was manually reduced and the plate was applied to the superior aspect of the SS with a medial cortical screw and subsequent lateral acromial and medial locking screws. To create a 90°-double plating construct as previously described by Rouleau and Gaudelli,<sup>1</sup> a 2.4 mm straight LCP (Synthes/compact foot set) was bent to the shape of the SS and first medially compressed with a cortical screw before being fixed with locking screws on either side of the fracture. **Figure 3A–F** shows a 3D modelling series of the scapula fracture with instructional detail for plate and screw positioning. On the lateral side at the level of the acromion, one anterior–posterior drilling out of the axis of the acromion occurred. We, therefore, created a 1 cm posterior subacromial incision to pass the index finger under the acromion and marked the AC joint with a needle under fluoroscopy. Two long locking screws could be placed in the axis of the acromion in posterior–anterior (pa) direction (**figure 3c** light blue) resulting in a stable locked 90°-double plate construct (**figure 3A–F**). Careful superior to inferior drilling without overdrilling and insertion of screws of the appropriate length are mandatory requirements in the region of the lateral border of the scapular spine to prevent injury to the suprascapular nerve which passes in close proximity to the lateral border of the scapular spine.

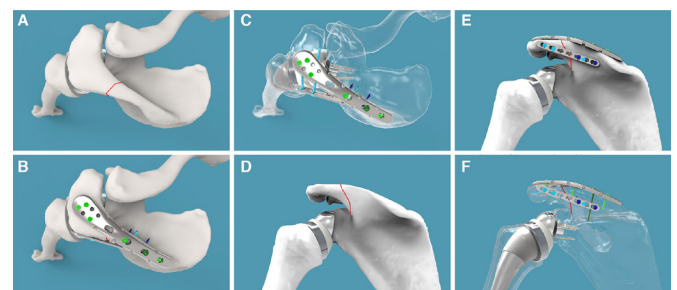
#### OUTCOME AND FOLLOW-UP

The patient was immediately pain free at the fracture site after ORIF. Since the construct appeared solid, we allowed active-assisted range of motion (ROM) without limitations. Three weeks after ORIF the patient reported new pain at the lateral aspect of the acromion. A new plate/screw-adjacent lateral acromion fracture was confirmed on radiographs and a CT scan (**figure 4A,B**). We, therefore, changed the aftercare to passive and active-assisted ROM exercises above 50° of abduction and flexion for 12 weeks out of a 50°-abduction orthosis which was applied continuously. Three months later, union of the SS fracture was confirmed by CT scan. The posterior plate was removed at 4 months after achievement of a good clinical

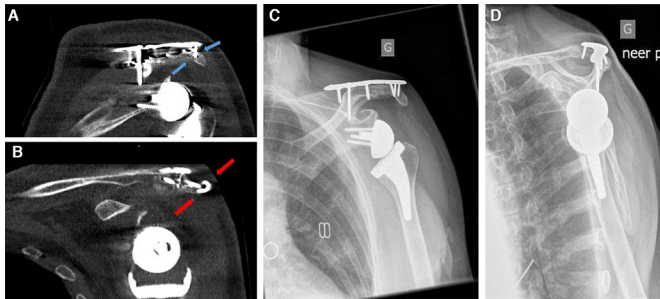


**Figure 2** (A) AP plain film radiography of the shoulder, day 0 post ORIF. (B) Neer view plain film radiography of the shoulder, day 0 post ORIF. ORIF, open reduction and internal fixation.

outcome since this plate had become more prominent due to an inferior tilt of the anterolateral acromion (**figure 4A,B**) associated with local subcutaneous discomfort. We decided not to



**Figure 3** (A) 3D-Scapula modelling, fracture location, superior view, (B) 3D-Scapula modelling, plate and screws positioning, superior view, (C) 3D-Scapula modelling, plate and screws positioning, superior view, (D) 3D-Scapula modelling, fracture location, posterior view, (E) 3D-Scapula modelling, plate and screws positioning, posterior view and (F) 3D-Scapula modelling, plate and screws positioning, posterior view.



**Figure 4** (A) Coronal CT scan: plate adjacent fracture of the anterolateral acromion (blue arrows). (B) Coronal CT scan: prominence of the posterolateral plate after plate adjacent fracture (red arrows). (C) AP plain film radiography of the shoulder, 1 year post-op. (D) Neer view plain film radiography of the shoulder, 1 year post-op.

remove the superior plate, which would have left the acromion and scapular spine completely unprotected with further stress risers due to empty screw holes and an increased risk for a new fracture. Figure 4C,D show the result after 1 year with union of the SS fracture and the plate adjacent acromion fracture. The patient was followed up more than 1 year after RSA with the following active ROM: active forward elevation: 140°; abduction: 140°; external rotation arm at side: 30°; external rotation arm elevated: 30°; internal rotation: L5. She reported no pain but slight discomfort ‘feeling’ her shoulder. At 6 months the subjective shoulder value (SSV) was 60% and the Constant score 56 points. At 1 year the SSV improved to 80% and the Constant score to 67 points with very good strength and no pain (Jobe Test with Micro-FT digital testing device: 16 pounds).

## DISCUSSION

The ideal treatment of SS fractures and acromion fractures after RSA remains unclear.<sup>3</sup>

These fractures occur in 1%–4% of patients after RSA.<sup>4–8</sup>

Anterior acromion fractures and lateral acromion fractures seem to show better outcomes after non-operative treatment than SS fractures.<sup>14</sup> Operative treatment with ORIF was recommended in the past but not well reported regarding the operative technique, intraoperative details as well as post-operative aftercare.<sup>4</sup> To date, there is only one report of a successful double plate ORIF in the literature despite of the awareness that non-operatively treated SS fractures are leading to poor outcomes after RSA with Constant scores below 44 points associated with persistent pain.<sup>4</sup>

This case highlights that previously described 90°-double plate ORIF of the SS and acromion can be successful in achieving SS union with a pain-free outcome. The fracture in the reported case occurred early after RSA (4 weeks) after a fall. The healing potential for chronic stress and fatigue fractures or associated pseudarthroses must be considered to be lower. In these situations, we recommend debridement to bleeding bone and autologous bone grafting in addition to the double plate technique as we have successfully undertaken in an unpublished case (follow-up <6 months at this stage) and as presented but not yet published in Utah 2020 and Munich 2019 by a leading expert, Dr Ludwig Seebauer. The acromion is unforgiving regarding drilling and screw placement. We believe that lateral screw crowding (too many lateral screws) and may be an erroneous drilling attempt have led to a stress riser and a second lateral, plate adjacent fracture. Therefore exact planning of the lateral screws and their interdigitation as illustrated in figure 3A–F

## Patients perspective

I do not have pain at rest and when using the arm but can still ‘feel’ my shoulder. I am happy with the result of my shoulder replacement.

## Learning points

- ▶ Locked 90°-posterior superior plating can result in pain-free union of SS fractures.
- ▶ An armholder helps to achieve tension-free reduction of the fracture.
- ▶ Lateral screw crowding and unnecessary drilling attempts creating stress risers should be avoided to protect the fragile acromion.
- ▶ Aftercare: 50°-abduction orthosis avoiding lower abduction angles for 6 weeks.
- ▶ Non-operative treatment of anterior–lateral acromion fractures can result in good reverse shoulder arthroplasty outcomes.
- ▶ Plate retention is preferable and in case of removal of a symptomatic plate retention of the second plate is advisable to prevent a new fracture (stress risers).

avoiding screw crowding, screw contact and unnecessary drilling attempts, a posterior subacromial incision to insert the surgeons finger for guidance and meticulous technique in drilling and inserting the screws are mandatory to prevent complications with the thin and fragile acromion. The initial rehabilitation approach with immediate unlimited active-assisted exercises may have contributed to the second fracture. This case also shows that anterior and lateral acromion fractures have a minor impact on RSA function as described in the literature. After the experience of the occurrence of a plate adjacent acromion fracture, we recommend passive exercises out of a 50°-abduction orthosis for 6 weeks after ORIF of SS fractures avoiding lower abduction angles. Based on the patient’s fracture aetiology, bone density, bone profile and previous history concomitant medical treatment according to current osteoporosis guidelines is additionally recommended.<sup>9</sup>

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