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# Reconstruction surgery of intra-articular scapular fracture nonunion: a case report and literature review

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A R T I C L E I N F O

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Intra-articular scapular fractures or glenoid fossa fractures are rare and are classified based on the Ideberg classification. Approximately 80% of intra-articular scapular fractures are treated surgically,[36] and various surgical management techniques have been reported as per the classification.

In contrast, the clinical outcomes of scapular fracture nonunion are excellent without surgery.[34] However, nonunion of the scapula with chronic symptoms and poor functional outcomes with highly displaced fractures can be an indication for surgical treatment.[10] Favorable clinical outcomes of reconstruction surgery for scapular nonunion have been described.[25]

To the best of our knowledge, only 23 cases of scapular nonunion that underwent reconstruction surgery (Table I) have been reported. All cases resulted from the failure of conservative management of scapular fractures. Twenty-two cases[1,3,5,8,11-14,18,21,23,25-29,35] involved extra-articular scapular nonunions, and most patients underwent open reduction and internal fixation (ORIF) using a Judet approach. However, only one case[19] involved intra-articular scapular nonunion, and ORIF was performed through a deltopectoral approach. Reports of the reconstruction for the "intra-articular" scapular nonunion are extremely rare, and no study has reported the reconstruction for the "postoperative" scapular nonunion.

We present a rare case of reconstruction surgery of Ideberg type V intra-articular postoperative scapula fracture nonunion. We used the Judet approach and infraspinatus tenotomy for the visualization of the glenoid neck and fossa. We also describe a detailed surgical technique and clinical outcomes after a 1-year follow-up, with a review of the literature.

## Case report

A 68-year-old man fell from a 3-m–high ladder and presented to our hospital. He had a left Ideberg type V scapular fracture and left proximal and distal clavicle fractures, showing the disruption of the superior shoulder suspensory complex (SSSC) with a floating shoulder (Fig. 1). ORIF was performed, with two cannulated cancellous screws (CCSs) and a distal clavicle plate (Fig. 2), under arthroscopy guidance to check for the reduction of the glenoid fossa. Postoperatively, rehabilitation was initiated with passive exercise. Three months postoperatively, he experienced minimal pain with daily activities and exhibited an elevation of 80°.

However, six months postoperatively, he complained of a limited range of motion (ROM) and persistent shoulder pain. His shoulder pain was 8/10 at rest on the visual analog scale and was refractory to medication. The active ROM of his left shoulder was 40° in elevation, 5° in external rotation, and L5 in internal rotation posteriorly. The passive ROM was 50° in elevation. He exhibited normal muscle strength of the upper extremity and showed no signs of axillary nerve palsy; however, atrophy of the infraspinatus was observed. The Japanese Orthopaedic Association score was 30, and the Constant score was 16. X-ray and computed tomography

The study received institutional review board approval.

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**Table I**
List of cases of reconstruction surgery for the scapular nonunion

| Author (year) | Case |
| --- | --- |
| Darrach[11] (1914) | 1 |
| Mick[26] (1983) | 1 |
| Garcia-Elias[14] (1985) | 1 |
| Ada[1] (1991) | 1 |
| Wikes[35] (1993) | 1 |
| Robinson[29] (1993) | 1 |
| Naested[27] (1995) | 1 |
| Ogawa[28] (1997) | 1 |
| Bohm[5] (1998) | 1 |
| Gupta[18] (1998) | 1 |
| Dounchis[12] (1999) | 1 |
| Michael[25] (2001) | 1 |
| Ferraz[13] (2002) | 1 |
| Kaminsky[21] (2002) | 1 |
| Haraguchi[19] (2002) | 1 |
| Charlton[8] (2003) | 1 |
| Marek[23] (2008) | 1 |
| As-Sultany[3] (2008) | 1 |
| Cole[10] (2011) | 5 |
| Total | 23 |

**Figure 1** Primary CT showing a left Ideberg type V scapular fracture, left proximal and distal clavicle fractures with the disruption of the SSSC, and floating shoulder. *CT*, computed tomography; *SSSC*, superior shoulder suspensory complex.

(CT) revealed union of the clavicle fracture; however, the glenoid fossa showed nonunion with inferior fragments which were internally rotated and anteriorly displaced (Fig. 3). Although magnetic resonance imaging (MRI) revealed no rotator cuff injury, the signal intensity on T2-weighted short tau inversion recovery of the infraspinatus was high, suggesting suprascapular nerve injury (Fig. 4). Owing to his refractory pain, limited ROM, and highly displaced glenoid neck and fossa fractures, reconstruction surgery was planned for this scapular nonunion.

Our surgical plan was as follows: First, using the Judet approach, infraspinatus tenotomy and capsular incision were performed to visualize the glenoid fossa. This was followed by osteotomy of the inferior lateral part of the scapula, reduction of the displaced glenoid fossa, and internal fixation of the scapula with CCSs and mesh plates. However, this reconstruction surgery (first reconstruction surgery) was not successful, resulting in the postoperative malreduction of the glenoid fossa, because of which we needed to repeat the surgery (second reconstruction surgery). The procedures of the first and second reconstruction surgeries are outlined in the following.

*First reconstruction surgery*

After the removal of all hardware, we used the Judet approach with slight modifications. The patient was placed in the lateral decubitus position using an arm positioner. The incision started at the posterior aspect of the lateral acromion process, extended medially along the scapular spine, and turned caudally at the medial border to the inferior pole. Dissection was extended to the fascia as full-thickness flaps. The deltoid was taken from its origin on the scapular spine from medial to lateral, exposing the infraspinatus and teres minor. The interval was identified between the infraspinatus and teres minor, and both muscles were carefully retracted to expose the lateral border of the scapula to avoid injury to the ascending branch of the circumflex scapular artery. Because suprascapular nerve injury was suspected preoperatively, we exposed the spinoglenoid notch and shaved its margin with a surgical airtome to decompress the suprascapular nerve and added neurolysis of the suprascapular nerve. No obvious abnormal findings of the nerve were identified.

Then, we added infraspinatus tenotomy approximately 1 cm proximal to the insertion on the greater tubercle of the humerus (Fig. 5) and exposed the glenoid posterior capsule. The capsule was

**Figure 2** X-ray after primary ORIF with two CCSs and a distal clavicle plate. *ORIF*, open reduction and internal fixation; *CCSs*, cannulated cancellous screws.

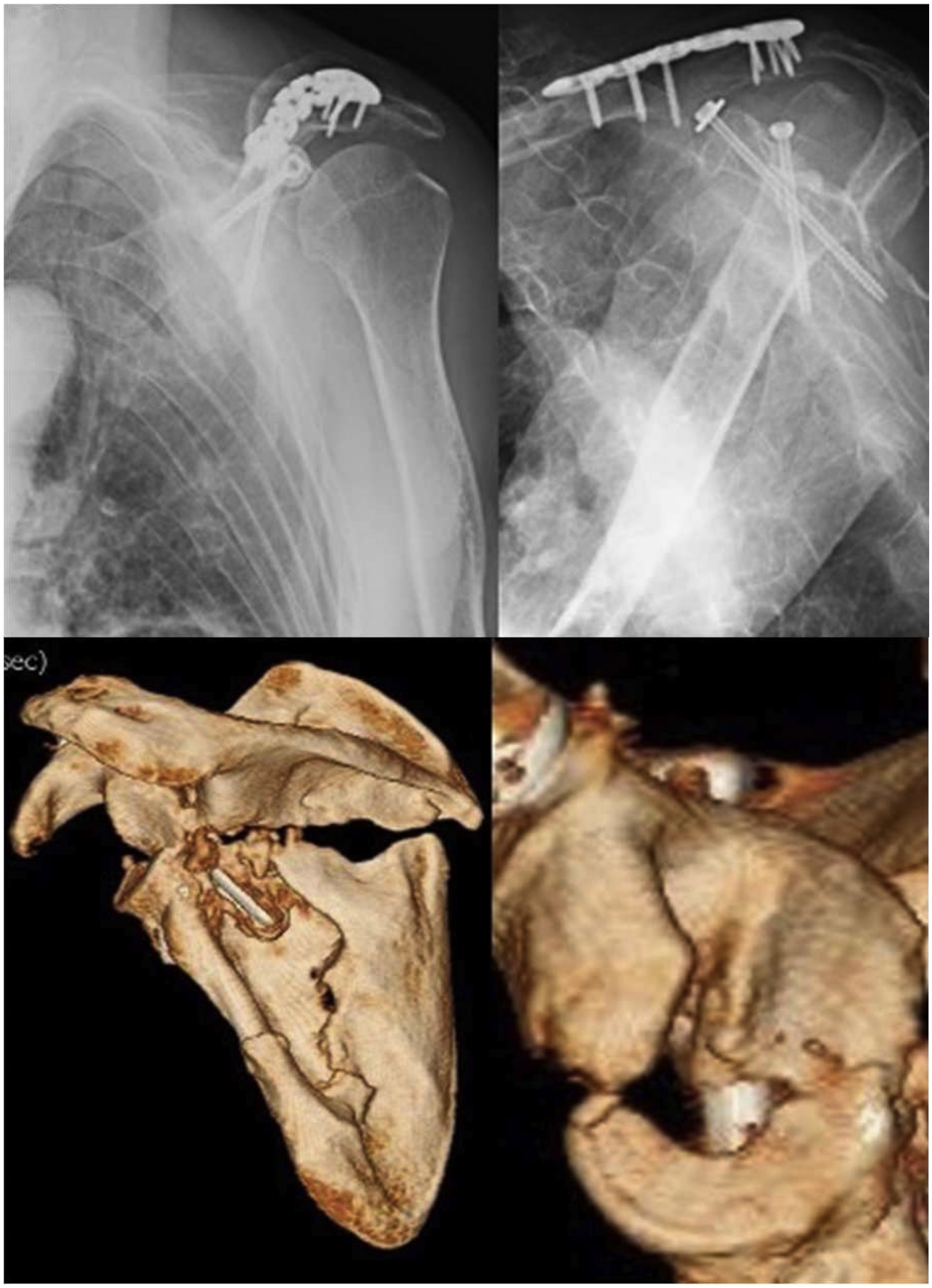

**Figure 3** X-ray and CT on the sixth postoperative month (before reconstruction) showing malunion of the glenoid fossa. *CT*, computed tomography.

incised with an inverted L-shape, and the glenoid labrum was preserved. Furthermore, to mobilize and reduce the glenoid nonunion, we exposed the inferior lateral part of the scapular body by retracting the teres minor inferiorly and performed osteotomy with a bone saw. However, both the mobilization of the nonunion and visualization of the glenoid fossa were insufficient. We added dry arthroscopy from anterior for added glenoid exposure; however, the entire glenoid fossa could not be visualized. Under the limited mobilization and visualization, we performed the reduction of the nonunion by controlling the fragments of the inferior lateral part of the scapula and conducted fixation with a 3.5-mm CCS (Meira, Japan) inserted from the posterior inferior aspect of the glenoid fossa and mesh plates (DePuy Synthes, West Chester, PA, USA) on the osteotomy site and medial scapular body. Finally, the capsule, infraspinatus, and deltoid were repaired.

Postoperative CT revealed that the malreduction of the glenoid remained. There were two possible reasons. First, osteotomy of the scapula was not sufficient for the mobilization of the displaced fragments. Second, we preserved the posterior labrum, which led to the limited exposure of the glenoid fossa. Reoperation was

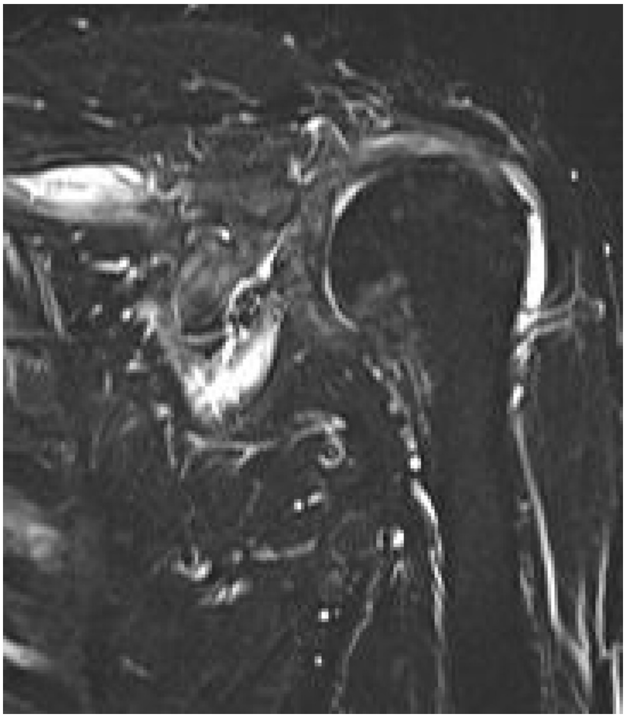

**Figure 4** MRI on the sixth postoperative month showing no rotator cuff injury and high intensity of T2-STIR of the infraspinatus. *MRI*, magnetic resonance imaging; *T2-STIR*, T2-weighted short tau inversion recovery.

performed one week later. Before reoperation, we assessed the alignment of the scapula and extent and adequacy of osteotomy using a three-dimensional CT simulation by comparing with the uninjured side for sufficient osteotomy.

### *Second reconstruction surgery*

We used the same approach as in the first reconstructive surgery, Judet approach, infraspinatus tenotomy, and posterior capsular incision at the same sites (Fig. 6). In addition, the glenoid posterior labrum was incised and detached, ensuring good visualization of the glenoid fossa under direct view. Subsequently, the inferior lateral part of the scapular body was exposed widely, and sufficient osteotomy was performed for the mobilization of the fragments with reference to the planned alignment. We refreshed nonunion parts and placed the autogenous bone graft obtained by the osteotomy. We performed the reduction and conducted fixation with two 3.5-mm CCSs inserted from the posterior inferior edge of the glenoid fossa and mesh plates on the glenoid neck, osteotomy site, and medial scapular body. The labrum, capsule, infraspinatus, and deltoid were all repaired.

Postoperative CT revealed good reduction and congruity of the glenoid fossa (Fig. 7). The patient's arm was placed in a sling, and passive pendulum exercise was initiated. On the sixth postoperative week, passive elevation exercise began, and active exercise was initiated on the eighth postoperative week. One year after the reconstruction, shoulder pain was almost absent during daily activities, and shoulder ROM was 120° elevation, 20° external rotation, and L5 internal rotation. No shoulder instability or impingement was observed. The Japanese Orthopaedic Association score was 71, and the Constant score was 42. CT revealed good reduction and osteosynthesis of the glenoid fossa (Fig. 8). MRI showed repair of the infraspinatus tenotomy site. A slightly increased T2-weighted short tau inversion recovery signal intensity of the infraspinatus remained (Fig. 9). The patient provided consent for this case report.

## Discussion

Most scapular fresh fractures within acceptable alignments can be treated conservatively.[24] This case revealed double disruptions of the SSSC with floating shoulder and an Ideberg V intra-articular scapular fracture, which is considered an operative indication by CCS fixation.[16,17] However, this case resulted in nonunion with glenoid malunion, probably due to inadequate fixation stability. Although most scapula nonunions attain good clinical outcomes with conservative treatment,[34] we proceeded with reconstruction surgery because of the patient's refractory pain, limited ROM, and highly displaced malunion of the glenoid fossa.

There is only one case of reconstruction surgery of "intra-articular scapular nonunion", reported by Haraguchi,[19] and there are no reports of reconstruction surgery of extra- and intra-articular scapular nonunion "after primary surgery". In the case reported by Haraguchi, a deltopectoral approach was chosen

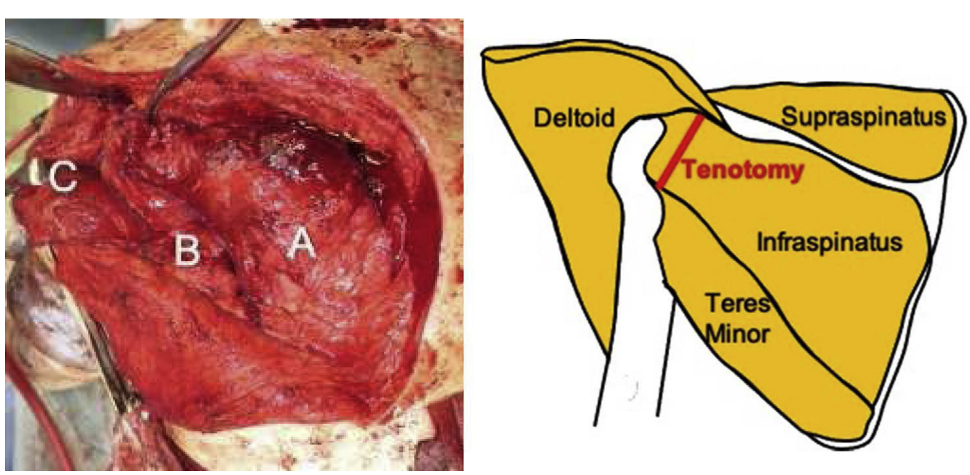


**Figure 5** The intraoperative image and schema of infraspinatus tenotomy. A: infraspinatus muscle, B: teres minor muscle, C: deltoid muscle.

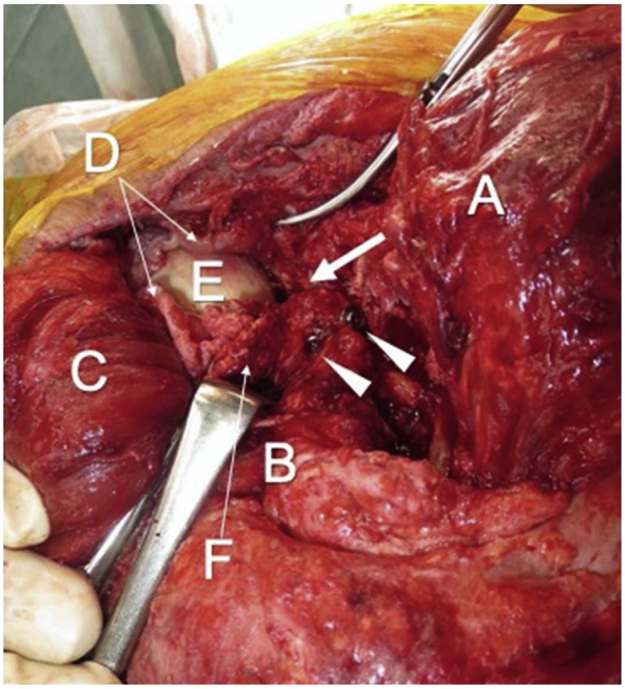


**Figure 6** The intraoperative image of the glenoid fossa in the reconstruction surgery. The infraspinatus muscle (A) was retracted proximally. The teres minor (B) and deltoid (C) muscles were retracted inferiorly. The posterior capsule (D) was incised with an inverted L-shape. Humerus head (E) and glenoid fossa were exposed. The posterior labrum (F) was detached partly, which allowed a good exposure of glenoid nonunion fracture (*a large arrow*). Two CCSs (*arrowheads*) were inserted from the posterior inferior edge of the glenoid fossa. *CCSs*, cannulated cancellous screws.

because a large defect would be produced by reduction in the anterior aspect of the glenoid neck. In this case, the anterior capsule was divided vertically to visualize the glenoid fossa, and osteotomy was performed for the original major fractures. The displaced upper fragment was mobilized and reduced only by holding the coracoid process, and a single plate was placed along the anterior border of the glenoid neck.

In contrast, in this case, we chose the Judet approach for two reasons. First, the primary fracture was Ideberg type V with SSSC disruptions and a floating shoulder, and more rigid fixation was considered necessary. As per retrospective studies, most primary scapular fractures that fulfill the operative indication criteria obtain favorable clinical outcomes with single or dual plating of the scapula through a Judet approach or straight incision.[2,6,9,20,31] In this case, the cause of malunion of the scapula was thought to be instability after primary fixation of CCSs only. A Judet approach allowed us to visualize both the lateral and medial aspects of the scapula and to place more hardware to facilitate rigid fixation. Second, the Judet approach had the advantage of exposing the glenoid neck and lateral border largely. We could perform accurate sufficient osteotomy of the inferior lateral part of the scapula to mobilize the highly displaced nonunion with reference to preoperative CT simulation.

However, it is difficult to visualize the glenoid fossa by the Judet approach alone. We needed infraspinatus tenotomy, capsular incision, and labrum detachment. Previous studies have reported that infraspinatus tenotomy showed favorable clinical outcomes without major complications and good exposure of the glenoid fossa.[15,22] However, the visualization of the glenoid was insufficient only by infraspinatus tenotmy and capsular incision alone. Arthroscopy has been used to observe the glenoid fossa in some reports,[32,33] and thus we added dry arthroscopy supplementarily. It was somewhat helpful; however, the entire glenoid fossa could still not be visualized, which led to imprecise reduction of the glenoid. Finally, by adding partial detachment of the glenoid posterior labrum, we could observe the displacement of the glenoid fossa precisely under direct view.

Complications are concerning. Although we performed infraspinatus tenotomy twice, the tenotomy site was identical, and no shoulder pain was observed at the final follow-up. Similarly, for labrum detachment, no obvious complications, such as impingement, were observed. We believe that the partial healing of the infraspinatus tendon and other structures was attained at the final follow-up. However, the limited ROM of external rotation may be related to the infraspinatus tenotomy.

For the hardware, we adopted two CCSs and mesh plates. Mesh plates exhibited good clinical outcomes in various fractures, such as patella or maxillofacial surgeries.[30] They can be tailored to any surface and rigidly fixed with sufficient coverage. We believe that scapular fractures are a good indication for mesh plates because of their morphology.

Suprascapular nerve injury with scapular fractures was suspected in this case based on physical examination and MRI, despite lack of confirmatory EMG. Because our Judet approach might put the nerve at risk, we added neurolysis and decompression of the suprascapular nerve during this approach, although most cases of incomplete suprascapular nerve palsy without evidence of space-occupying lesions can be managed conservatively.[4,7] No obvious abnormal findings of the nerve were identified. We cannot ascertain the efficacy of this neurolysis and doubt if he had suprascapular nerve injury in the first place; however, at least no shoulder pain related to suprascapular nerve injury was identified at the final follow-up.

Finally, we emphasize that this reconstruction surgery is technically demanding, particularly in the reduction process of the glenoid fossa. Sufficient osteotomy for the mobilization of displaced fragments and good visualization of the glenoid fossa by infraspinatus tenotomy, capsular incision, and partial detachment of the glenoid posterior labrum through the Judet approach contributed to a good reduction of the glenoid fossa and favorable clinical outcomes.

## Conclusion

We performed a technically demanding reconstruction surgery of Ideberg type V scapular fracture nonunion through a Judet approach with infraspinatus tenotomy.

Favorable functional outcomes were obtained by achieving the anatomical reduction of the glenoid fossa with sufficient osteotomy of the glenoid and good visualization of the entire glenoid fossa.

## Disclaimers

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Conflicts of interest: The author, their immediate family, and any research foundation with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

Patient consent: Obtained.

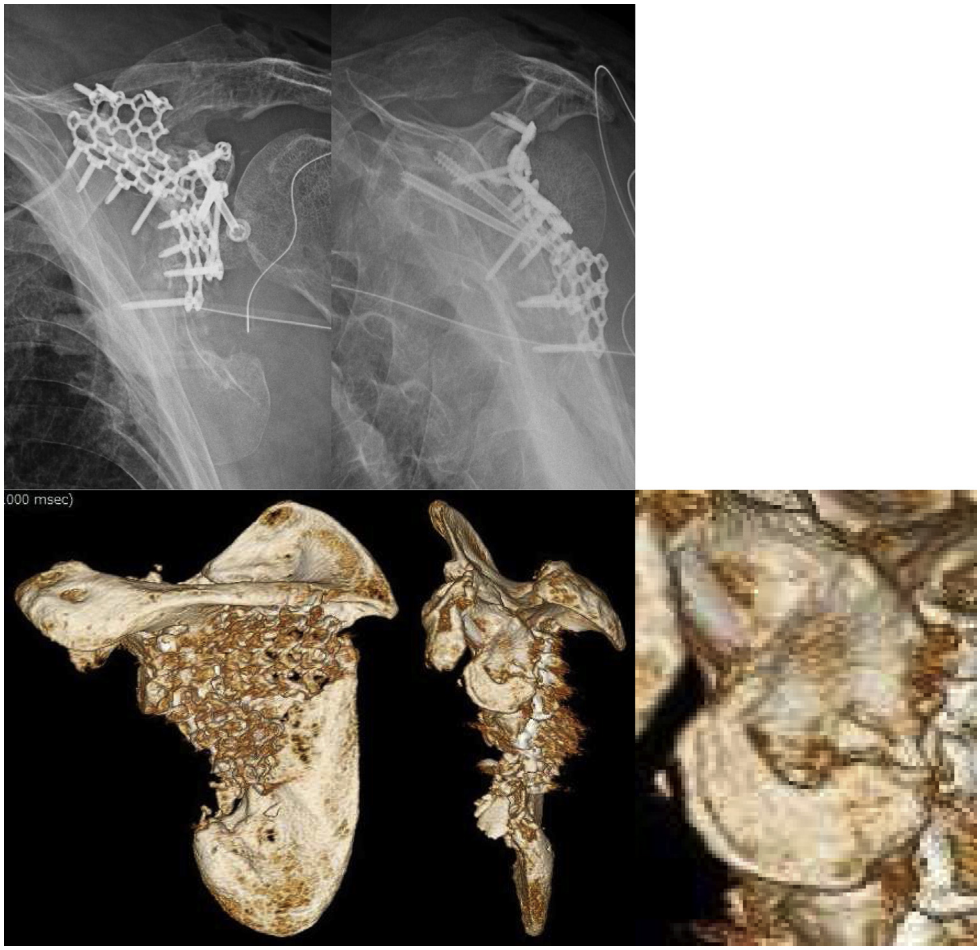


**Figure 7** X-ray and CT after the second reconstruction surgery showing good reduction of the glenoid fossa with two CCSs and mesh plates. *CT*, computed tomography; *CCSs*, cannulated cancellous screws.

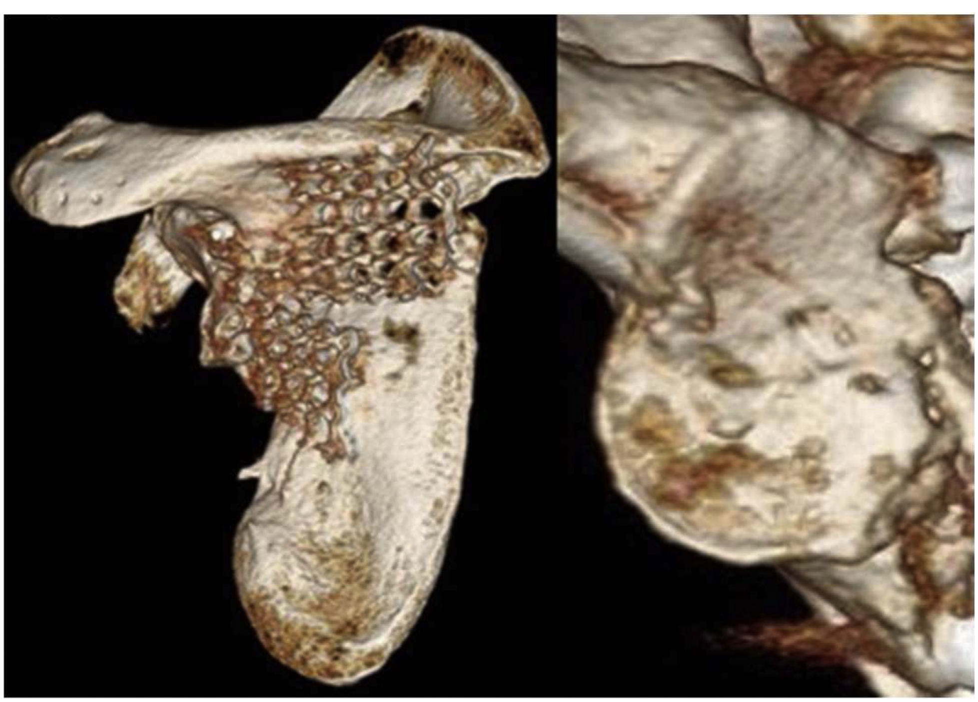

**Figure 8** CT on the first postoperative year showing good reduction and osteosynthesis of the glenoid fossa. *CT*, computed tomography.

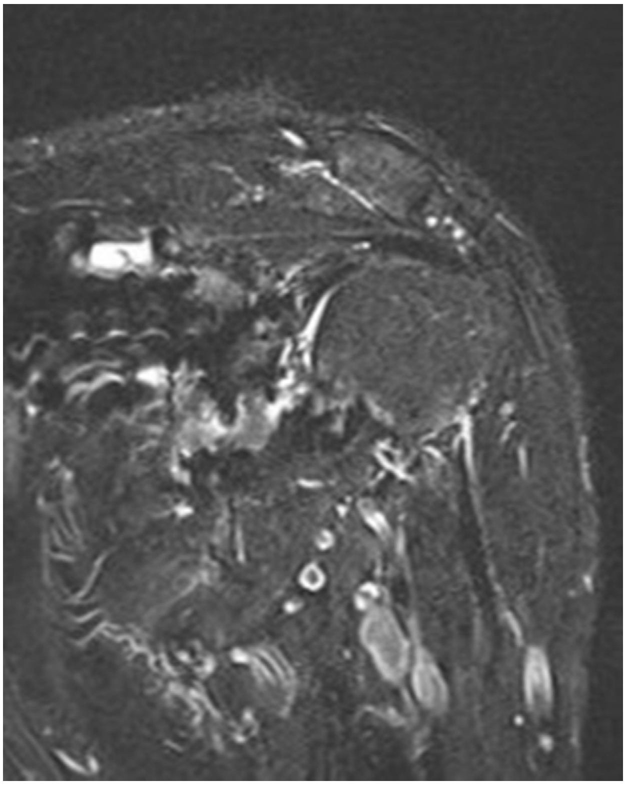

**Figure 9** MRI on the first postoperative year showing slightly increased T2-STIR signal intensity of the infraspinatus. *MRI*, magnetic resonance imaging; *T2-STIR*, T2-weighted short tau inversion recovery.

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