



Analysis of complication after open coracoid transfer as a revision surgery for failed soft tissue stabilization in recurrent anterior shoulder instability

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Received: 9 December 2018 / Published online: 18 June 2019
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Abstract

Background The coracoid transfer represents a treatment option for patients with recurrent shoulder instability. Only a few studies exist about the complication rate of the coracoid transfer as a revision surgery following failed soft tissue stabilization. The purpose of this study was to analyze the results and complication rate after coracoid transfer as a revision surgery.

Methods In this study 38 patients (4 females, 34 males, mean age 27 years) were included of whom 29 patients were available for follow-up after a mean of 27 months. Previous shoulder stabilization procedures were predominantly arthroscopic ($n=25$). Complications were divided according to their timely appearance into early (<3 months) and late (>3 months) postoperatively as well as need for revision. Clinical scores [Constant Score (CS), Rowe Score (RS), Walch-Duplay-Score (WDS), WOSI and Subjective-Shoulder-Value (SSV)] were evaluated preoperatively and at final follow-up.

Results In this patient cohort, the overall complication rate was 27.6%, all of them occurred >3 months postoperatively. In seven of eight cases (24.1%) a repeat surgical procedure was conducted. Recurrent instability occurred in three patients (10.3%) of which two received a revision surgery ($n=1$ iliac-crest bone graft, $n=1$ labral repair). Due to persistent pain five patients underwent an arthroscopic implant removal. The complication rate was with 40% higher in patients with two or more previous surgeries ($n=4$ out of 10 patients) compared to patients with one previous surgery (21%, $n=4$ out of 19 patients). The scores increased significantly comparing pre- to postoperative [CS 74–90 points, RS 27–91 points, WDS 16–89 points, WOSI 40–76% and SSV 41–82% ($p < 0.05$)].

Conclusion The open coracoid transfer as a revision surgery after failed soft tissue stabilization leads to satisfying clinical results. However, the complication rate is high though comparable to data in the literature when used as a primary surgery. The indication for a coracoid transfer should be judged carefully and possible alternatives should be considered.

Keywords Shoulder instability · Shoulder stabilization · Coracoid transfer · Latarjet procedure · Complications

Introduction

Anterior shoulder instability often affects young people with high functional demands. In nearly all cases of recurrent instability, damage of the capsulolabral complex is present [1]. The arthroscopic soft tissue stabilization or Bankart repair is frequently used to treat antero-inferior shoulder instability in patients without significant bony glenoid defects [2]. The results are usually satisfying but recurrent shoulder instability in up to 42% is described [3, 4]. Most of these patients with failed soft tissue stabilization are physically active and revision surgery is required. Risk factors for failure of arthroscopic soft tissue stabilization include young age, male gender, number of preoperative dislocations and contact sports [5–12]. Substantial glenoid or humeral

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head bone loss, the presence of anterior labroligamentous periosteal sleeve avulsion or capsular insufficiency are also associated with recurrent shoulder instability [5, 8, 13–17]. Glenoid bone loss can be found in 86% of shoulders with recurrent anterior instability [18]. Different surgical techniques are available for glenoid reconstruction. Eden and Hybbinette originally described the bone block procedure as a mechanical dislocation barrier in patients with recurrent shoulder instability [19, 20]. Today free bone grafting techniques via an open or arthroscopic approach are frequently used for an anatomic reconstruction of the glenoid concavity [21–26]. The coracoid transfer is also a well-described primary treatment for recurrent anterior shoulder instability in patients with significant glenoid bone loss. First described by Latarjet in 1954 this extra-anatomical procedure has been refined over time and achieved good long-term results [3, 27, 28]. By transferring the coracoid with the conjoined tendons to the anterior glenoid rim the aim is to restore shoulder stability. The bony surface of the glenoid surface is enlarged by the size of the coracoid and the conjoint tendon provides a dynamic sling effect in abduction and external rotation. The coracoid transfer has been relatively successful for preventing recurrent shoulder instability, particularly when glenoid bone loss is present. However, this procedure is associated with several intraoperative or long-term complications, which often require revision surgery. An overall complication rate of 30% after shoulder stabilization using the coracoid transfer is described in a systematic review by Griesser et al. [29]. Several studies reported about the clinical outcome, complication and revision rate of the Latarjet procedure as primary surgery in cases of recurrent shoulder instability. Only few reports exist about the complication rate of the coracoid transfer as a revision surgery after failed prior soft tissue stabilization. The aim of this study was to evaluate the clinical and radiological outcome after open coracoid transfer as a revision surgery following soft tissue stabilization with emphasize on the complication rate and need for revision surgery. The study hypothesis was that the Latarjet procedure leads to satisfying clinical and radiological results, but complications are frequent and must be taken into consideration when discussing different surgical techniques with the patient.

Patients and methods

This prospective non-randomized cohort study has been approved by the local ethics committee (EA1/062/17).

38 patients ($n = 34$ male/ $n = 4$ female) who suffered from recurrent shoulder instability after arthroscopic or open shoulder stabilization were prospectively enrolled in this study. The average age was 27 (18–48) years. Patients with concomitant pathologies such as rotator cuff tears, nerve

lesions, SLAP V-lesions and humeral fractures, confirmed by clinical examination, MRI or CT were excluded from the study.

Surgical technique

All operations were performed by the senior author (M.S.) in the same technique. The patients were placed in the beach chair position under general anaesthesia and perioperative antibiotics (Fig. 1a). A diagnostic arthroscopy was performed using a standard posterior portal for evaluation of concomitant pathologies, integrity of the capsulolabral complex and residual implants (Fig. 1b).

The deltopectoral approach was performed with carefully preserving the cephalic vein. After subdeltoid mobilization, the coracoid process was prepared (Fig. 1c). Medially, the pectoralis minor was released from the coracoid (Fig. 1d). Laterally, the coracoacromial ligament was detached from its acromial insertion leaving it attached to the coracoid for later capsular augmentation (Fig. 1e). The osteotomy of the coracoid was performed from medial to lateral. The undersurface of the coracoid graft was smoothed and prepared for later fixation. Two drill holes were established for later placement of two malleolar screws (Fig. 1f). After a horizontal subscapularis split and a vertical capsular split a Fukuda-retractor was used for exposure of the glenohumeral joint and the anterior glenoid rim was prepared for later graft fixation. The coracoid was transferred and fixed with two malleolar screws and the coracoacromial ligament was attached to the anterior capsule (Fig. 1g). After radiologic control of the correct graft and screw positioning the joint capsule and deltopectoral approach were closed in a standard fashion.

Postoperative treatment

The patients were advised to wear a sling for at least 4 weeks. From day 2 onwards after surgery passive mobilization of the shoulder up to 60° of flexion, 60° of abduction, 60° of internal rotation and 0° of external rotation was allowed. From week 4 passive range of motion was increased up to 90° of flexion, 90° of abduction, free internal rotation. External rotation was further prohibited to 0°. Carefully active assisted exercises in the pain-free range of motion were started. Free flexion and abduction were allowed from week 7 and mobilization of external rotation was started.

Clinical evaluation

Preoperatively as well as postoperatively, patients underwent a physical examination including range-of-motion and shoulder instability testing. Clinical scores [Constant Score (CS), Rowe Score (RS), Walch-Duplay-Score (WDS),

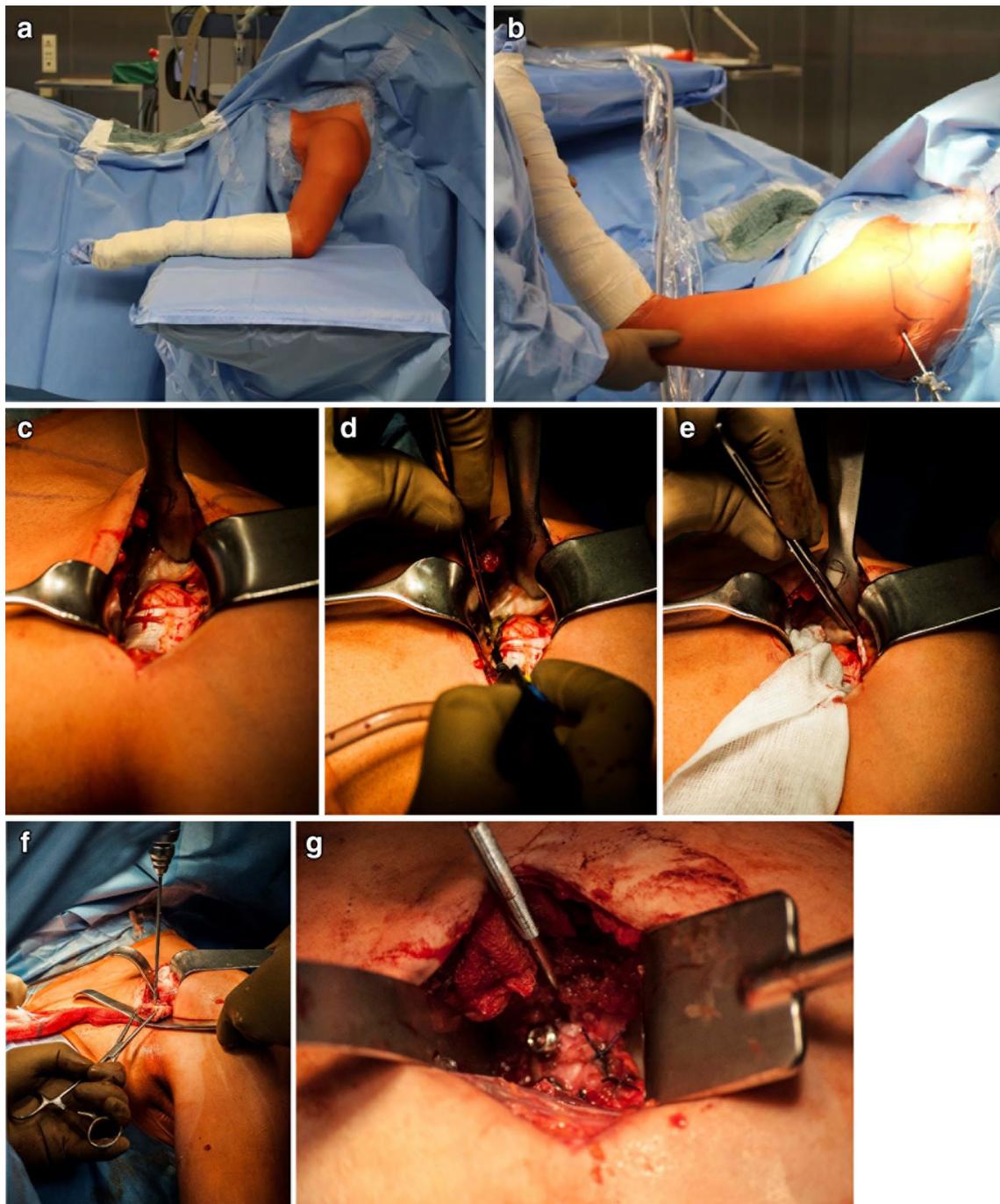


Fig. 1 **a** Patient in the beach chair position. **b** Diagnostic arthroscopy. **c** Deltopectoral approach. **d** Medial detachment of the pectoralis minor muscle. **e** Lateral detachment of coracoacromial ligament. **f**

Preparing the coracoid with two drill holes. **g** Fixation of the coracoid with two malleolar screws and attachment of the coracoacromial ligament to the anterior capsule

Western-Ontario-Shoulder-Instability-Index (WOSI) and Subjective-Shoulder-Value (SSV)] were evaluated preoperatively and at final follow-up. Complications were divided according to their timely appearance into early (<3 months) and late (>3 months) postoperatively as well as need for revision.

Radiological evaluation

In all patients, the same radiologic protocol was used. For quantification of potential glenoid bone loss, a preoperative CT-scan with 3D reconstruction of both shoulders was performed. Glenoid defects were assessed and classified

according to Scheibel et al. [30]. Type II defects include chronic fragment-type lesions with an extra-anatomically consolidated or pseudoarthrotic fragment, which is insufficient for a defect reconstruction due to a resorption process. Type III glenoid defects include erosion-type defects on the anterior glenoid rim which is either the result of chronic abrasion due to recurrent dislocation or develops based on a glenoid fracture with subsequent resorption of the fragment. Type III defects are further distinguished into minor (IIIA) or major (IIIB) glenoid bone loss.

Postoperatively, the correct graft and screw positioning were evaluated radiographically using the true a.p. and axial/Bernageau view. An optimal graft positioning was defined as a coracoid graft, which is at the level of the glenoid subchondral plate by a maximum deviation of 1 mm. Accordingly, a medial or lateral graft positioning was defined by a deviation of the graft in relation to the glenoid subchondral plate more than 1 mm in the medial or lateral direction. After 6 months, 12 months, and at final follow-up, glenohumeral arthritis was evaluated according to Samilson and Prieto [31].

Statistics

The preoperative and postoperative assessed clinical scores were compared using the Wilcoxon–Mann–Whitney-*U*-test. The level of significance was set at $p < 0.05$. The SPSS software package (version 25.0, SPSS, Chicago, IL, USA) was used for statistical analyses.

Results

After a mean follow-up of 27 (18–42) months 29 patients were available for follow-up examination, 9 patients moved away or changed their contact details. In the patient population available for follow-up (25 men, 4 women, mean age 28 years) the right shoulder was affected in 10 cases and the left shoulder in 19 cases. The mean follow-up was 27 (18–42) months. Two patients had a follow-up period less than 24 months (18 months in both cases). The patients reported about subjective well-being when they were contacted for the 24 months follow-up examination. After 18 months, clinical and radiological examination did not show any pathological findings in these two cases.

In 41% ($n = 12$) the dominant side was affected. The patients had an average of 13 (2–60) previous dislocations. 19 patients underwent a single previous surgery before. The majority ($n = 17$) of these were arthroscopic soft stabilization procedures, in two cases an open labral repair was performed. Eight patients underwent two previous operations. Among these patients two received an open surgery as revision shoulder stabilization. Another two patients underwent three previous operations of the affected shoulder before,

which were all conducted arthroscopically. As far it is possible to judge to our opinion the reasons for failure of index surgeries and recurrent instability were glenoid bone loss in all cases, since all patients showed a type II or type III glenoid defect (see radiological results).

Clinical results

The evaluation of the shoulder functional scores in the total population resulted preoperatively in an average CS of 74 (45–90) points, a RS of 27 (5–50) points, a WD of 16 (5–30) points, a WOSI of 40 (6–76)% and an average SSV of 41 (20–65)%. In comparison to the postoperative results with a mean follow-up of 27 months, the clinical scores increased significantly ($p < 0.05$) to an average CS of 90 (69–100) points, a RS of 91 (70–100) points, a WD of 89 (55–100) points, a WOSI of 76 (40–99)% and an average SSV of 82 (40–100)% (Fig. 2). The apprehension test was positive in three cases. The evaluation of the postoperative range of motion showed an average flexion of 177° (160–180), abduction of 175° (140–180), external rotation of 65° (50–85) and internal rotation in 90° abduction of 76° (60–90).

Complications and radiological results

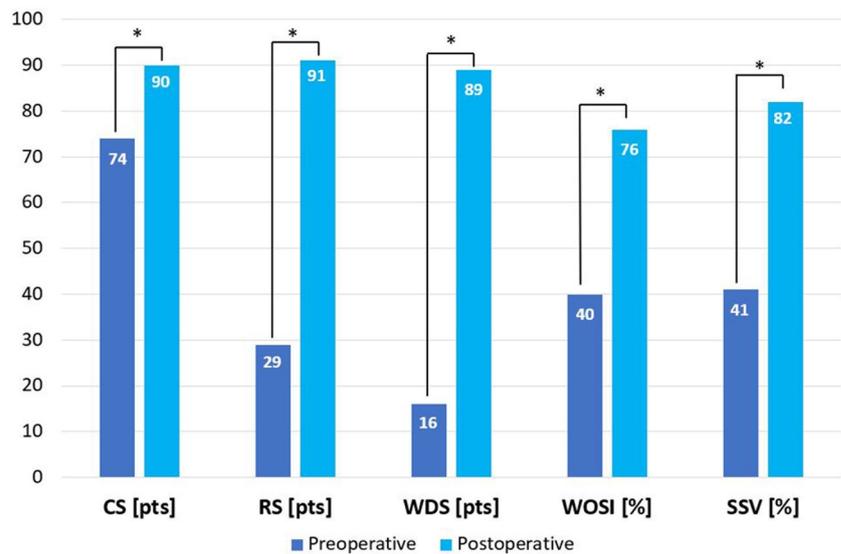
Preoperative CT scans showed a type II glenoid defect in 14 patients. Another 13 patients showed a type IIIA glenoid defect and 2 patients a major osseous defect (type IIIB).

Postoperative x-ray controls (axial/Bernageau) showed an optimal position of the graft in 79% ($n = 23$) without non-union or medial or lateral overhang (Fig. 3a). In four cases (14%) the coracoid graft was in a medial position in relation to the glenoid-rim (Fig. 3b) and in two cases (7%) in a lateral position (Fig. 3c). The CT-control of one patient with recurrent instability showed a non-union of the coracoid (Fig. 4), and the CT of another patient with persistent pain showed a posterior overhang of the screws with irritation of the infraspinatus muscle and suprascapularis nerve (Fig. 5).

In ten cases osteoarthritis I° and in two cases II° according to Samilson and Prieto could be observed [31]. The osteoarthritis was preexisting preoperatively in eight cases.

According to their timely appearance, the complications were divided into early (< 3 months postoperatively) and late (> 3 months postoperatively) as well as need for revision. In this patient population, the overall complication rate was 27.6% ($n = 8$), all of them occurred more than 3 months postoperatively. In seven patients (24.1%) a repeat surgical procedure was performed. Recurrent instability occurred between 9 and 24 months in 3 (10.3%) patients. In one patient with recurrent instability and non-union of the coracoid, which was confirmed in a CT-scan, revision surgery was performed using an autologous iliac-crest bone graft. Another patient with recurrent shoulder instability did not

Fig. 2 Shoulder functional scores pre- and postoperative ($*p < 0.05$). CS Constant Score, RS Rowe Score, WDS Walch-Duplay-Score, WOSI Western-Ontario-Shoulder-Instability-Index, SSV Subjective-Shoulder-Value



show any radiological or intraoperative signs of non-union. In this patient, a labral repair was performed as revision. Another patient reported about recurrent subluxation events during physical activity but did not require revision surgery.

A repeat surgical procedure was performed in 7 patients (24.1%) averagely after 15.6 (5–30) months. Five patients received an arthroscopic implant removal due to persistent pain. A pathomorphological correlate was found in one patient with an irritation of the infraspinatus muscle/suprascapular nerve due to a posterior prominent screw as described before (Fig. 4). One low-grade infection with *Staphylococcus epidermidis* and *Propionibacterium acnes* led to revision 8 months postoperatively. After arthroscopic debridement and removal of the implants, the patient was treated with antibiotics. At revision surgery after 30 months with implant removal of another patient with persistent pain, a distinct chondrolysis and narrowing of the joint space was detected. Although the microbiological analysis was negative, this case was rated as highly suspicious for infection. In Table 1 the complications and repeat surgical procedures are summarized. Half of the patients showing complications including recurrent instability after coracoid transfer had more than one previous surgery. The complication among patient that had one prior shoulder stabilization procedure was 21% (4 out of 19 patients). The complication rate among patients which had more than one previous surgery was 40% (4 out of 10 patients).

Discussion

In agreement with previous studies we found a significant increase in all clinical scores and satisfying results after open coracoid transfer as a revision surgery after failed prior

soft tissue stabilization. However, the analysis of complication showed that complications after this extra-anatomical procedure are frequent and revision surgery can be challenging. The complication rate we found is comparable to other publications and needs to be considered in the treatment decision process. The risk for complications was higher among patients who had more than one previous surgery compared to patients who had one previous shoulder stabilization procedure (40% vs. 21%).

Our results show that the open coracoid transfer as a revision surgery leads to good clinical results with an overall complication rate of 27.5%. Only few studies have addressed the results of open coracoid transfer as a revision surgery after failed soft tissue stabilization. Most studies report about the promising results of the Latarjet procedure as a primary surgery in patients with recurrent antero-inferior shoulder instability. In a retrospective case series Schmid et al. evaluated 49 consecutive patients with one ($n=32$), two ($n=12$) or at least three ($n=5$) previous stabilizations and recurrence of anterior glenohumeral instability, who were treated with a coracoid transfer as a revision surgery [32]. After an average follow-up period of 38 months, 2 patients reported about subluxations and 5 patients about shoulder apprehension without redislocation or subluxation leading to a 14% failure rate of shoulder stabilization as stated by the authors. Clinical results were generally good-to-excellent and no revision surgery was necessary. However, five patients reported about unspecified shoulder symptoms and persisting pain [32]. In our case series, we made a similar observation in five patients who complained about persisting pain without pathological findings in a re-arthroscopy in two patients. In a retrospective case series, Mizuno et al. found persistent pain during sports in 26.5% and activities of daily living in 13.2% of their patients. They

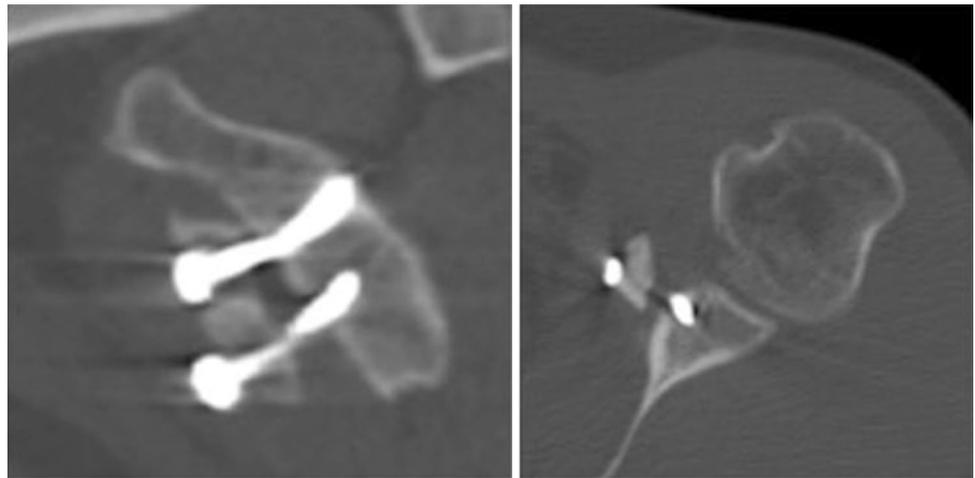
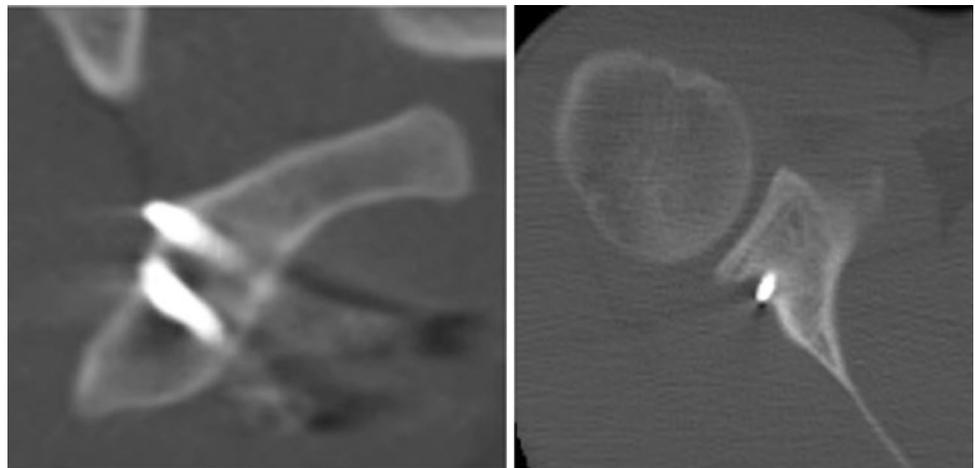
Fig. 3 Postoperative position of the coracoid graft in optimal (a), medial (b) or lateral (c) position in relation to the glenoid rim



present the long-term results of 68 Latarjet procedures at a mean of 20 years postoperatively [28].

When evaluating complication rates of the Latarjet procedure one must differentiate between intraoperative or early adverse events and long-term complications. Intraoperative complications include neurovascular injury or can be

graft-related with mispositioning or fracture of the graft. Neurological damage or irritation and infection can occur immediately postoperative or delayed. Other delayed or long-term complications include non-union or osteolysis of the graft, recurrent instability and osteoarthritis. Persisting pain is also a common complication as pointed out

Fig. 4 Non-union of the coracoid graft**Fig. 5** Posterior prominent screw leading to irritation of the infraspinatus muscle and suprascapularis nerve**Table 1** Complications and repeat surgical procedures after coracoid transfer as a revision surgery after soft tissue stabilization

Gender	Age	Number and kind of previous surgeries	Complication after coracoid transfer	Repeat surgical procedure	Time to repeat surgery (months)
Male	25	$n=2$, arthroscopic soft tissue stabilizations	Persistent pain, chondrolysis	Arthroscopic implant removal, microfracturing, biopsies	30
Female	22	$n=3$, arthroscopic soft tissue stabilizations	Recurrent instability	Arthroscopic labral repair	24
Male	19	$n=1$, arthroscopic soft tissue stabilization	Persistent pain, implant irritation due to posterior prominent screw	Arthroscopic implant removal	25
Male	30	$n=2$, arthroscopic soft tissue stabilizations	Recurrent instability	Arthroscopic iliac-crest bone graft	9
Male	37	$n=2$, first arthroscopic second open soft tissue stabilization	Persistent pain	Arthroscopic implant removal	8
Female	32	$n=1$, arthroscopic soft tissue stabilization	Persistent pain	Arthroscopic implant removal	5
Male	24	$n=1$, arthroscopic soft tissue stabilization	Recurrent instability	None	–
Male	36	$n=1$, arthroscopic soft tissue stabilization	Low grade infection	Arthroscopic implant removal and biopsies, postoperative antibiotic treatment	8
	28				15.6

above and neglected in the current literature. Unspecified shoulder symptoms reported by the patient without pathological intraarticular findings occur frequently after coracoid transfer and are difficult to treat in our experience. Further investigation is needed to clarify if this persistent pain is patient-related and caused by chronification of preoperative existing pain as suggested by Schmid et al. or related to the procedure and possibly caused by neurological irritation or changing of the anatomy and biomechanics of the glenohumeral joint [32].

Recent systematic reviews report about the short and long-term complications of coracoid transfer operations [29, 33–35]. Butt et al. performed a comprehensive systematic review of the literature to quantify and characterize the complication rate associated with this procedure. 30 studies describing the results of 1658 coracoid transfer procedures were included [34]. Revision surgery was documented in 4.9% and recurrent instability occurred in 6.0%. Hardware complications occurred in 6.5%. The rate of graft non-union, fibrous union or postoperative graft migration was 10.1% and graft osteolysis occurred in 1.6%. Nerve palsy was found in 1.2% and the infection rate was 1.5%. Intraoperative fractures occurred in 1.1% [34]. In summation, the overall complication rate was 32.9%.

Griesser et al. performed a similar systematic review and analysed 45 studies with 1904 shoulders and found an overall complication rate of 30% [29]. The rate for revision surgery was with 6.9% slightly higher, while the rate for recurrent instability was lower with 2.9%. Rates of neurovascular injury, infection, graft fracture, non-union or osteolysis were similar compared to the review by Butt et al. (1.8%, 1.3%, 1.5%, and 12.6%). The authors of both systematic reviews concluded that the coracoid transfer procedure can improve shoulder stability with acceptable recurrence rates but is associated with a broad range and significant incidence of complications [29, 34]. In our prospective cohort study, we found a comparable complication and recurrent instability rate. The revision rate was 24% higher than reported in the literature and can be explained by our low threshold for repeat surgery after the open coracoid transfer. In our opinion, it is reasonable to perform a diagnostic arthroscopy to exclude any of the possible complications.

Gupta et al. provide a comprehensive paper discussing different options for the most common complications of the Latarjet procedure and point out that the precise graft positioning and graft osteolysis remain unsolved challenges [36]. Especially the management of recurrent instability after the coracoid transfer is challenging because of the extra-anatomical situation and scar tissue from prior surgery [36].

When discussing different treatment options with patients who present with recurrent shoulder instability after failed shoulder stabilization, intraoperative or early adverse events as well as long-term complications of the coracoid transfer

procedure must be considered and possible treatment alternatives have to be discussed.

This study has some limitations that need to be mentioned. First, the follow-up period is not long enough to evaluate the development of glenohumeral osteoarthritis and rate of recurrent instability. Second, we present a relatively small patient cohort. Furthermore, we did not conduct CT scans postoperatively in all patients for exact evaluation of the graft position and eventual osteolysis or nonunion. The strengths of our study are the homogenous patient population, who presented with recurrent antero-inferior shoulder instability after failed soft-tissue stabilization and the assessment of valid outcome parameters. All patients have been treated by a single surgeon using a standardized coracoid transfer technique.

Conclusion

The open coracoid transfer as a revision surgery after failed prior soft tissue stabilization leads to satisfying clinical results. However, the complication rate is high and needs to be taken in consideration when discussing different treatment options with the patient. Complications are more likely in patients that had two or more previous surgeries. Due to our results and the published complication rates we believe that the indication for a coracoid transfer as a revision surgery should be judged carefully and possibly more anatomical procedures using a free bone block should be considered.

Compliance with ethical standards

Conflict of interest Marvin Minkus, Julia Wolke and Pit Fischer declare that there is no conflict of interest. Markus Scheibel is a consultant for Arthrex, which is not related to this study.

Ethical standards The study has been approved by the local ethics committee in Berlin, Germany (EA1/062/17).

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