



Subscapularis function after transosseous repair in shoulder arthroplasty: transosseous subscapularis repair in shoulder arthroplasty

Dennis Liem, MD^{a,*}, Kira Kleeschulte, MD^a, Nicolas Dedy, MD^a,
Tobias L. Schulte, MD^a, Joern Steinbeck, MD^b, Bjoern Marquardt, MD^b

^aDepartment of Orthopedics and Tumor Orthopedics, University Hospital, Muenster, Germany

^bOrthopaedic Practice Clinic, Muenster, Germany

Background: Postoperative subscapularis function has been identified as an essential factor influencing the outcome of shoulder arthroplasty. The goal of this study was an evaluation of subjective and objective subscapularis function after transosseous refixation.

Methods: Twenty-three patients with an average age of 71 years (range, 51-86) and follow-up of 43 months (range, 24-67) were included in this study. The subscapularis was tenotomized from the lesser tuberosity and refixation was performed in a transosseous technique through bone tunnels with nonabsorbable sutures. Subscapularis function was evaluated subjectively by the ability to tuck a shirt and objectively with the lift-off test and strength measurement in internal rotation. Radiological assessment included ultrasound evaluation of the subscapularis and an axillary x-ray.

Results: No complete, but 7 partial subscapularis tears were found on ultrasound (30.4%). Five patients were not able to tuck their shirt postoperatively (22.7%). This was associated with an inferior clinical outcome (American Shoulder and Elbow Surgeons [ASES] score 53.3 vs 76.4; $P = .023$). The lift-off test was positive in 4 patients (17.4%), which was also associated with an inferior clinical result (Constant score 52.3% vs 74.2%; $P = .021$). Nineteen patients were able to go through an internal rotation strength testing in the lift-off position, and averaged 3.8 kg.

Conclusion: Although overall reliable refixation of the subscapularis was achieved by transosseous repair, almost 25% of patients showed signs of decreased function and 30% showed signs of partial defects. Subjective and objective functional deficits had a significant influence on the clinical outcome.

Level of evidence: Level IV, Case Series, Treatment Study.

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Keywords: Shoulder; total shoulder arthroplasty; hemiarthroplasty; subscapularis; lift-off-test; lesser tuberosity

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*Reprint requests: Dennis Liem, MD, University Hospital Muenster, Albert-Schweitzer-Campus 1a, 48149 Muenster, Germany.

E-mail address: dl@dennisliem.de (D. Liem).

Shoulder arthroplasty has become a routine procedure with reliable results in the treatment of primary and secondary forms of osteoarthritis of the shoulder.^{4,13,14} The deltopectoral approach is widely used as the standard approach for shoulder arthroplasty. Its use requires take-down of the subscapularis tendon to gain sufficient exposure of the glenohumeral joint. The tendon is later reattached as a tendon-to-tendon repair, directly to the lesser tuberosity with bone tunnels or as a bone-on-bone fixation after lesser tuberosity osteotomy.^{4,13,14} Post-operative tears of the subscapularis have been identified as a potential, serious complication. Miller et al reported a retear rate of 5.8% in a large series.⁸ Several diagnostic options are available for diagnosis of a subscapularis tear. The use of ultrasound to evaluate subscapularis integrity has previously been introduced for shoulder arthroplasty and has been shown to correlate with clinical findings.^{2,15} It can be a viable alternative to computed tomography (CT) or magnetic resonance imaging (MRI) in evaluating the integrity of the subscapularis; although, fatty infiltration and atrophy of the muscle cannot be assessed. Even after successful repair of the subscapularis, complete function is not always regained: a problem that has also been recognized for a younger patient group after subscapularis tenotomy in the setting of open instability repair.¹² The problem of decreased subscapularis function has not received much attention in the past.

In 2003, Miller et al published their results of subscapularis function after shoulder arthroplasty, and fittingly called the loss of function “a seldom recognized problem.”⁹ Since then, function of the musculotendinous unit of the subscapularis has been identified as an important factor in determining the outcome of shoulder arthroplasty. A number of clinical studies have included subscapularis function in their outcome assessment and found deficits in up to 40% of their patients.^{3,5,7,10} In order to improve subscapularis integrity and function, several different techniques of subscapularis takedown and refixation have recently been introduced including lesser tuberosity osteotomy and double-row repair.^{1,3,5}

The purpose of this study was to assess tendon integrity and the rate of subscapularis dysfunction after transosseous repair, which was the standard approach for shoulder arthroplasty at that time in patients with primary shoulder arthroplasty, and to correlate functional deficits with the clinical outcome.

Material and methods

Twenty-three consecutive patients (23 shoulders) were included in this retrospective study. All patients received primary hemiarthroplasty ($n = 9$) or total shoulder arthroplasty (TSA) ($n = 14$) for primary osteoarthritis with transosseous subscapularis refixation between 2004 and 2007 at our institution. This was the standard method of refixation if external rotation preoperatively was 30° or less. Otherwise, patients were treated with

a tendon-to-tendon refixation of the subscapularis. Patients with a tendon-to-tendon fixation were excluded from this study. The study group consisted of 9 men and 14 women with an average age of 71.3 years (range, 51-86). The average follow-up was 43 months (range, 24-67), with a minimum of 24 months. The dominant shoulder was involved in 21 cases (91.3%). Patients were operated by 1 of 2 shoulder fellowship trained orthopedic surgeons. All other indications for shoulder arthroplasty such as post-traumatic arthritis, osteonecrosis, cuff tear arthropathy, and rheumatoid arthritis were not included in this study. Other exclusion criteria were previous arthroscopic or open surgery of the shoulder.

Patient assessment

All patients were evaluated by the same experienced shoulder fellowship trained orthopedic surgeon not involved in the operation. Clinical results were evaluated using the American Shoulder and Elbow Surgeons (ASES) score that had also been documented preoperatively. Additionally, the Constant score was used post-operatively on the operated and contralateral shoulder. All patients underwent ultrasound examination for subscapularis integrity. The absence of the tendon and a lack of tendon mobility on shoulder rotation were used as ultrasound criteria for a full thickness tear. Partial tears were defined as having an attenuated tendon of more than 50% of the original thickness without retraction of the muscle belly.¹⁰ Fatty infiltration or muscle atrophy was not evaluated. Function of the subscapularis was evaluated subjectively and objectively. Subjective subscapularis function was assessed by the ability to tuck in a shirt behind the back. Objective function was tested with the lift-off test and measurement of internal rotation strength in the lift-off position. All patients received a series of standardized radiographs with an anteroposterior, axillary, and outlet view. The axillary views were analyzed for anterior decentralization as a sign for subscapularis insufficiency. According to a classification described by Habermeyer et al, anterior decentring was defined as a deviation of more than 5 mm to the glenoid center line in the axillary view.⁶

Operative technique

In all patients, surgery was performed in beach-chair position under general anesthesia. A deltopectoral approach was used to gain access to the shoulder joint. Release of the superior part of the pectoralis major insertion was performed as needed. The coracohumeral ligament was released while the coracoacromial ligament remained intact. After exposure of the subscapularis, the rotator interval, bicipital groove, and circumflex vessels were identified as landmarks and 2 tagging sutures were placed in the tendon. The circumflex vessels were ligated and the tenotomy of the subscapularis and capsule was performed directly at its insertion on the lesser tuberosity, starting at the rotator interval and ending at the insertion of the latissimus dorsi, which was incised. The rotator interval was opened up to the base of the coracoid. The glenohumeral ligaments were released from superior to inferior followed by resection of hypertrophic synovium and capsule to gain sufficient exposure to access the glenoid.

One type of prosthesis (Univers I; Arthrex, Naples, FL, USA) was used in all 23 patients. In 14 patients (61%), a cementless

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