



Failure of the lesser tuberosity osteotomy after total shoulder arthroplasty

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Background: Lesser tuberosity osteotomy (LTO) as an approach during total shoulder arthroplasty (TSA) is a reliable technique with strong biomechanical fixation and a low failure rate. Complications have been infrequently reported in the literature.

Methods: We report a case series of 5 patients who sustained failure of the LTO repair after primary TSA. The data on the patient demographic characteristics, surgical technique, postoperative care, revision surgery, and clinical outcomes are reported.

Results: The mean age of the 5 patients was 52 years, all patients were men, and the mean body mass index was 28 kg/m². They were followed up for a mean of 29 months (range, 24-38 months). The mean time from initial TSA to diagnosis of LTO failure was 9 weeks (range, 5-12 weeks). Two patients reported no trauma, 2 had minor trauma (using a pulley, rolling over in bed), and 1 sustained a fall. At the latest follow-up, the mean visual analog scale; Single Assessment Numeric Evaluation; University of California, Los Angeles; and American Shoulder and Elbow Surgeons scores were 4 (range, 0-6), 48 (range, 20-70), 19 (range, 11-22), and 63 (range, 48-83), respectively. Only 1 patient required no additional procedures beyond the revision LTO repair. Another patient required a second revision LTO repair. The remaining 3 patients either underwent or were recommended to undergo reverse arthroplasty.

Conclusion: Failure of the LTO repair after TSA may possibly be an under-reported complication that is associated with poor clinical outcomes and limited options for revision surgery. In patients with a high risk of LTO failure, considerations should be made to augment the LTO repair during the index TSA procedure.

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

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Keywords: Total shoulder replacement; lesser tuberosity osteotomy; reverse shoulder replacement

The surgical exposure of a total shoulder arthroplasty (TSA) through the deltopectoral approach requires the release and mobilization of the subscapularis tendon to access the glenohumeral joint. Surgical techniques to perform this

release have included subscapularis tenotomy, subscapularis peel, and lesser tuberosity osteotomy (LTO).^{3,6,18} Although some studies have shown satisfactory outcomes after tendon-to-tendon repair,¹ other studies have shown high rates of

This study received institutional review board approval from the Partners Human Research Committee (protocol No. 2012-P-000631/1).

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muscle dysfunction postoperatively that is associated with poor clinical outcomes.^{2,8,13,14} Thus, an alternate technique of subscapularis mobilization and repair through an LTO was developed with the goal of providing more reliable healing and better functional outcomes.⁴

Studies have shown that the repair of an LTO can provide consistent bone-to-bone healing of the osteotomy site. Biomechanically, there is some evidence that the LTO provides a stronger repair of the subscapularis.^{9,16,21} Some studies also have proposed that the integrity of the LTO repair can be adequately assessed with an anteroposterior or axillary radiograph.¹²

Few reports of failure of the LTO repair have been published in the literature.^{12,16} However, it remains a valid concern that can potentially cause significant morbidity after surgery. We present a series of patients who underwent TSA using the LTO technique and subsequently had failure at the osteotomy site. We report on their diagnosis, treatment, and outcomes.

Methods

The medical records of 5 patients who had nonunion of the LTO site after TSA were retrospectively reviewed. All patients underwent their index TSA between February 2010 and September 2011, and all TSAs were performed by the senior author (L.D.H.).

Operative technique

The TSA was performed through a standard deltopectoral approach. The cephalic vein was identified and mobilized. The long head of the biceps tendon was elevated out of its groove and underwent tenodesis to the top of the pectoralis major tendon. The LTO was performed by placing an osteotome in the biceps groove and performing osteotomy of the lesser tuberosity. The osteotomy exited between the medial edge of the subscapularis insertion and the humeral head cartilage surface, yielding an osteotomy approximately 5 to 6 mm thick. The subscapularis remained attached to the bone fragment that had undergone osteotomy, and its tendon was mobilized and released from the anterior capsule. After the shoulder prosthesis was placed, the LTO was repaired with 5 No. 5 FiberWire sutures (Arthrex, Naples, FL, USA) placed in mattress fashion, in a transosseous manner and around the humeral implant. The subscapularis and lesser tuberosity were repaired anatomically with bone-to-bone contact. The postoperative rehabilitation protocol consisted of immediate passive range-of-motion exercises with no external rotation (ER) beyond 30°. Strengthening exercises were permitted 8 weeks after surgery.

Follow-up

Range-of-motion and strength testing was performed as tolerated by each patient. Standard radiographic views of the shoulder were obtained. In each of the patients in this series, when clinical concern for LTO failure was present, a computed tomography (CT) arthrogram was obtained for further evaluation. Revision surgery to repair the LTO nonunion was performed in each patient after confirmation of the diagnosis.

Clinical analysis

Clinical outcomes for patients were objectively measured with a visual analog scale score; Single Assessment Numeric Evaluation score; University of California, Los Angeles shoulder score; and American Shoulder and Elbow Surgeons shoulder score. Patients were also asked to subjectively rate their level of satisfaction with the TSA on a scale from being very satisfied to very dissatisfied with assessment of their operations.

Results

Demographic characteristics

The 5 patients' index TSAs were performed between February 2010 and September 2011. In 2010 and 2011, the senior author (L.D.H.) performed 162 TSAs, all using the LTO technique. There were no other known cases of LTO failure. The incidence of LTO failure in these 2 years was 3% (5 of 162 TSAs). The clinical summary of the 5 patients who had nonunion of the LTO site after primary TSA is shown in [Table I](#). The mean total length of follow-up after the initial TSA was 29 months (range, 24 to 38 months). The mean age of this group of patients was 52 years (range, 42 to 63 years), all patients were men, and the mean body mass index was 28 kg/m² (range, 23.7 to 30.8 kg/m²). All 5 patients were right hand dominant, and surgery was performed on the dominant shoulder in 4 of 5 patients. All patients had a history of at least 1 prior shoulder surgery. With the exception of the open Bankart repair performed 32 years before the TSA in patient 2, all prior procedures were arthroscopic procedures, and none involved the rotator cuff or lesser tuberosity.

Mechanism and time to failure of LTO

Two patients (patients 1 and 3) had failure of the LTO repair without a known injury or trauma; these patients were diagnosed at 10 and 11 weeks after their index procedures. One patient (patient 4) felt his shoulder subluxate anteriorly when rolling over in bed approximately 12 weeks after surgery. One patient (patient 2) injured his shoulder exercising on a pulley 7 weeks after surgery, and another patient (patient 5) sustained a fall 5 weeks after surgery.

Physical examination

Mean preoperative ER and forward flexion (FF) were 5° (range, -10° to 25°) and 87° (range, 65° to 105°), respectively ([Table I](#)). Immediately postoperatively, passive ER averaged 50° (range, 45° to 60°) and mean FF was 155° (range, 150° to 160°). These findings represent an average increase of 45° (SD, 19°) in ER and 68° (SD, 18°) in FF after the index operation. At the time of diagnosis of failure of the LTO, clinic examination showed persistent or worsening pain, particularly with the belly-press sign or bear-hug sign (present in all 5

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