

Longitudinal Supraspinatus Tear Associated with Antegrade Humeral Intramedullary Nailing: A Case Report and Literature Review with Focus Placed on Nail Entry Point

Min Soo Shon, Tae Jung Bang, Jae Chul Yoo^{1,2}

Department of Orthopedic Surgery, Center for Joint Surgery, National Medical Center, ¹Department of Orthopaedic Surgery, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea

Iatrogenic damage of the rotator cuff followed by postoperative shoulder function loss is a potential complication after antegrade intramedullary nailing (AIN) for a humeral fracture. The authors present a case of arthroscopic rotator cuff repair and subacromial decompression of a non-healed rotator cuff tendon (mainly supraspinatus) and secondary impingement syndrome caused either by the tear or a proud nail after AIN for a mid-shaft humeral fracture. At presentation, the patient complained of right shoulder pain and 'snapping', especially during forward elevation and abduction of the shoulder, of 4 years duration. Right shoulder pain started sometime after pain due to the humeral shaft fracture, operation had subsided, and persisted after nail removal. Arthroscopic findings showed a longitudinal rotator cuff tear at the nail entry point that had not healed and severe fibrous hypertrophy on the acromion underspace, which is a unique finding since most longitudinal splits of tendon fibers are more likely to heal than conventional rotator cuff tears detached from bone. The torn rotator cuff was repaired after debridement and placing side-to-side sutures. At his 34-month follow-up after rotator cuff repair, the patient showed complete recovery and had excellent clinical scores.

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Key Words: Rotator cuff; Complications; Intramedullary nailing; Arthroscopy

Antegrade intramedullary nailing (AIN) has been recently recognized as a valid option and a reliable alternative to locking plate fixation for humeral fractures, and is more in accord with the principles of minimal invasive surgery.¹⁾ In fact, AIN has several advantages, that is, better rotational stability, a good lever arm effect, less soft tissue damage at the fracture site, shorter operative time, lower infection rates, and earlier functional recovery. However, it is also associated with persistent shoulder pain and an unsatisfactory outcome rate of 20% to 40%, in some cases shoulder function does not return to normal even after nail removal.¹⁾ Complications associated with poor shoulder function after antegrade intramedullary nail insertion in the humerus include, rotator cuff damage near the point of insertion, impingement or superior protrusion of the nail in the subacromial space, nail loosening, screw back-out, and joint stiffness.¹⁾

Here, we present a case of a non-healed longitudinal tear of the supraspinatus tendon at the insertion point of an intramedullary humeral nail with severe secondary impingement, its clinical results after cuff repair, and subacromial decompression. The patient provided informed consent for the publication of his case information in the form of a case report.

Case Report

A 29-year-old man presented complaining of a 4-year history of right shoulder pain and snapping, especially during forward elevation and abduction of the right shoulder. The patient sustained a mid-shaft fracture of the right humerus during a fall from a height of 8 m while working in July 2004. At that time, he was treated at a local hospital immediately, although

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Correspondence to: Jae Chul Yoo

Department of Orthopaedic Surgery, Samsung Medical Center, 81 Irwon-ro, Gangnam-gu, Seoul 135-710, Korea

Tel: +82-2-3410-3501, **Fax:** +82-2-3410-0061, **E-mail:** shoulderyoo@gmail.com

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preoperative radiographs were not available to us, and his brief operative and radiographic reports showed that the fracture had been treated using an antegrade humeral intramedullary nail of the bent type with proximal curvature (Fig. 1). He could not remember precisely the time of shoulder pain onset, but it

gradually worsened and shoulder function decreased even after achieving clinical union at the fracture site. He underwent nail removal at the local hospital after bone union in August 2006, but even after nail removal, the shoulder pain and loss of function persistent. Several months of conservative treatment with

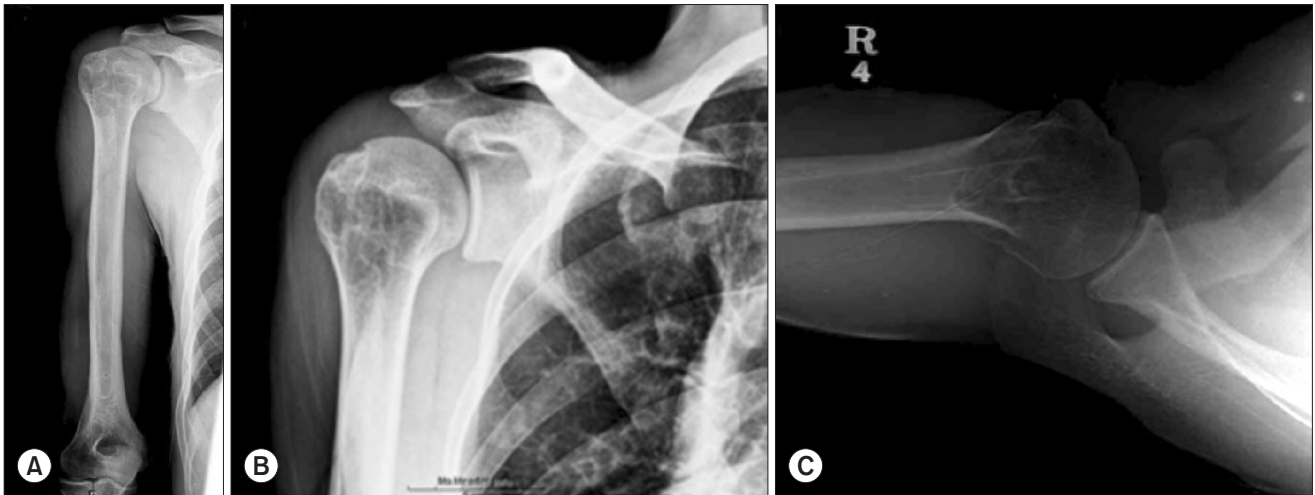


Fig. 1. (A) Preoperative anteroposterior radiographs showing complete union of the fracture site on the mid-shaft of the right humerus with no sign of humeral malrotation or malalignment. True anteroposterior (B) and axillary views showing no specific abnormality, excepting a bony irregularity at the nail entry point on the greater tuberosity (C).



Fig. 2. Preoperative fat suppressed T1-weighted and T2-weighted images showing poor integrity of the supraspinatus and abnormal tissues filling up the hole at the entry point of the antegrade intramedullary nailing (arrows).

non-steroidal anti-inflammatory drugs and physical therapy did not relieve his symptoms.

The patient visited our clinic in August 2008, that is, 2 years after nail removal. Inspection of the involved shoulder revealed an incisional scar corresponding to the anterolateral approach. On physical examination, range of shoulder motion was not restricted in any direction, but he experienced aggravated pain, especially during forward elevation and abduction. Greater tuberosity tenderness was moderate to severe. Functional outcome scores were poor; visual analogue scale for pain 6 points, American Shoulder and Elbow Surgeons (ASES) score 60 points, and Constant score 75 points. Preoperative radiographs showed complete union of the fracture site on the mid-shaft of the humerus with no signs of an acromial spur, osteoarthritis of the glenohumeral joint, or malrotation or malalignment of the humerus (Fig. 1). However, magnetic resonance imaging revealed the presence of rotator cuff pathology at the sulcus medial to the greater tuberosity, posterior to bicipital groove as the insertion point of the nail (bent type) (Fig. 2), and subsequent diagnostic arthroscopy confirmed the presence of a rotator cuff tear. Routine anterior and posterior portals were made for glenohumeral joint evaluation, the articular surface of the rotator cuff was found to be torn slightly above (or lateral to) the rotator cable near the insertion site of the greater tuberosity (Fig. 3A, B). The

scope was then moved to evaluate the bursal surface, acromioplasty was performed because of evidence of impingement with severe fibrous hypertrophy on the acromion underspace caused either by the tear or by the proud nail (Fig. 3C, D). The supraspinatus tendon was found to have a >25 mm longitudinal tear (Fig. 4A, B), and this was repaired using three side-to-side stitches with non-absorbable sutures (No. 2/0 Ethibond) (Fig. 4C, D).

Postoperatively, the patient underwent a rotator cuff repair rehabilitation protocol, involving, 3 weeks of immobilization in an abduction brace, followed by gentle range of motion exercises, and then (after achieving full range of motion) resistive exercises. At his 34-month follow-up, the patient was asymptomatic with a painless full range of motion, improved clinical outcome scores (ASES score 100 points and a Constant score of 94 points).

Discussion

Antegrade intramedullary humeral nailing is mainly criticized for its potentially deleterious effects on shoulder function caused by iatrogenic damage to the rotator cuff at the nail entry point.¹⁾ To the best of our knowledge, this is the first arthroscopic report to describe a non-healing tear of the rotator cuff at the nail insertion point arising as a complication of AIN.

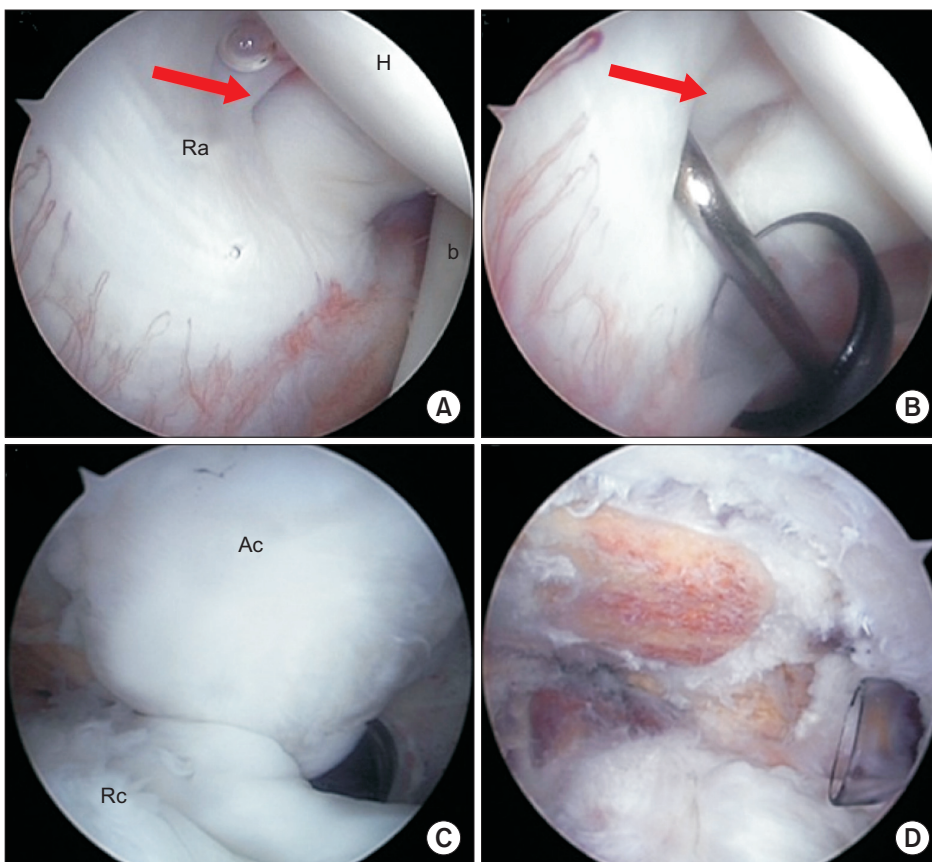


Fig. 3. (A) Arthroscopic image of the right shoulder showing the intra-articular site of the rotator cuff tear (arrow) from the posterior viewing portal with the patient in the lateral decubitus position. (B) Arthroscopic image of the full-thickness rotator cuff tear (arrow) as shown by the probe. Bursoscopy of the right shoulder in the lateral decubitus position. (C) Arthroscopic image of the right shoulder from the posterior portal showing fibrous hypertrophy on the acromion underspace and rotator cuff impingement. (D) Arthroscopic image from the anterolateral portal showing complete subacromial decompression with acromioplasty. Ra: articular surface of the rotator cuff, b: long head of the biceps tendon, H: humeral head, Ac: underspace of the acromion, Rc: bursal side of the rotator cuff.

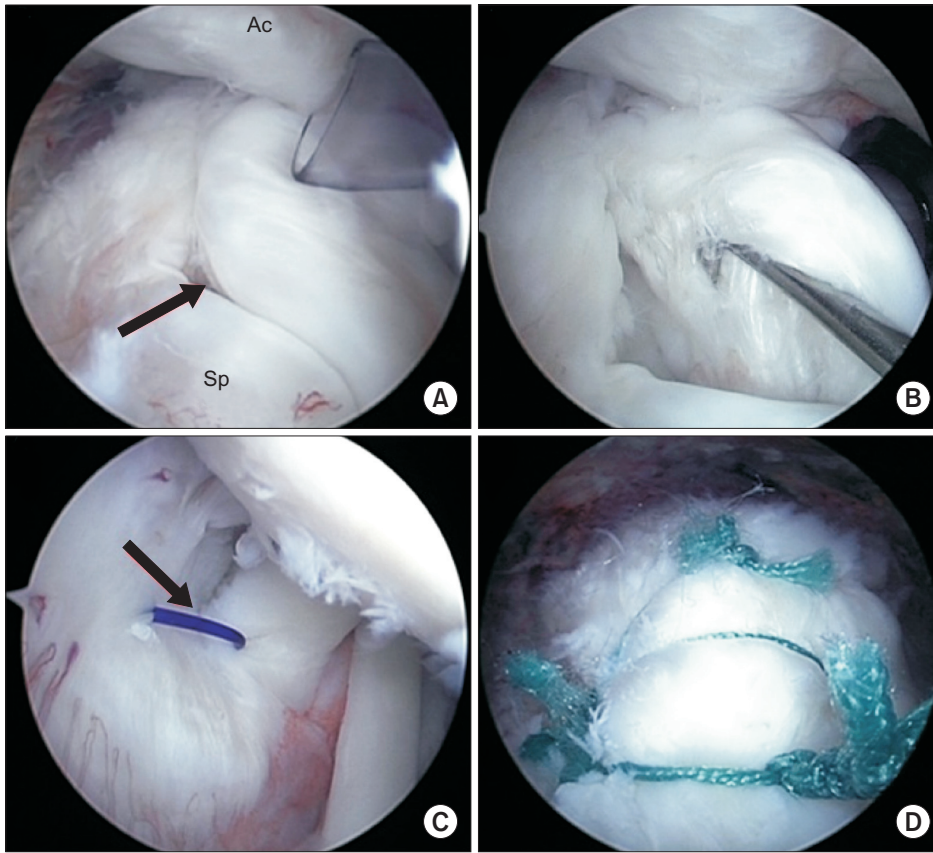


Fig. 4. (A) Arthroscopic image of the right shoulder showing a rotator cuff tear (arrow) from the anterolateral portal in the lateral decubitus position. (B) Arthroscopic image of a full-thickness rotator cuff tear as shown by the probe. (C) Arthroscopic image of the intra-articular portion from the posterior portal in the lateral decubitus position. The initial suture loaded with polydioxanone (PDS™) suture (arrow) was used for full-layer repair of the torn rotator cuff. During this procedure, care is needed not to damage the long head of the biceps tendon. (D) Arthroscopic rotator cuff repair using three side-to-side stitches. Ac: underspace of the acromion, Sp: supraspinatus tendon.

The correct identification and creation of the nail insertion point is crucial for anatomic reduction and primary stability. However, the entry point chosen for antegrade intramedullary nail insertion may contribute to damage of the supraspinatus tendon.²⁾ Gierer et al.³⁾ described the direct visualization and quantification of microcirculatory dysfunction of the supraspinatus tendon using the orthogonal polarization spectral imaging technique after stabilizing a humerus fracture by AIN, concluded that implantation of an antegrade humeral intramedullary nail, which requires splitting the rotator cuff, nearly halves the functional capillary density of the supraspinatus tendon.

When conventional methods are adopted through the anterolateral deltoid split approach, which is the most commonly used for the AIN of a humeral fracture, the standard entry point for a bent type nail is at the medial sulcus of the greater tuberosity.⁴⁾ However, this approach requires incising the supraspinatus tendon in its midsubstance (a critical hypovascular region), this procedure is not uncommonly followed by poor shoulder function. García-Bógallo et al.⁵⁾ performed sonographic assessments on rotator cuffs during nail insertion in 23 patients that underwent AIN for a humeral diaphyseal fracture, and postoperatively, partial tears of between 26 mm and 30 mm were found in 4 patients. Interestingly, they also found that Constant scores did not correlate with sonographic findings, that is, that cuff damage did not correspond to functional deficit.

Technological developments aimed at decreasing trauma to rotator cuffs at nail insertion sites, may lead to better results for the intramedullary nailing of humeral fractures. Recently, some authors suggested a more medial articular starting point for the straight nail at the apex (highest point) of the humeral head and splitting the rotator cuff through more muscle and well-vascularized tissue. Furthermore, in a recent report by Hatzidakis et al.,⁶⁾ patients managed by antegrade locking intramedullary nailing of surgical neck fracture of the humerus via an articular entry point demonstrated reliable fracture-healing, favorable clinical outcomes, and little residual shoulder pain. In addition, several approaches, such as, the rotator interval splitting approach,⁷⁾ approach via Neviasser ioportal,⁸⁾ and an all-arthroscopic technique,⁹⁾ have been developed that involve nail insertion through a more medial entry point to minimize postoperative shoulder pain and preserve the critical hypovascular region of the rotator cuff. However, these techniques result in a tradeoff at the cost of articular cartilage damage, and its long-term effects are unknown. Other authors have described an extra-articular, extra-rotator cuff entry point located more lateral to the greater tuberosity using an angulated nail that preserves the articular surface and rotator cuff integrity.¹⁰⁾ Nonetheless, each of these techniques has its unique advantages and disadvantages, and therefore, the most appropriate technique should be selected after considering factors known to influence functional outcomes,

such as, patient characteristics, bone quality, fracture type, and surgeon's experience.

Although it is not clear when it occurred, our experience indicates that iatrogenic damage of the rotator cuff in the described patient could have happened at any step of the conventional AIN technique, such as, during awl insertion, reaming, or nail implantation or removal. However, we wholly agree with others that it is crucial to meticulously avoid violating the tendinous insertion of the rotator cuff on the greater tuberosity to prevent rotator cuff-related complications.

This case report cautions that the identification of rotator cuff damage after AIN is of considerable clinical importance, and unique as the longitudinal split of the supraspinatus tendon did not healed after a considerable time. To achieve painless, good functional results after AIN, the procedure should be performed carefully, and in particular, meticulous dissection should be conducted to minimize soft tissue damage at the nail entry point and rotator cuff splits should be repaired as completely as possible. Furthermore, the possibility of rotator cuff damage should be considered after inserting or removing an AIN nail. Finally, we suggest modified techniques that spare the rotator cuff should be considered under selected conditions.

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