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# Effectiveness of the extended surgical approach to visualize the axillary nerve in the blind zone in an arthroscopic axillary nerve injury model

Andrés A. Maldonado [a], Robert J. Spinner [a,*], Allen T. Bishop [b], Alexander Y. Shin [b], Bassem T. Elhassan [b]

[a] *Mayo Clinic, Department of Neurologic Surgery, 200 1st Street South West, Rochester, MN 55905, USA*
[b] *Mayo Clinic, Department of Orthopedic Surgery, Division of Hand Surgery, 200 1st Street South West, Rochester, MN 55905, USA*

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**KEYWORDS**
Axillary nerve;
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**Summary** *Introduction:* The aims of this study were to create a model of axillary nerve (AN) injury during an arthroscopic capsular plication to analyze the site for potential nerve injury and to determine the AN length that can be visualized through standard and extended anterior, axillary, and posterior approaches.
*Material and methods:* Six arthroscopic inferior capsular plications were performed in 3 human adult frozen cadavers. A nonabsorbable suture was used to plicate the inferior capsule aiming at capturing the AN (at a location closest to the joint capsule). We then attempted to explore the AN through 3 different surgical approaches (each approach was performed in 2 shoulders): a standard and an extended anterior, axillary, and posterior approach. Surgical clips were used to mark the AN length that was visualized through each approach.
*Results:* The AN injury was located in a range from 5.4 to 7.8 cm from its origin from the posterior cord. This location corresponds with the previously described AN injury zone B (blind) and zone C (circumflex). Compared to the standard approaches, the extended anterior, axillary, and posterior approaches improved the visualization of the AN by 3.6, 1.5, and 2.8 cm, respectively. None of these approaches independently was sufficient to expose the entire course of the AN.
*Conclusions:* The blind zone is a potential location for AN injury after inferior capsular plication. On the basis of this study, a combination of a standard and an extended surgical approach may lead to better exposure of most of the AN length.


* Corresponding author. Fax: +1 507 284 5206.
*E-mail address:* spinner.robert@mayo.edu (R.J. Spinner).

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## Introduction

The axillary nerve (AN) is reported to be one of the most commonly injured nerves during surgical procedures of the shoulder.[1,2] It is most commonly injured (6% of all the brachial plexus injuries) during different orthopedic surgeries (e.g., shoulder arthroscopy, thermal shrinkage of the shoulder capsule, plate fixation, etc.)[3] and shoulder dislocations.[4]

AN exploration is sometimes performed to evaluate and treat these lesions. Our previous study[5] describes a segment of the AN that cannot be evaluated through standard combined anterior (deltopectoral) and posterior approaches. This surgical "blind zone" (injury zone B) of the AN was localized to the quadrilateral space and in proximity to the glenohumeral joint.

The aims of this anatomical study were as follows: first, to create an AN injury model through a standard shoulder arthroscopic capsular plication in order to analyze the location of this injury in relationship with the whole AN; and second, to determine the length of the AN that can be observed through the standard and extended anterior, axillary, and posterior approaches. These extended approaches were based on releasing the anatomical structures obstructing further dissection: the conjoined tendon after a standard anterior approach, latissimus dorsi tendon after a standard axillary approach, and the long head of the triceps tendon after a standard posterior approach. We hypothesized that depending on the potential location of an AN injury, a specific approach (standard or extended anterior/axillary/posterior) could permit a safer and easier nerve exploration.

## Anatomical study

After approval of the Institutional Research Board, 6 shoulders from 3 full adult human frozen cadavers were used for this study. Specimens with gross or radiographic shoulder pathologies or those with apparent prior shoulder surgery were excluded.

### AN injury model

A shoulder arthroscopic capsular plication was performed in the six shoulders. A standard arthroscopic capsular plication technique was performed.[6,7] The arthroscope was introduced through a standard posterior approach and an accessory distal-posterior portal was created for the suture placement. An additional anterior portal was created to facilitate the arthroscopic technique. The location of the AN was consistently confirmed deep to the anterior aspect of the inferior capsule (previously described as the closest zone between the AN and the shoulder joint[5]). A nonabsorbable suture was used to plicate the inferior capsule where the location of the AN is closest to the joint capsule.

Three different standard approaches (anterior, axillary, and posterior) and their extended approaches were evaluated in two cadavers each.

### Anterior (deltopectoral) approach

#### Standard approach

The AN was dissected through a standard deltopectoral approach.[8] The dissection was carried out in the supine position with 45° shoulder abduction and external rotation. A 5-cm skin incision was done over the deltopectoral interval. The coracoid was exposed and the pectoralis minor tendon insertion on its medial aspect was fully released from its attachment. The lateral cord, the brachial artery, and the medial cord were identified and medially retracted. The AN and the radial nerve were identified from their origin from the posterior cord. The AN was carefully dissected distally as far as possible. Extension of the skin incision was performed when necessary to better visualize the nerve. A surgical clip (Ligaclip, Ethicon, Johnson & Johnson, New Jersey, USA) was used to mark the most distal part of the AN that could be observed.

#### Extended approach

The conjoined tendon was transected 2 cm distal to its origin from the tip of the coracoid to allow later tendon repair. The AN was again dissected distally as far as possible. A second surgical clip was used to mark the most distal part of the visualized AN (Figure 1).

### Axillary approach

#### Standard approach

The AN was dissected through an axillary approach as described by Bertelli et al.[9] The dissection was carried out in the supine position with 90° of shoulder abduction and external rotation. After a skin incision across the axilla and subcutaneous tissue separation, the latissimus dorsi tendon was identified. The AN was located over the subscapularis muscle. Proximal and distal AN dissections were performed as far as possible. A first surgical clip was used to mark the most distal part of the AN that could be observed, and a second surgical clip, for the most proximal part of the AN.

#### Extended approach

The latissimus dorsi tendon was then transected 2 cm distal to its attachment on the humerus to allow later tendon repair. The AN was again dissected distally as far as possible. A third surgical clip was used to mark the most distal visualized part of the AN (Figure 2).

### Posterior approach

#### Standard approach

The AN was dissected through a standard posterior approach.[10] An incision along the posterior border of the deltoid muscle along the longitudinal axis of humerus was done in the lateral position with 90° of shoulder abduction. Long head of the triceps was inferiorly retracted to expose the quadrilateral space. Teres major muscle was identified. The AN was dissected as proximal as possible from this posterior approach. A first surgical clip was used to mark the most proximal part of the AN from this posterior approach.