Arthroscopic Perspective of the Axillary Nerve in Relation to the Glenoid and Arm Position: A Cadaveric Study

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Purpose: The purposes of this study were to examine the morphologic features of the axillary nerve and its relation to the glenoid under an arthroscopic setup, and to determine the changes in nerve position according to different arm positions. **Methods:** Twenty-three fresh-frozen fore-quarter cadaveric shoulder specimens were used for evaluations in an arthroscopic setup with the lateral decubitus position. The main trunk of the axillary nerve with or without some of its branches was exposed after careful arthroscopic dissection. Morphologic features and the course of the axillary nerve from the anterior and posterior portals were documented. The closest distances from the glenoid rim were measured with a probe by use of a distance range system. The changes in nerve position were determined in 4 different arm positions. At the end of arthroscopic examination, the nerves were marked and verified by open dissections. **Results:** The axillary nerve appeared in the joint near the inferior edge of the subscapularis muscle. With reference to the inferior glenoid rim horizontally, the nerve had a mean running angle of 23° (range, 14° to 41°; SD, 8°). The closest points from the glenoid were between the 5:30- and 6:00-o'clock position (right) or 6:00- and 6:30-o'clock position (left). The closest distance range varied from 10 to 25 mm in the neutral arm position. The abduction-neutral position resulted in the greatest distance between the inferior glenoid and the nerve. **Conclusions:** The abduction–neutral rotation position was the optimal position for minimizing axillary nerve injuries, because it resulted in the greatest distance between the inferior glenoid and the nerve. **Clinical Relevance:** Knowledge of the anatomy of the axillary nerve aids the shoulder surgeon in avoiding nerve injury during arthroscopic procedures. Abduction–neutral rotation may be more helpful for arthroscopic surgeons performing procedures in the anteroinferior glenoid with the nerve being farther away from the working field. **Key Words:** Anatomy—Arthroscopy—Axillary nerve—Glenoid—Cadaveric shoulder.

The axillary nerve is considered to be one of the most important structures for proper shoulder function and has also been reported to be one of the most commonly injured nerves during surgical procedures directed at the shoulder.[1-3] Hence, for shoulder surgeons, the importance of protecting the axillary nerve during shoulder surgery can never be overemphasized. Over the past several decades, surgeons have become familiar with the anatomy of the axillary nerve in open procedures by virtue of several anatomic studies.[4-7] However, despite the increasing number of surgeries being performed with arthroscopy, there have been few reports describing the morphology of the axillary nerve and its relation to surrounding structures from an arthroscopic perspective.[3,8,9]

Because the axillary nerve is not so much out of the "visual field" but is an extra-articular structure while the surgeon is looking intra-articularly during arthro-

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scopic procedures, especially inferior capsulolabral reconstruction, thermal shrinkage of the anteroinferior capsule, and inferior capsule release,[10-15] it is crucial to avoid injury to the axillary nerve during such arthroscopic operations.[16] The purposes of this study are to describe the morphology of the axillary nerve in an arthroscopic setting and to evaluate its position change during different arm positions arthroscopically. We hypothesized that an arthroscopic evaluation in a cadaveric model would represent the relation between the axillary nerve and its surrounding structures in an arthroscopic environment with a fluid pump system.

METHODS

We used 23 fresh-frozen cadaveric shoulder specimens (13 cadavers [10 paired and 3 single side], 7 female and 6 male) in this study. The mean age of the specimens was 69 years (range, 45 to 89 years). No history of any shoulder disorders was available, but none of the shoulder specimens had surgical scars. The shoulder specimens were mounted on a table with a bony clamp attached to the scapula. We tried to simulate the actual arthroscopic surgical condition as closely as possible. Standard anterior and posterior portals were used with a pump inflow (10k100; Linvatec, Largo, FL) of 80 mm Hg at room temperature. The glenohumeral joint was examined from the posterior portal with a 30°, 4.5-mm arthroscope (Linvatec), visualized with a camera, and displayed on a monitor. The arthroscopic findings were documented on a DVD recording system (Linvatec). After routine arthroscopic examination, the anterior bundle of the inferior glenohumeral ligament (IGHL) was released by use of arthroscopic scissors through the anterior portal. Then, after switching of the viewing portal to anterior and the working portal to posterior, the posterior bundle of the IGHL was released partially. The axillary nerve was identified near the subscapularis muscle at the 4- or 8-o'clock position by shaving the inferior capsule. Soft tissue along the axillary nerve was gently removed to enable visualization of the entire course of the nerve.

For estimation of the closest distance from the axillary nerve to the glenoid, the accessory superior portal described by Neviaser[17] was created approximately 1 cm medial to the acromion between the clavicle and scapular spine. We inserted a probe with a premarked 5-mm scale through the Neviaser portal and measured the closest distance range (Fig 1A). This portal enabled us to reach the axillary nerve parallel to the glenoid surface, which best simulated the direct measurement from the glenoid rim to the axillary nerve with the probe. Because accurate measurement of the distance was not possible, we categorized the closest distance from the nerve to the glenoid rim in 5-mm units (0 to 5 mm, 5 to 10 mm, 10 to 15 mm, and so on). In addition, the closest point at which the nerve approximated the glenoid rim was divided into 30-minute increments via a clock orientation system (4:30, 5:00, 5:30, and so on). The reference was the long head of the biceps tendon (12 o'clock) and

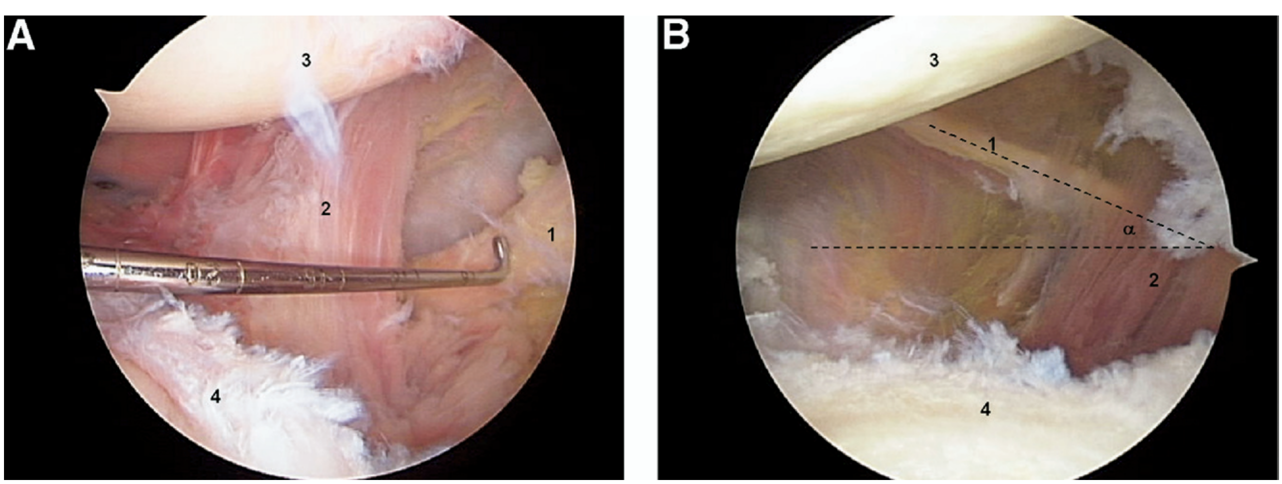

FIGURE 1. (A) Arthroscopic view of right shoulder from posterior portal. Note that (1) the axillary nerve entered an arthroscopic field at the 4-o'clock position around (2) the inferior edge of the subscapularis muscle and showed a distance range of 20 to 25 mm. The distance range could be determined by use of the probe through the Neviaser portal. (B) The running angle (α) of the nerve was measured with reference to (2) an imaginary line that was horizontal to (4) the glenoid surface. (3, humeral head.)