Technical Note

Arthroscopic Axillary Nerve Neurolysis From the Anteroinferior Glenoid Through the Quadrilateral Space to the Terminal Deltoid Branches

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Abstract: Axillary nerve compression is a rare cause of posterolateral shoulder pain. Once the diagnosis is confirmed and after failure of conservative measures, open procedures have been the mainstay of treatment for several decades. More recently, arthroscopic techniques have been proposed, which offer several advantages, including improved access to difficult locations, better visualization, and less surgical morbidity. The objective of this Technical Note is to describe an arthroscopic neurolysis of the axillary nerve from the inferior humeral pouch, through the quadrilateral space and into the subdeltoid recess.

Axillary nerve compression along its course is a rare cause of posterolateral shoulder pain, deltoid or teres minor weakness, and posterior shoulder atrophy. Described etiologies of compression include fibrous bands, venous distension, space-occupying lesions, humeral head or glenoid osteophytes, scarring after scapular fractures or trauma, and muscular hypertrophy in the quadrilateral space, especially after glenohumeral dislocation or proximal humerus fracture).[1,2] Before teres minor or deltoid atrophy are present, establishing the correct diagnosis is challenging when considering only history and examination factors alone. In some cases, advanced imaging can help eliminate intra-articular pathologies, but rarely is definitive compression or nerve pathology identified. Unfortunately, many affected patients have a history of arthroscopic procedures that ultimately fail to resolve their symptoms. Therefore, axillary nerve compression remains an important component of the differential diagnosis of posterior or lateral shoulder pain, especially in the revision setting.

Once the diagnosis is confirmed, either through 3-dimensional imaging or electromyography, first-line treatment is conservative measures, including discontinuation of offending activities in combination with physical therapy.[2] Once nonsurgical measures fail, several surgical options exist. Open surgical techniques traditionally have been used and offer the ability for not

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The authors report the following potential conflicts of interest or sources of funding: J.J.R. reports other from Steadman Philippon Research Institute, outside the submitted work. P.C.N. receives support from Arthrex, outside the submitted work. J.W.A. reports grants from Arthrex and DJO Global, outside the submitted work. D.R.R. reports personal fees from Steadman Philippon Research Institute, outside the submitted work. J.A.H. reports personal fees from Steadman Philippon Research Institute, outside the submitted work. T.W. reports personal fees from Steadman Philippon Research Institute, outside the submitted work. A.K.T. reports other from Steadman Philippon Research Institute, outside the submitted work. P.J.M. is a consultant for and receives royalties from Arthrex, Medbridge, and Springer; owns stock in VuMedi; receives support from the Steadman Philippon Research Institute and Vail Valley Medical Center; and has corporate sponsorship from the Steadman Philippon Research Institute, Smith & Nephew, Arthrex, Siemens, and Össur, outside the submitted work. Full ICMJE author disclosure forms are available for this article online, as supplementary material.

Research performed at the Steadman Philippon Research Institute, Vail, Colorado, U.S.A.

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2212-6287/211278
https://doi.org/10.1016/j.eats.2021.11.003

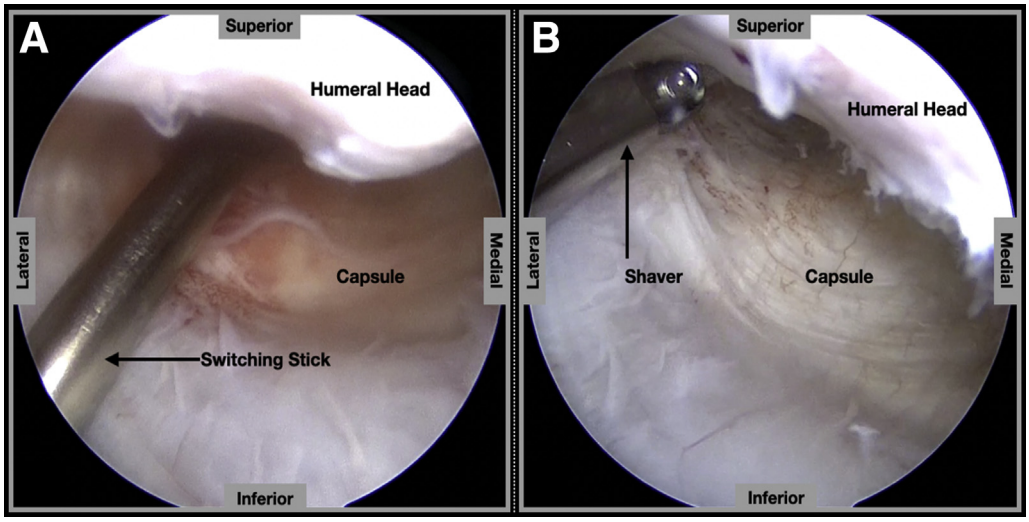

Fig 1. Arthroscopic view of the left shoulder from the posterior viewing portal using a 30° arthroscope. A switching stick (A) and arthroscopic shaver (B) can be seen during diagnostic arthroscopy and debridement of the inferior capsule before the introduction of an 18-gauge spinal needle and subsequent establishment of the posterior inferior portal.

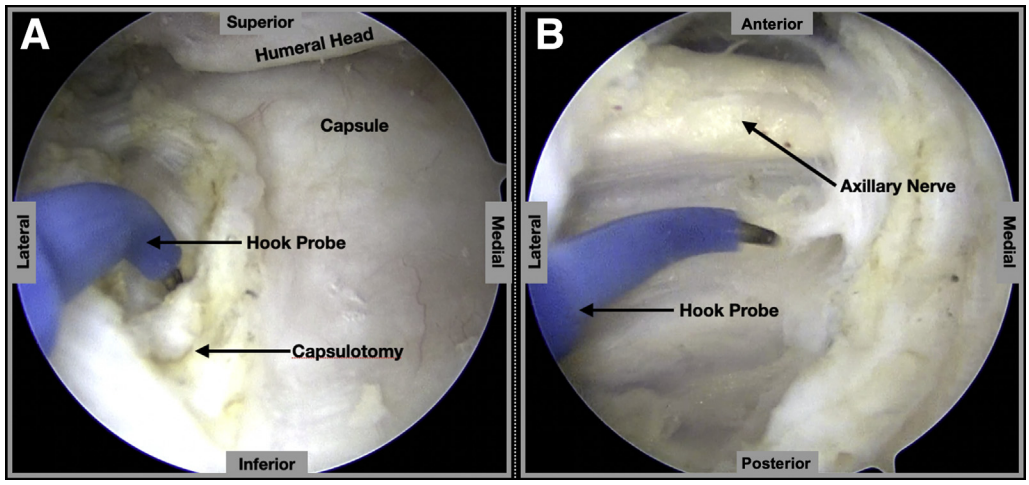

Fig 2. Arthroscopic images from a 30° arthroscope of a left shoulder from the posterior viewing portal showing dissection to the axillary nerve. An arthroscopic hook-probed electrocautery device (Arthrex, Naples, FL) is demonstrated opening the inferior capsule (A) and after careful dissection, the axillary nerve branches are encountered just below the inferior capsule (B).

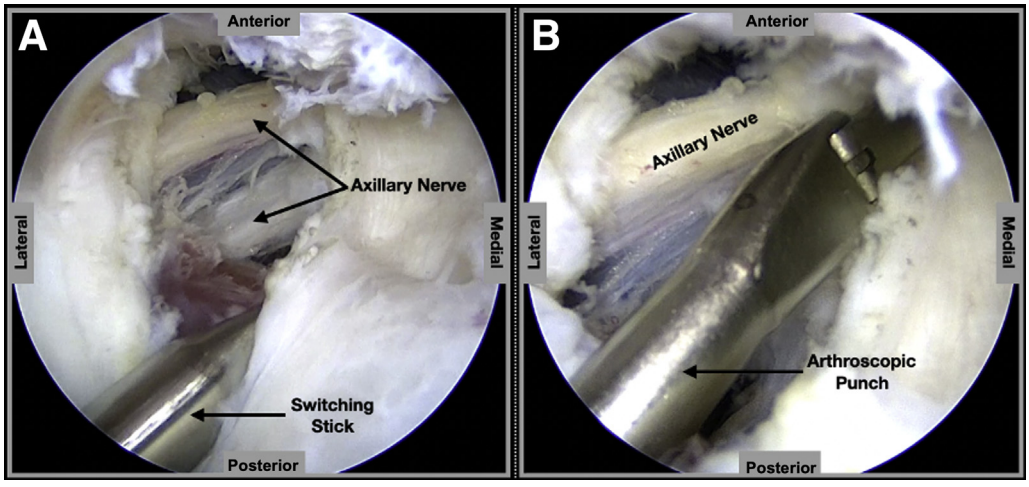

Fig 3. Arthroscopic images from a 30° arthroscope of a left shoulder from the posterior viewing portal showing the release of the axillary nerve. Blunt release of the axillary nerve is carried out in the anterior to posterior direction with a switching stick (A) and an arthroscopic punch (B) as to no disrupt any branches of the axillary nerve.

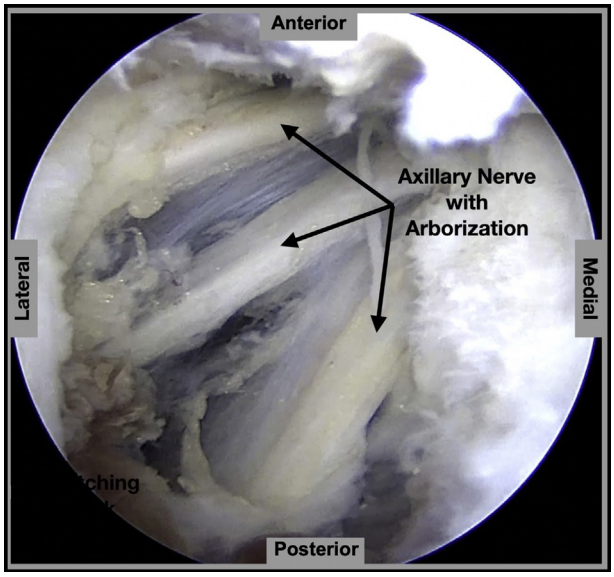

Fig 4. Arthroscopic image from a 30° arthroscope of a left shoulder from the posterior viewing portal showing the final release of the axillary nerve and its arborization, visualization of all arborizations is imperative to ensure no tethering is present. This concludes the intraarticular portion of the procedure.

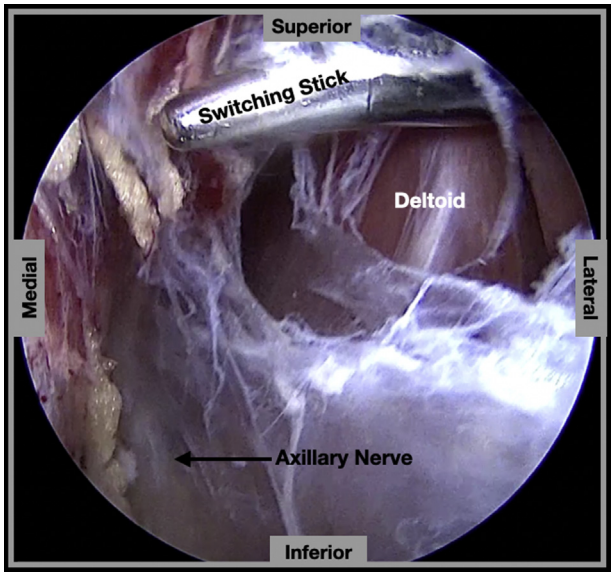

Fig 6. Arthroscopic image from a 30° arthroscope of a left shoulder from the anterolateral portal into the subdeltoid space during blunt dissection to the axillary with a switching stick. Blunt dissection is used as to not damage the axillary nerve, which can be visualized in the lower left quadrant of the figure.

only neurolysis but also neurorrhaphy or nerve grafting in the setting of complete neurotmesis. Such approaches can be anterior, posterior, or combined, depending on the site of pathology.[3] More recently, arthroscopic techniques have been described,[1,4] which offer a much less-invasive and morbid solution to compression, especially in the difficult-to-access region inferior to the inferior glenohumeral ligaments or the quadrilateral space. The purpose of this Technical Note is to demonstrate an axillary neurolysis from the level of the inferior glenohumeral ligaments through the subdeltoid recess.

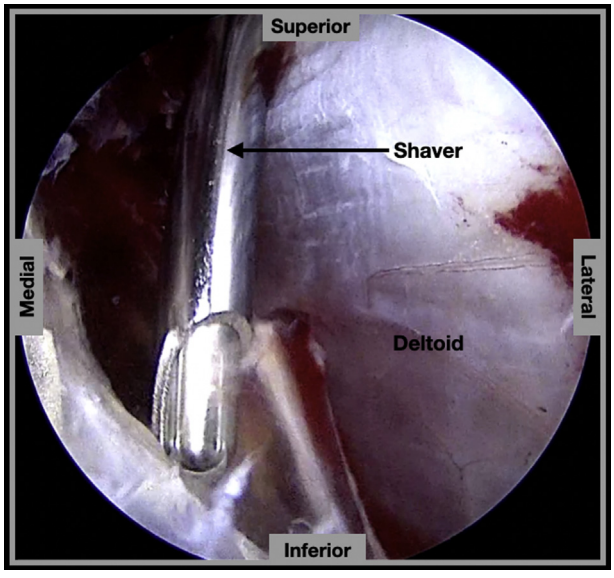

Fig 5. Arthroscopic image from a 30° arthroscope of a left shoulder from the anterolateral portal into the subdeltoid space demonstrating a 4-mm arthroscopic shaver being used to expose the space.

Surgical Technique (With Video Illustration)

A narrated video with demonstration of the described surgical technique may be seen in Video 1.

Patient Positioning and Diagnostic Arthroscopy

The patient is positioned in the beach-chair position with a pneumatic arm holder to aide in arm manipulation and positioning. A diagnostic arthroscopy is performed and the axillary pouch is viewed. An additional posterior inferior portal is made in line with the lateral edge of the posterior acromion going inferiorly approximately 7 cm from the acromial edge (Fig 1). A spinal needle is used to determine the appropriate location and trajectory to reach the humeral head osteophyte. Then, a cannula is then inserted into the axillary pouch.

Axillary Nerve Neurolysis

An arthroscopic shaver is inserted through the cannula and an inferior humeral osteoplasty is performed due to a large spur being present. A hook probe electrocautery device (Arthrex, Naples, FL) is then used through the cannula to release the inferior capsule with great care to avoid damage to the axillary nerve (Fig 2). Just beneath the capsule, the axillary nerve is visualized

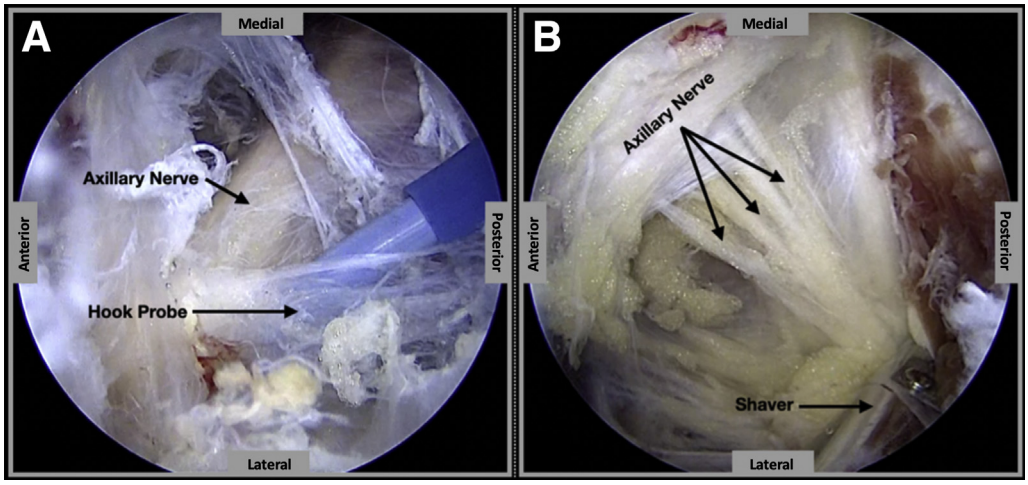

Fig 7. Arthroscopic images from a 30° arthroscope of a left shoulder from the anterolateral portal into the subdeltoid space during release. An arthroscopic hook-probed electrocautery device (Arthrex, Naples, FL) (A) and an arthroscopic shaver (B) are used via the posterior portal to free the axillary nerve within the subdeltoid region.

and can be dissected from anterior to posterior with a switching stitch and the hook probe electrocautery (Fig 3). With the use of these instruments and an arthroscopic meniscus basket, all tethered areas are completely released so arborization of the axillary nerve can be visualized (Fig 4).

The camera is the inserted into the subacromial space and a bursectomy is performed to allow for visualization. The subdeltoid region is completely exposed (Fig 5). A switching stick is then inserted that is used to perform blunt dissection to expose the axillary nerve as it enters from the quadrilateral space while viewing from the subacromial space (Fig 6). A hook probe electrocautery device is again used, now from the subacromial space, to further dissect out the nerve anteriorly and posteriorly around the humerus (Fig 7). An arthroscopic meniscus basket can also be used to release scar bands. The camera and instruments are alternated back and forth between 2 lateral portals for complete visualization and release. Furthermore, a combination of 30° and 70° arthroscopes are also alternated to aid in optimal visualization. Identification of the axillary nerve in the quadrilateral space is seen as it arborizes through the teres minor and into the deltoid. This completes the thorough arthroscopic axillary nerve neurolysis from the inferior glenoid, through the quadrilateral space and through the subdeltoid space (Fig 8).

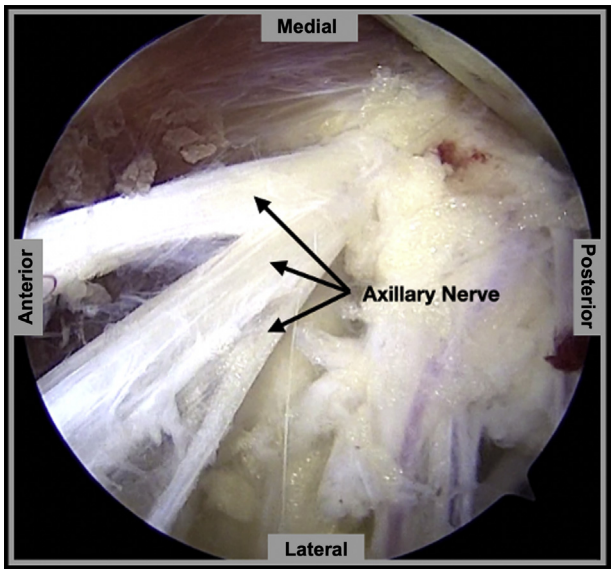

Fig 8. Arthroscopic image through a 30° arthroscope of a left shoulder from the anterolateral portal into the subdeltoid space showing the released axillary nerve with its arborization. The axillary nerve arborizations can be visualized without any tethering after careful and thorough release.

Postoperative Rehabilitation

A sling is placed to be worn for comfort only. Physical therapy is started immediately without limitations on range of motion. Once full motion is achieved, strengthening is started at the 4-week postoperative mark.

Discussion

Axillary nerve injuries are a rare etiology of posterior shoulder pain and dysfunction but should not be overlooked, as they are common in certain injury patterns, reported in up to 16% of anterior shoulder dislocations.[5] Other nontraumatic etiologies of injury or compression include fibrous bands, venous distension, space-occupying lesions such as osteochondromas, humeral head or glenoid osteophytes, scarring, and/or muscular hypertrophy in the quadrilateral space. Although severing of the axons, Axonotmesis, or the entire nerve, neurotmesis, can occur, these pathologies are frequently the results of an iatrogenic injury, stab wound, gunshot wound, or high-energy fracture or dislocation. Under such acute circumstances in which patients present with acute loss of deltoid function, early surgical intervention with nerve repair and nerve

Table 1. Pearls and Pitfalls

Pearls	Pitfalls
For the transcapsular axillary neurolysis portion of the procedure, access to the inferior glenohumeral recess should be posterior.	Penetration of the inferior glenohumeral capsule either centrally or anteriorly impairs visualization and places the axillary nerve at risk.
When dissecting and freeing the nerve of adhesions, blunt objects, including switching sticks and a 90°, hook-tipped, arthroscopic radiofrequency device, are recommended for dissection to maximize control and to minimize the propensity for iatrogenic injury.	The use of arthroscopic shaving devices with active suction should be avoided when in proximity of the nerve.
Should a goat's beard osteophyte or osteochondroma resection be planned, intraoperative fluoroscopy should be used to guide and to ensure adequacy of resection.	
A 70° arthroscope can be used when viewing from the subacromial space to aid in nerve visualization, especially posterior once it exits the quadrilateral space.	

grafting is indicated. Most injuries encountered, however, are due to neuropraxia.[6] These are usually the result of compression, and therefore, more commonly present with an insidious onset and can be difficult to diagnose, as patients have often undergone other interventions without significant resolution of symptoms.

Traditionally, open surgical approaches have been the mainstay of treatment primarily due to surgical familiarity as well as versatility.[3,6,7] However, given the deep location and circuitous route traversed by the axillary nerve, open approaches, whether anterior, posterior, or combined, are invasive and have the potential for significant soft-tissue disruption. For these reasons, Gaskill and Millett[4] pioneered the use of arthroscopy to identify, neurolyse, and decompress the axillary nerve. The technique and early clinical results for arthroscopic transcapsular axillary nerve decompression have been previously reported in this *Journal*.[2] The current Technical Note describes the next progression of axillary nerve decompression from the inferior glenohumeral capsule all the way to its terminal arborization in the subdeltoid space.

This technique has several advantages over traditional open neurolysis, including facilitating visualization, creating less soft-tissue disruption, and accelerating rehabilitation.[2] Furthermore, an arthroscopic approach allows for decompression of a common etiology of axillary nerve compression, the inferior humeral goat's beard osteophyte,[1] without having to disrupt the subscapularis. There are, however, several limitations of this approach (Table 1). First, it requires use of arthroscopic portals that are somewhat unfamiliar to surgeons, including the low posterolateral portal used for accessing the inferior glenohumeral pouch. Inappropriate placement of this portal can put the axillary nerve at risk, so an understanding of the neuroanatomy and practice on cadaveric specimens is recommended before attempting this portal. Second, several unique instruments, including the 90° fine tip radiofrequency ablation device (CoolCut Radiofrequency Ablation Device; Arthrex) for fine, careful dissection are used, which not only require a learning curve but also increase the overall cost of the procedure.

In conclusion, this Technical Note outlines the technique for arthroscopic axillary neurolysis from the inferior glenohumeral capsule to its terminal branches at the deltoid. Although technically challenging, it is felt that appreciation for the pathology, neuroanatomy, and surgical decompression techniques are necessary tools in the complex shoulder surgeon's armamentarium.

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