Technical Note

In-Office Nano-Arthroscopy of the Shoulder with Acromioplasty

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Abstract: Subacromial decompression with acromioplasty is among the most commonly performed shoulder procedures. The advantages of in-office nano-arthroscopy include the capability of diagnosing and treating subacromial impingement, swifter patient recovery, improved cost-effectiveness, and superior patient satisfaction. The purpose of this technical report is to describe our technique for performing in-office nano-arthroscopy for subacromial decompression (subacromial bursectomy and acromioplasty), with a particular focus on appropriate indications, providing sufficient local anesthesia, optimizing visualization, and discussing the advantages of the in-office setting compared to the operating room.

Subacromial impingement syndrome is one of the leading causes of shoulder pain in adults.[1-3] First described by Charles Neer in the 1970s, the syndrome involves a narrowing of the subacromial space, which is defined by the humeral head (inferiorly), the anterior edge and undersurface of the anterior third of the acromion, the coracoacromial (CA) ligament, and the acromioclavicular (AC) joint (superiorly).[3-5] The subacromial space is occupied by the rotator cuff tendons, the long head of the biceps, the subacromial bursa, as well as the CA ligament. Narrowing of the subacromial space results from the formation of osteophytes about the undersurface of the acromion, from subacromial bursitis, or from osteophytes about the AC joint.[4,5]

In patients with subacromial impingement, anatomic and biomechanical studies have demonstrated that when the affected arm is abducted (typical painful arch from 60° to 90° abduction), osteophytes about the anterior acromion and undersurface of the AC joint can constrict the supraspinatus tendon and the long head of the biceps, resulting in mechanical stress, overload, and, ultimately, tendon inflammation and degeneration.[6] Open acromioplasty was initially used to treat subacromial impingement; however, the advent of arthroscopic subacromial decompression, introduced by Harvard Ellman in the mid-1980s,[7] popularized the technique, and it remains the standard procedure for surgical treatment of subacromial impingement.[8]

Contemporary advancements in the techniques for in-office nano-arthroscopy (IONA) have obviated the need for a formal operating room setting or anesthesiologists, affording the possibility of wide-awake arthroscopic procedures to be performed, even in the office setting.[9-16] Early results have shown high patient satisfaction, as well as high rates of return to work and sports.[12] Novel technological improvements in nano-arthroscopy include the use of an optic chip at the tip of the arthroscope, which provides better image quality compared to previous nano-arthroscopy methods (similar to that of conventional arthroscopy), allowing for improved visualization and better identification of pathology. The purpose of this technique guide is to

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Table 1. Advantages and Disadvantages of the Proposed Technique

Advantages	
	Reduced operating room use, avoidance of anesthesia complications
	Potential for true patient/physician education and shared decision-making
	Potential for improved patient satisfaction
	Improved ability to diagnose anatomic variants compared to magnetic resonance imaging
	Reduced cost and resource use
	Less swelling and pain
Disadvantages	
	Potential for patient pain or discomfort
	Learning curve

describe an effective and reproducible method for IONA of the shoulder with acromioplasty for the treatment of subacromial impingement (Video 1). Indications and contradictions of this procedure can be found in Tables 1 and 2. Additionally, a step-by-step guide can be found in Table 3.

Surgical Technique

Positioning, Local Anesthesia, and Room Setup

The patient is positioned supine on an examination table with the back of the bed inclined to approximately 75°, similar to the beach chair position. The operative shoulder is positioned such that the lateral, anterior, and posterior aspects of the shoulder are easily accessible (Fig 1). The extremity is prepped using a mixture of chlorhexidine gluconate with isopropyl alcohol and draped in usual sterile fashion. A well-padded mayo stand is used to support the arm, which is held in slight abduction and forward flexion to facilitate entry into the subacromial space. Relevant surface anatomy markings are made, including the anterior, posterior, and lateral portal sites (Fig 2).

Before the procedure, a mixture of 5 mL of a 1:1 ratio of 0.5% bupivacaine and 1% lidocaine with epinephrine is injected into the planned arthroscopy portal sites. After 5 to 10 minutes, another injection of 10 mL of a 1:1 ratio of lidocaine with epinephrine and bupivacaine is used to infiltrate the subacromial space, ensuring adequate portal access. A 13-inch high-definition monitor with an integrated HDMI output to extend the video signal to the in-room display allows the patient to follow along and watch their procedure as it is narrated in real time by the lead surgeon.

Operative Technique

A small 2 mm stab incision is made with a no. 11 surgical scalpel blade to establish the standard posterior arthroscopy portal approximately 2 cm distal and 2 cm medial to the posterolateral tip of the acromion, which can accommodate the 1.9 mm 0° nano-arthroscope (NanoScope; Arthrex, Naples, FL). A blunt trocar is then used to enter the joint space. The camera is exchanged over the trocar and connected to the integrated inflow and outflow fluid management system

Table 2. Pearls and Pitfalls of the Proposed Technique

Pearls	
	Patient selection is critical
	At least 10 minutes between portal and intra-articular local anesthetic injection and procedure
	Familiarity of office staff with room setup, instrument turnover, and workflow
	Thorough pre-procedure discussion with patient with regard to mental readiness and expectations for wide-awake procedures
	At least 10 minutes between portal and intra-articular local anesthetic injection and procedure
	5 mL of epinephrine in 1L of normal saline solution for hemostasis and visualization
Pitfalls	
	Failure to provide adequate pre-procedural local anesthesia or adequate time for anesthesia to take effect
	Careless placement of trocar leading to articular cartilage damage
	Poor indications of patients with excessive expectations
	Inadequate time between local anesthetic and procedure
	Poor portal placement given 0° needle scope

Table 3. Step-by-Step Guide to Performing the Proposed Technique

Step 1. Position the patient comfortably seated on an examination table, with the back of the bed to set approximately 70° to 80° and the ipsilateral shoulder is positioned so that the posterior, lateral, and anterior aspects of the shoulder are unobstructed (Fig 1).
Step 2. The ipsilateral arm should be supported on a padded mayo stand in slight forward flexion and abduction to allow for optimum entry in the glenohumeral joint. Mark out relevant surface anatomy and anticipated portals including anterior, posterior and lateral portals (Fig 2).
Step 3. Before the procedure, the planned arthroscopy portal sites are injected with 5 mL of a 1:1 ratio of 0.5 bupivacaine and 1% lidocaine with epinephrine. After 5 to 10 minutes, another 20 mL of 1:1 ratio lidocaine with epinephrine and bupivacaine is then used to infiltrate the joint one more time and establish that the portals can adequately gain access to the joint.
Step 4. A standard posterior arthroscopy portal is made using a number 11-blade. A small 2 mm stab incision is made.
Step 5. Under direct visualization, the anterior ("working") portal is established by passing a spinal needle 1 cm inferior to the biceps tendon. Diagnostic arthroscopy is then performed using an 18-gauge spinal needle as both a probe and outflow. Once confirmed that our anterior portal site is adequate, a small 3 to 4 mm stab incision is made.
Step 6. Using a combination of an electrocautery, 90° ablator (Apollo RF MP90 aspirating ablator, Arthrex), and a 2.0 mm shaver, subacromial bursectomy is performed to expose the lower surface of the acromion, as well as the anterior and lateral edges (Fig 3).
Step 7. Before initiation of the acromioplasty, the acromial branch of the thoracoacromial artery is identified about the medial aspect of the coracoacromial ligament, and it is cauterized.
Step 8. Using a 3 mm NanoResection burr (Arthrex), acromioplasty is performed by gradual resection of anterior and lateral bone spurs, working from lateral to medial (Fig 4).
Step 9. Electrocautery is used intermittently to maintain hemostasis during the acromioplasty (Fig 5).
Step 10. Apply wound closure and soft dressing as indicated.

Fig 1. In-office nano arthroscopy standard shoulder setup. The patient is seated comfortably on an examination table, with the back of the bed set to approximately 70° to 80°, and the ipsilateral shoulder is prepped and draped in sterile fashion. A well-padded mayo stand is used to support the arm in slight forward flexion and abduction, which facilitates entry into the subacromial space.

(DualWave; Arthrex) at a pressure of 35 mm Hg. Inflow consists of 1 L of 0.9% normal saline solution mixed with 5 mL of epinephrine. In our experience, adding epinephrine allows for improved hemostasis and visualization. Under direct visualization, the anterior ("working") portal is established by passing a spinal needle 1 cm inferior to the biceps tendon. A diagnostic arthroscopy is then performed using an 18-gauge spinal needle as both a probe and outflow. Once confirmed that our anterior portal site is adequate, a small 3 to 4 mm stab incision is made. A blunt trocar is then used to enter the subacromial space and then replaced by a 2 mm shaver.

Using a combination of electrocautery, 90° ablator (Apollo RF MP90 aspirating ablator; Arthrex), and a 2.0 mm shaver, a subacromial bursectomy is performed to expose the lower surface of the acromion, as well as the anterior and lateral edges (Fig 3). The bursectomy proceeds in an organized fashion, from anterior to posterior and from lateral to medial. Before initiation of the acromioplasty, the acromial branch of the thoracoacromial artery is identified at the medial aspect of the CA ligament, and it is cauterized. The goal of the acromioplasty is to flatten the acromion by removing undersurface irregularities and osteophytes that may impinge on the rotator cuff.

Using a 3 mm NanoResection burr (Arthrex), an acromioplasty is performed by gradual resection of anterior and lateral bone spurs, working from lateral to medial from the anterior portal using the cutting block technique (Fig 4). Electrocautery is used intermittently to maintain hemostasis during the acromioplasty (Fig

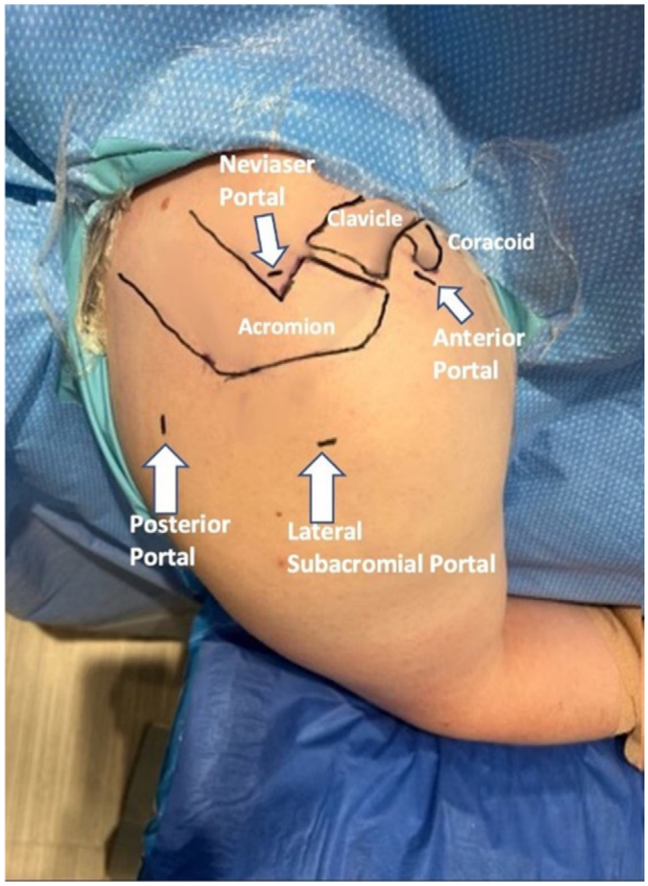

Fig 2. The prepped and draped right shoulder with the patient in an upright, beach chair position, with the bed set at approximately 70° to 80°. Relevant surface anatomy markings include the acromion, clavicle, and coracoid. The posterior portal, which is the primary viewing portal, is made approximately 2 cm inferior and 2 cm medial to the posterolateral border of the acromion. The anterior portal, which is the primary viewing portal, is made 1 cm lateral to the coracoid. If needed, the lateral, working portal is made 1 cm distal to the lateral edge of the acromion.

5). Laterally, care is taken to avoid the muscle fibers of the deltoid. Depending on surgeon preference, an additional lateral portal can be made and used for further bony resection. Through the lateral portal, the acromioplasty can be continued while viewing from the posterior portal followed by the burr in the posterior portal while viewing from the lateral portal, to ensure complete resection of any osteophytes. A 2 mm shaver is inserted into the subacromial space on completion of the acromioplasty to remove any bony debris

Portal sites are closed using adhesive wound closure strips (Steri-Strip; 3M, Saint Paul, MN), or the portals may be closed using simple sutures as determined by the operating surgeon. A dry, sterile dressing is applied that facilitates early shoulder range of motion.

Fig 3. Arthroscopic view of the left shoulder through the posterior portal. With a 2 mm shaver in the anterior portal, subacromial bursectomy is performed to expose the lower surface of the acromion, as well as the anterior and lateral edges. The bursectomy proceeds in an organized fashion from anterior to posterior and from lateral to medial.

Fig 4. Arthroscopic view of the left shoulder through the posterior portal. With a 3 mm NanoResection burr (Arthrex) in the anterior portal, acromioplasty is performed by gradual resection of anterior and lateral bone spurs, working from lateral to medial in the posterior portal and from anterior to posterior in the lateral portal. Laterally, care is taken to avoid the muscle fibers of the deltoid. Depending on surgeon preference, an additional lateral portal can be made and used for further bony resection. Through the lateral portal, the acromioplasty can be continued while viewing from the posterior portal, followed by the burr in the posterior portal while viewing from the lateral portal to ensure complete resection of any osteophytes.

Postoperative Protocol

After surgery, the arm is placed into a sling for comfort. The patient is counseled and encouraged to come out of the sling on postoperative day 2 and is instructed to perform pendulum exercises to mobilize the shoulder to prevent contracture. Ice and elevation are encouraged for 24 to 36 hours. Acetaminophen and nonsteroidal anti-inflammatory drugs are generally sufficient for pain control. The patient returns to the office on postoperative day 5, and formal physical therapy is initiated at that time.

Discussion

Arthroscopic subacromial decompression, including subacromial bursectomy and acromioplasty, remains among the most commonly performed shoulder procedures.[17] To our knowledge, this is the first technical (and video) description regarding the use of IONA for the treatment of subacromial impingement. The technique is simple, requiring just 2 or 3 small portals and basic nano-arthroscopy instruments (nano-arthroscope, shaver, burr, electrocautery). It is reproducible, as each of the authors included in the study demonstrated proficiency, (the majority of whom are postgraduate year-4 orthopaedic surgery residents). Last, the technique is effective, because an adequate subacromial bursectomy and anterior/anterolateral acromioplasty could be performed by use of this technique.

The advantages of IONA are numerous, including decreased cost, decreased surgical morbidity, decreased anesthesia risks (no formal anesthesia or anesthesiologist), and faster post-procedural recovery.[11,12] Practical advantages include higher diagnostic accuracy, sensitivity, and specificity than magnetic resonance imaging, which has been demonstrated in previous studies.[18-21] Additionally, there may a lower risk of nerve injury and chondral damage during intra-articular use. Previous work has demonstrated greater patient satisfaction and higher rates of return to sport and work after IONA compared to standard arthroscopy performed in the operating room with the patient under general anesthesia.[12] By using “nano”-sized instruments, local soft tissue trauma is likely decreased, allowing patients to experience less pain, compared to standard arthroscopic techniques used in the operating room. This may also explain why patients who undergo IONA do not require narcotic medication after surgery and are treated with acetaminophen and nonsteroidal anti-inflammatory drugs.

Fig 5. Arthroscopic view of the left shoulder through the posterior portal. An electrocautery, 90° ablator (Apollo RF MP90 aspirating ablator; Arthrex) is inserted into the anterior portal and is used intermittently to maintain hemostasis during the acromioplasty.

A previous report by Colasanti et al.[12] regarding IONA for the treatment of anterior ankle impingement found that patients experienced minimal pain and found the live video feed and narration to be a positive experience overall. Interestingly, a large proportion of the cohort (94%) reported a willingness to undergo the procedure again and specifically cited the ability to inquire in real time about their condition, to identify pathology, and to watch the surgeon address it, as support for the positive experience associated with IONA.

The main limitations of our proposed technique include inaccessibility to nano-instruments and the lack of appropriate office space to accommodate a semi-operating room setup. The indications (and contraindications) mirror those of standard arthroscopic techniques (at the very least) but will need to be expanded upon as more experience is gained with this novel technique. For example, patients who cannot tolerate the sight of scant amounts of blood (e.g., that may be visible after a minuscule skin incision) or who do not want to be awake for a procedure would certainly not be candidates for IONA.

Conclusion

Subacromial decompression with bursectomy and acromioplasty is the standard of care for refractory subacromial impingement. In appropriately selected patients, in-office needle arthroscopy of the shoulder with subacromial decompression can be performed by this simple technique.

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