

Surgical Management of Shoulder Heterotopic Ossification

Justin Hallock, M.D., and Larry D. Field, M.D.



Abstract: The formation of heterotopic ossification around the shoulder is a rare but potentially debilitating condition. It is found most commonly around the hip and is usually associated with an inciting event such as trauma, burn, previous surgery, or traumatic brain/spinal cord injury. The formation of shoulder heterotopic ossification following arthroscopic surgery is very uncommon, with few data pertaining to it in the current literature. Formation of heterotopic ossification in the shoulder after arthroscopic surgery typically occurs around the acromioclavicular joint and in the subacromial space. This location may lead to chronic pain and decreased mobility. The purpose of this article is to describe an arthroscopic technique for excision of heterotopic ossification.

Heterotopic ossification (HO) is the formation of trabecular bone outside the normal skeletal system in the surrounding skin, muscle, subcutaneous tissue, and fibrous tissue surrounding joints.¹ HO typically occurs after a trauma, previous surgery, neurologic injury, or burn. The pathogenesis of HO is not well understood but is likely multifactorial and related to increased prostaglandin activity, hypercalcemia, tissue hypoxia, prolonged immobilization, and genetics.¹⁻⁶ In neurologic injury, there is thought to be an upregulation in tissue bone morphogenic protein as well as prostaglandin E-2, which promote osteoblast formation from mesenchymal stem cells.² Several genetic conditions are associated with formation of HO, including fibrous dysplasia ossificans progressiva, progressive osseous heteroplasia, and Albrights hereditary osteodystrophy.²⁻⁵

HO can form anywhere in the body but most commonly occurs around the hip, knee, and elbow. Several studies have found the rate of HO formation following total hip arthroplasty or open reduction and internal fixation of acetabulum fractures to range from 5% to 90%.^{5,7,8} The occurrence of HO around the shoulder is uncommon compared with other locations, especially in the setting of arthroscopic surgery. Several studies looking at HO in shoulder arthroplasty have demonstrated rates of formation ranging from 15% to 62%.⁹⁻¹¹ The only predisposing factors they found were male sex and rotator cuff arthropathy, which has a slightly increased risk of formation. Even in patients with radiographic HO around the shoulder, it is unclear whether it has any significant detriment to clinical/functional results in this patient population. This is commonly seen following arthroplasty and is likely due to the location of the HO, which is most commonly anteromedial between the inferior lateral aspect of the glenoid and the proximal humerus.⁹

With the evolution of arthroscopic surgical techniques and thus decreased incidence of open shoulder procedures, the documented rates of shoulder HO have decreased substantially. There is a paucity of literature regarding HO formation after shoulder arthroscopy. There are several case reports in the literature demonstrating HO after shoulder arthroscopy, with the most common locations in the resected acromioclavicular joint and subacromial space.^{11,12} HO formation in these locations often leads to impingement and decreased range of motion as well as chronic pain (Figs 1-4). Initial treatment of HO involves conservative therapy

From Mississippi Sports Medicine and Orthopaedic Center, Jackson, Mississippi, U.S.A.

The authors report the following potential conflict of interest or source of funding: L.D.F. receives consulting income from Smith & Nephew and research and educational support from Arthrex, Mitek, and Smith & Nephew. Full ICMJE author disclosure forms are available for this article online, as [supplementary material](#).

Received December 12, 2018; accepted May 13, 2019.

Address correspondence to Larry D. Field, M.D., Mississippi Sports Medicine and Orthopaedic Center, 1325 E Fortification St, Jackson, MS 39202, U.S.A. E-mail: lfield@msmoc.com

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2212-6287/181563

<https://doi.org/10.1016/j.eats.2019.05.019>



Fig 1. Standing anteroposterior radiograph of the right shoulder demonstrating significant ectopic bone formation in the subacromial space, which can serve as a source of impingement and block to motion.

with nonsteroidal anti-inflammatory drugs, physical therapy, and corticosteroid injections. If these modalities fail to adequately alleviate symptoms, then surgical excision is the only curative treatment for this problem. The purpose of this study is to describe our surgical technique for arthroscopic resection of HO around the shoulder.

Surgical Technique

This technique can be performed in either the beach chair or lateral decubitus position. The authors prefer the beach chair position due to the ease at which the arm can be manipulated. No changes in technique are made when this procedure is performed in the lateral position. This technique is demonstrated in [Video 1](#). Careful radioactive evaluation with orthogonal views is necessary preoperatively to localize the ectopic bone to assist with surgical planning ([Figs 1-4](#)). The bony anatomy is palpated and marked out to assist with portal placement. The operative extremity is prepped and draped in routine sterile fashion. A standard posterior portal is created and a 30-degree arthroscope is placed in the glenohumeral joint.

Next, a standard anterosuperior portal is localized with an 18-gauge spinal needle, taking care to enter the center of the rotator interval perpendicular to the joint capsule. A thorough diagnostic arthroscopy is then performed, with the examination of all key anatomic structures. A probe can be used in the anterior portal to

palpate any calcific-appearing soft tissue. These patients also often develop a dense, reactive capsule circumferentially that hinders motion and is readily visualized arthroscopically ([Video 1](#), [Fig 5](#)). To address this, an arthroscopic biter is used to carefully perform a circumferential capsular release ([Fig 6](#)). Once the glenohumeral joint is thoroughly inspected and managed, both the anterior and posterior cannulae and arthroscope are removed. The blunt trocar and cannula are placed back in the posterior portal and redirected into the subacromial space. Again, dense adhesions within the subacromial space are very common in patients with HO, and a sweeping motion with the metal trocar/cannula aids in separating some of these adhesions from the overlying acromion.

A Wissinger rod is then passed through the posterior cannula, across the subacromial space and out the anterior portal incision. The anterior cannula is then advanced into the subacromial space. At this time, an 11-blade knife is used to make a standard lateral portal, and the shaver is introduced into the subacromial space (Dyonics 4.5 mm Incisor Plus Platinum Shaver, Model: 72203013; Smith & Nephew Dyonics, Andover, MA). Marked adhesions of the rotator cuff to the overlying



Fig 2. Standing anteroposterior radiograph of the right shoulder demonstrating a shell of ectopic bone formation in the subacromial space, which appears to be lying on top of or within the rotator cuff tendons. This shelf of bone is commonly seen lying on top of the rotator cuff tendons and can be a significant pain generator.



Fig 3. Standing anteroposterior radiograph of the right shoulder again showing diffuse formation of heterotopic ossification in the subacromial space. Ectopic bone formation can occur as a diffuse, unorganized wad of bone, such as is shown, or a more-organized shell of bone, as seen in [Figures 1](#) and [2](#).



Fig 4. Standing scapular Y radiograph of the right shoulder demonstrating the presence of a large piece of ectopic bone in the subacromial space. It is important to obtain orthogonal views of the shoulder to better appreciate the size and location of the bone, which will assist in preoperative planning.

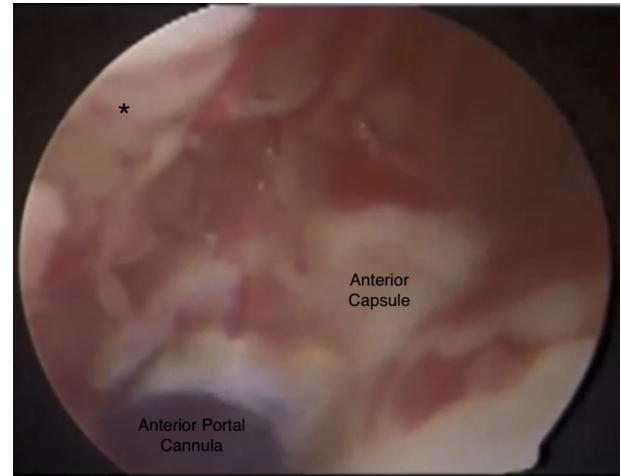


Fig 5. Arthroscopic picture of the right glenohumeral joint in beach chair position viewed from the posterior portal looking at the anterior and superior capsule. The * marks the inferior border of the acromion. Note the synovitis and thickening of the capsule. Patients with heterotopic ossification often develop this highly reactive, thickened capsule, resulting in significant contractures that require release.

acromion are commonly present and require careful separation and extensive resection to re-establish the subacromial space ([Fig 7](#)). The arthroscopic shaver is used to perform a full subacromial bursectomy and lysis of what often represents extremely thick adhesions throughout the subacromial space, including the subdeltoid bursal area as well. Not uncommonly, HO characterized by bony spicules and well-formed

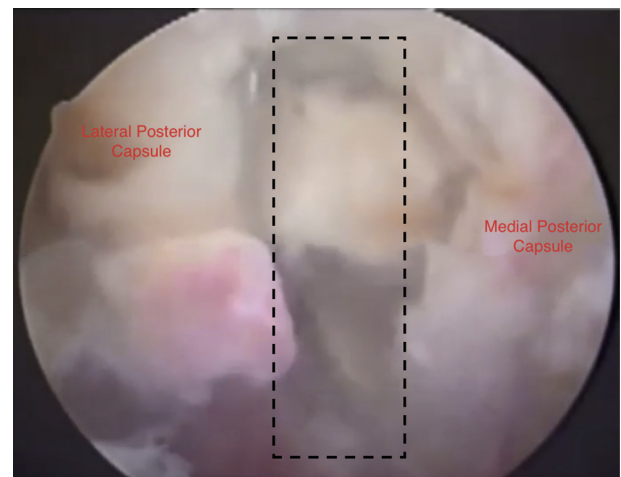


Fig 6. Arthroscopic picture of a right shoulder in beach chair position looking in the glenohumeral joint from the anterior portal at posterior capsule. The dash outline box shows the area of posterior capsule excised using an arthroscopic biter as demonstrated in the video. Note the thickened capsule. Once the anterior and posterior capsule is released circumferentially from the glenohumeral joint, we then go subacromial to address the ectopic bone.

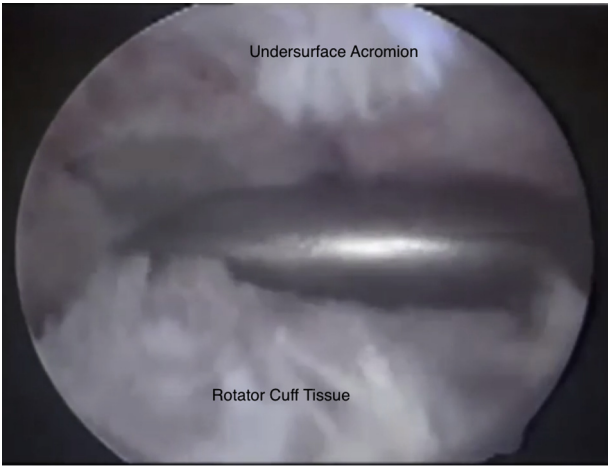


Fig 7. Arthroscopic image of the subacromial space in a right shoulder in beach chair position viewing from the posterior portal. Oftentimes the rotator cuff is adhered to the undersurface of the acromion, requiring the shaver to develop a plane between the cuff tissue and surrounding bony architecture. This allows re-establishment of the subdeltoid space and one to proceed with removal or bony fragments.

calcifications is identified in the subacromial space and within the rotator cuff tendon tissue and must be thoroughly removed. The arthroscopic shaver is then used to create a circumferential plane around any calcific masses that may be present (Fig 8). Once the mass is freed up, it is then removed either whole with a grasper or in piecemeal fashion depending on the size and consistency (Fig 9).

Following the capsular release and exostectomy, the shoulder is then manipulated and taken through a

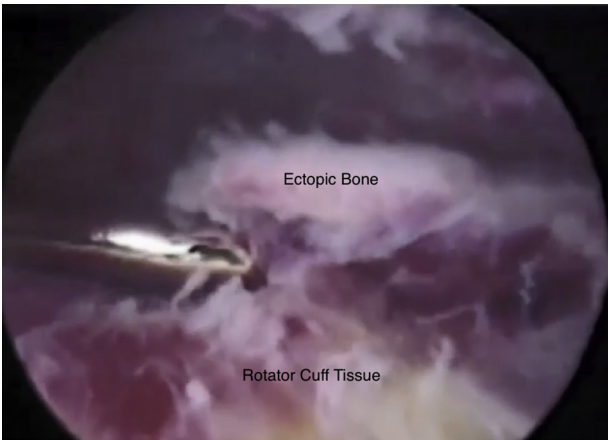


Fig 8. Arthroscopic image of the right subacromial space in beach chair position viewing from the lateral portal. Oftentimes ectopic bone will be found within the rotator cuff tissue itself and can be excised using an arthroscopic shaver and grasper. The shaver is inserted through the posterior portal in this case to free up adhesions and skeletonize the bony prominence from the underlying rotator cuff tissue to make for easy removal.

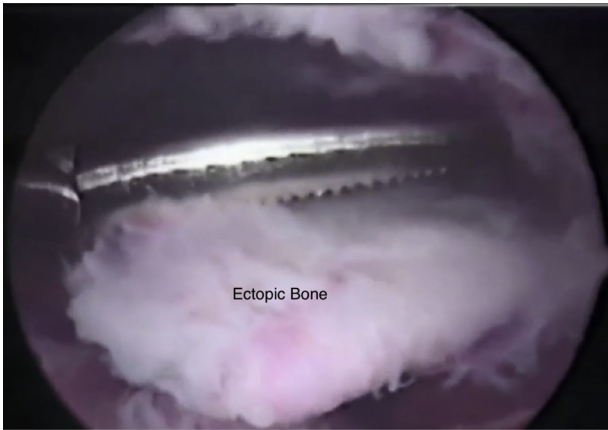


Fig 9. Arthroscopic image of the right subacromial space in beach chair position viewing from the lateral portal. The ectopic bone fragment has been shelled out and is now easily removed as a whole or in piecemeal fashion using an arthroscopic grasper.

range of motion to ensure that no additional adhesions or blocks to motion remain. Intraoperative fluoroscopy is then used to confirm removal of all HO.

Patients are routinely seen on postoperative day 1 and are instructed at that time to use the hand, arm, and shoulder without restriction. Also, organized physical therapy including passive, active assisted, and active range of motion is initiated on postoperative day 2 and continued for 4 to 12 weeks until range of motion and function is restored. An arm sling, provided at the time of surgery, is optional, and patients are encouraged to use the affected extremity as symptoms allow. Also, unless contraindicated, Indocin SR 75 mg (Iroko Pharmaceuticals, Philadelphia, PA) to be taken by mouth once daily is continued for 2 weeks postoperatively for HO chemoprophylaxis.

Discussion

HO around the shoulder joint is a rare phenomenon that is often asymptomatic. However, HO can be extremely painful and debilitating in some patients. HO most frequently occurs after a trauma, neurologic injury, burn, or previous surgery. The bulk of the

Table 1. Pearls and Pitfalls Regarding Surgical Planning and Technique of Arthroscopic Excision of Ectopic Bone Around the Shoulder

- Extensive arthroscopic capsular release is often necessary to regain range of motion.
- Arthroscopic application of bone wax to undersurface of acromion and other exposed cancellous bone helps prevent recurrence.
- Intraoperative fluoroscopy is useful to confirm the excision of all calcification and ectopic bone.
- Postoperative treatment with non-steroidal anti-inflammatory drugs (Indomethacin) $\times$ 1 month is recommended to prevent recurrence
- Early initiation of physical therapy is necessary to regain range of motion.

Table 2. The Advantages, Disadvantages, and Limitations of Arthroscopic Excision of Ectopic Bone Formation Around the Shoulder

• Advantages
○ Minimal soft-tissue trauma, which decreases the risk of HO recurrence
○ Excellent visualization of the subacromial space and AC joint
○ Faster recovery and earlier mobilization compared with open procedures
• Disadvantages and limitations
○ Technically demanding procedure, especially when performing extensive capsular release
○ Unable to adequately visualize and access ectopic bone that forms in the soft tissues around the axilla outside the glenohumeral joint and subacromial space.
○ Future studies needed to determine the long-term efficacy and recurrence rates following arthroscopic excision

AC, acromioclavicular; HO, heterotopic ossification.

literature regarding HO around the shoulder is associated with arthroplasty or neurologic injury. The most common anatomic locations of HO following open procedures, especially shoulder arthroplasty, are in the anterior and posterior inferior soft tissue as well as around the axilla.¹³ These lesions are typically asymptomatic and can be managed with non-steroidal anti-inflammatory drugs and physical therapy. In a retrospective study, by Ko et al.⁸ looked at a series of 164 consecutive patients undergoing reverse shoulder arthroplasty and found radiographic evidence of HO in 61%. In another study, Verhofste et al.⁹ similarly looked at their series of patients undergoing reverse shoulder arthroplasty and found the rate of HO formation to be 29%. They found HO to be a nonprogressive lesion that typically forms early and often is of little clinical significance.⁹

However, if a patient is symptomatic and does not respond to conservative treatment, surgical excision is the only other option and often leads to improved clinical and functional outcomes. Excision has typically been performed through an open approach, which is determined by the anatomic location of the bony lesions. This can be a technically challenging procedure, as the bone often encompasses the neurovascular structures and can potentially lead to iatrogenic injury. That being said, the results are often quite favorable, with significant improvements in both range of motion as well as functional outcomes.¹⁴

The occurrence of HO following arthroscopic shoulder surgery is very rare. This is likely due to the minimally invasive nature of the surgery, which reduces soft-tissue trauma as well as the constant irrigation through the joint that dilutes the osteoinductive marrow elements. There are several case reports in the literature pertaining to this complication. However, no large retrospective studies exist. Berg et al.^{11,14} conducted a retrospective review of patients undergoing both open and arthroscopic acromioplasty and distal clavicle excision

and found an incidence rate of HO formation of 3.2%. They found 40 patients with radiographic evidence of HO. Twenty of the 40 underwent open excision of the HO with good results.^{11,14} Boynton and Enders¹⁵ published a case report of significant HO formation in the deltoid and rotator cuff spanning from the acromion distal to the humeral shaft. This patient underwent extensive conservative treatment without clinical improvement and ultimately underwent a shoulder arthrodesis with good results. Tytherleigh-Strong et al.¹⁶ published a case report in which a patient underwent arthroscopic acromioplasty and distal clavicle excision who later went on to reossify and fuse across the acromioclavicular joint, resulting in pain and decreased motion. An open procedure was performed to remove the ectopic ossification, and the patient recovered uneventfully with minimal residual deficits.

The aforementioned cases all address the issue of ectopic ossification status following shoulder arthroscopy. However, they were all treated with subsequent open resection. The authors' technique, described here, details the technical steps for arthroscopic excision of heterotopic bone following shoulder arthroscopy. Although this technique may be technically demanding depending on the extent of the bony lesions and the degree of capsular contracture, when performed by an experienced arthroscopist and using the aforementioned technique and tips, excellent results may be expected (Table 1).

The authors believe that the described technique has several advantages compared with an open procedure to remove ectopic bone (Table 2). First, arthroscopic surgery allows for a minimally invasive approach, which is known to result in a lower risk of muscle and soft-tissue trauma and could reduce the risk of recurrent HO. This arthroscopic approach also may lead to a faster recovery and an easier rehabilitative course for some patients. This technique also uses equipment and portals that are very familiar to the shoulder arthroscopic surgeon and can thus be performed reliably and with reproducible results.

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