Trapezius-sparing Approach to Osteochondromas on the Ventral Surface of the Scapula

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Abstract: Lesions affecting the ventral surface of the scapula are rare but can be associated with significant mechanical symptoms, such a pseudowinging or snapping scapula syndrome. Excision of osteochondromas arising from this region can be challenging due to the numerous muscle origins and attachments. Access to the bony surface of the scapula may be associated with extensive muscular detachment and soft tissue dissection. We describe a novel open trapezius-sparing approach to the ventral surface of the scapula.

Key Words: scapula, ventral surface, trapezius, osteochondroma

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Tumors and tumor-like lesions of the scapula are rare and can be associated with significant mechanical symptoms, reduced range of movement, snapping scapula syndrome and infrequently, pseudowinging.[1,2] Symptoms from scapular tumors are caused by direct pressure on the adjacent anatomic structures, mechanical interference of joint range of motion, or by reactive bursitis.[3] Osteochondromas are the most common benign neoplasm of the scapular with an incidence of 4.6%.[4,5] In this location they predominantly present on the ventral surface (63%) and can be associated with pain with reduced range of movement.[6] Excision of osteochondromas arising from this region is challenging due to the numerous muscle origins and attachments. Access to the bony surface of the scapula can be associated with extensive muscular detachment and soft tissue dissection. Although rhomboid major is typically reflected from the medial border of the scapula, previous open techniques approaches have described division of the trapezius to safely access the scapulothoracic plane.[3,6–10] Although no complications were reported by the authors of these techniques, most patients with ventral scapular lesions present with problems related to scapulothoracic movement. It seems prudent therefore to preserve muscle attachments where possible to affect an expeditious and natural recovery in the postoperative period. Here we describe a novel trapezius-sparing approach to the ventral surface of the scapula, which we utilize for resection of symptomatic osteochondromas.

CASE HISTORY

A 24-year-old right-hand dominant woman presented to the sarcoma service with a history of increasing left shoulder pain radiating into her left hand. She reported reduced function in the left shoulder due to pain in all planes of scapula motion. This had deteriorated to the extent that she was unable to use her left arm for activities of daily living, including self-care. In total, the shoulder had been symptomatic for 3 years with exacerbation in symptoms intensifying over a 3-month period before the most recent review. She reported mechanical clunking in abduction and scapular protraction. She did not report any neurovascular or paraneoplastic symptoms. She has a medical history of hereditary multiple exostosis (HME) with previous successful excisions of osteochondromas around her right knee, right scapula, and derotation osteotomies of both proximal femora. On examination, her arm was held in an exaggerated protective position, and she had widespread tenderness over the posterior aspect of the scapula. Muscle bulk was symmetrical with no gross scapular winging. She was unable to actively abduct or flex her shoulder past 80 degrees and further passive abduction and flexion produced pain. She had preserved external rotation and extension, but internal rotation was limited to the level of her sacroiliac joint, compared with vertebral body T8 on her contralateral side. Painful, corrugated clunking over the ribs was observed with active scapulothoracic motion. In the range of movement displayed, scapula dyskinesia was present. Rotator cuff examination revealed an intact supraspinatus, infraspinatus, and teres minor with normal power observed. Grade 4 medical research council power in Gerbers lift-off and the belly-press test was observed. Impingement tests were negative and ipsilateral hand, wrist and elbow examination were normal. A normal cervical range of movement was demonstrated and contralateral shoulder range of movement and power were normal (2 years following excision of 2 osteochondromas from the ventral surface of the scapula utilizing the technique described herein). Neurovascular examination revealed an intact brachial plexus, and normal radial and ulnar pulses.

Our patient underwent magnetic resonance imaging (MRI) of her left shoulder, which revealed 2 ventral scapular exostoses: the first measured 16 mm and arose from the ventral surface just proximal to the inferior tip of the scapula, and the second measured 10 mm and arose more proximal and central to this (Figs. 1, 2). We choose MRI as the sole imaging modality given her history of HME and multiple radiograph and computed tomographic examinations previously conducted.

The appearances were unchanged from MRI imaging preformed 1 year previously, with no features of malignancy. Given the debilitating symptoms she was experiencing, a decision was taken to remove the osteochondromas; these were excised *en masse* with no perioperative complications. The patient was discharged on postoperative day 1. Clinical review at 6 weeks and 3 months revealed improvement in both pain and function. Histopathology reports confirmed the tumors to be benign exostoses with no evidence of chondrosarcomatous transformation.

SURGICAL TECHNIQUE

Patient Setup

The patient was brought to the operating room and placed in the lateral position on the operating table with their left arm draped over a bolster. The pelvis was fixed with a wide bolster placed vertically on the sacrum and a smaller bolster placed anteriorly on the anterior superior iliac spine. Following skin preparation, the surgical site was draped using square drapes with the arm draped free in a stockinette. The patient position and drape setup are illustrated in Figures 3 and 4.

Incision and Approach

This approach utilizes the internervous plane between the trapezius (accessory nerve) and the latissimus dorsi (thoracodorsal

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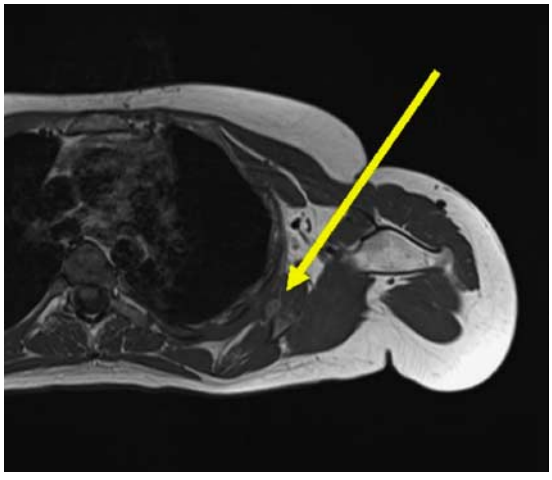

FIGURE 1. Axial magnetic resonance imaging demonstrating one of the osteochondromas. The arrow shows the ventral surface osteochondromas on the scapula. full color online

nerve). A 10 cm oblique longitudinal incision was performed perpendicular to the medial border of the scapula (Figs. 4, 5) traversing the triangle of auscultation. The triangle of auscultation is depicted in the lithograph by Quain and highlighted in red (Fig. 5) titled plate 22. The borders of the triangle are as follows: the medial border is defined by the lateral edge of trapezius, the lateral border is defined by the vertebral border of the scapula and the inferior border of the triangle is defined by superior edge of latisimus dorsi.[12] The scapular attachment of rhomboid major defines the floor of the triangle. Following superficial sharp dissection, electrocautery was used to continue the incision through superficial fat until the deep fascia was encountered. At this point, a self-retaining retractor was inserted into the skin edges (Fig. 6).

The lateral edge of the inferior fibers of the trapezius can be identified and retracted medially. In a similar manor the horizontal muscle fibers of latisimus dorsi are identified and retracted inferiorly thereby enlarging the auscultatory triangle.

Attention was now turned to the rhomboid major muscle. The confluent fascia and tendinous attachments of this muscle onto the medial border of the scapula were incised and reflected

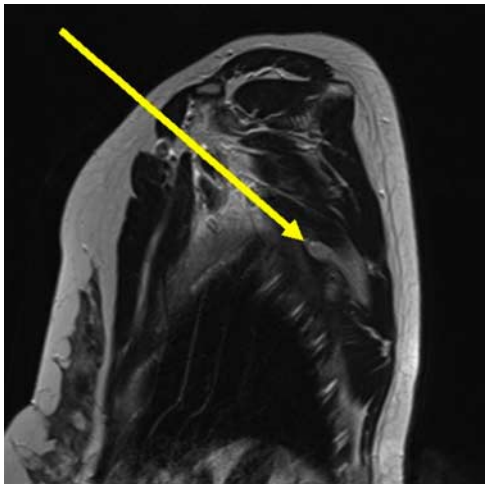

FIGURE 2. Sagittal magnetic resonance imaging demonstrating the second osteochondroma. The arrow shows the ventral surface osteochondromas on the scapula. full color online

FIGURE 3. Lateral position over elbow bolster. full color online

from the tip of the scapula and along the medial scapula border superiorly a length of 4 cm (Fig. 7). This incision provided a cuff of tissue amenable to repair on closure. At this point a bone hook was placed on the tip of the scapula, which was elevated by the surgeon's assistant (Fig. 8). A self-retainer placed in the reflected fibers of rhomboid major allowed for clear visualization of the ventral surface of the scapula (Fig. 9). A long ring-handled spike was gently placed into the scapulothoracic plane and held in line with the lateral border of the scapula to protect the lateral structures. Both osteochondromas were then removed using an osteotome, which was placed in the plane between the subscapular fossa and subscapularis (Fig. 10). Hemostasis was achieved, rhomboid major cuff repaired with a braided absorbable suture, followed by fascial closure and monofilament absorbable suture to the subcuticular layer.

The osteochondromas where inspected and no unusual features where identified. The specimens were sent for histology (Figs. 11, 12).

Postoperative Regime and Patient Outcome

The patient initially rested in a sling for 48 hours for comfort. An early full range of comfortable passive movement was allowed. Formal physiotherapy was initiated at 2 weeks with assisted forward elevation, abduction, and rotation. Active full range of movement was commenced at 6 weeks postoperation with isometric strengthening commenced 2 weeks after. At 3-month postoperation our patient has described her

FIGURE 4. Scapula outlined and incision placement indicated dotted line. full color online

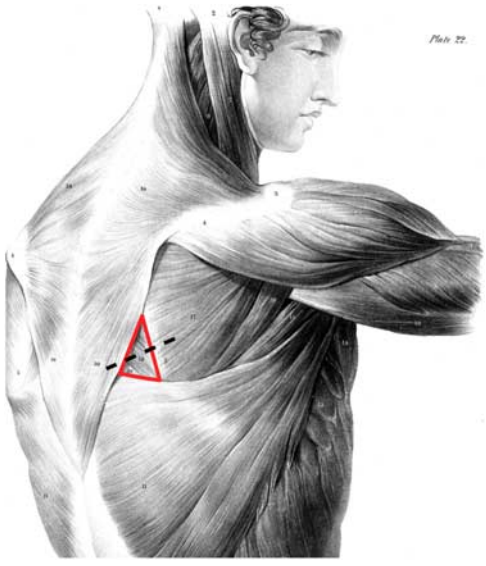

FIGURE 5. Plate 22 lithograph detailing relationship of the muscles and bone which form the auscultatory triangle. Triangle highlighted in red. Incision dotted line.[11] full color online

shoulder as functioning normally with a recorded range of movement: forward flexion 180 degrees, backward extension 30 degrees, external rotation 90 degrees, internal rotation 60 degrees, abduction 150 degrees, and rotator cuff power grade 5 and symmetrical with right side.

Risks of the Approach

Major Blood Vessels

The scapula receives its arterial supply from an anastomotic ring formed from the circumflex scapular artery and thoracodorsal arteries (branches of the subscapular artery), and the dorsal scapular artery (terminal branch of the deep transverse cervical artery). The thoracodorsal artery runs along the inferolateral border of the scapula, with branches to the infraspinous fossa, and it is not encountered in this approach. The dorsal scapular artery runs down the medial border of the scapula in the substance of the rhomboid major. This vessel was not encountered during this approach. Foreseeably, branches of this vessel may be encountered, although the risk of significant damage is minimized by incision into the confluent fascia and tendinous portion of the insertion of rhomboid major, followed by meticulous subperiosteal elevation, leaving the muscles substance of rhomboid major intact. If significant bleeding is encountered, ligation of effected vessels can be undertaken due to the well-developed anastomosis around the scapular tip.[13]

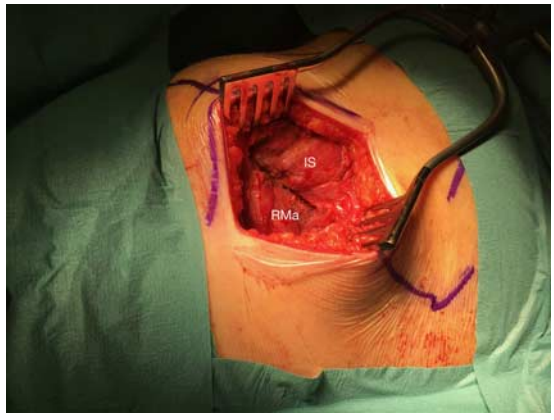

FIGURE 7. Rhomboid major (RMa) is detached from the scapula. Infraspinatus (IS) is visualized. full color online

Major Nerves

This technique utilizes a true internervous plane between the latissimus dorsi and the trapezius. The dorsal scapular nerve runs through the substance of the rhomboid major and, like the artery, could potentially be injured while reflecting rhomboid major from its scapula origin. Careful blunt dissection is utilized at the inferomost aspect of the rhomboid major to minimize this risk. There are 3 branches of the posterior cord of the brachial plexus that run through the scapulothoracic plane: the superior and inferior subscapular nerves, which provide motor innervation to subscapularis, and the thoracodorsal nerve, which provides motor innervation to the latissimus dorsi. These nerves run in a plane between the subscapularis and the thoracic wall and they should not be encountered in this approach provided the subscapularis muscle is not perforated by the osteotome when working on the ventral bone of the scapula.

DISCUSSION

Solitary osteochondromas are commonly encountered in the long bones and less frequently observed in the flat bones

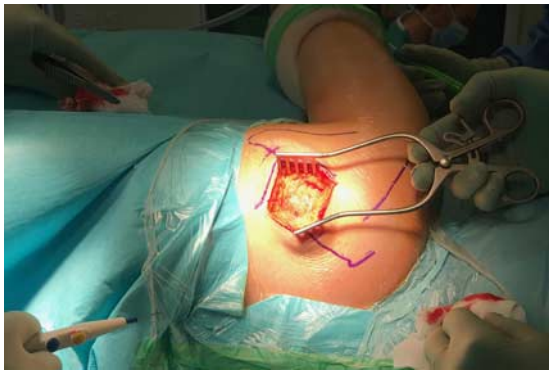

FIGURE 6. Superficial dissection traversing the triangle of auscultation. full color online

FIGURE 8. The scapula can be retracted allowing access to subscapularis. full color online

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FIGURE 9. Visualization of the osteochondromas. full color online

such as the scapular.[14] Even though they are encountered less frequently in this bone, osteochondromas are the most common benign neoplasm of the scapular with an incidence of 4.6%.[4,5] In this location they predominantly present on the ventral surface (63%).[6] Although the incidence of osteochondroma on the ventral surface of the scapula has been published, an association in correlation of symptoms is limited to case reports and case series. Chondrosarcomatous transformation occurs in 1% of solitary osteochondromas, and in up to 27% of patients with HME, with scapular osteochondromas recognized as having the highest risk of malignant transformation of all anatomic sites.[14] For these reasons, surgical excision is often advised.[15]

The authors are aware of 7 other papers describing techniques for resection of tumors on the ventral surface of the scapula. Perez et al[16] and Fukunaga et al[17] describe minimally invasive resection of ventral osteochondromas using a thoracoscope with no immediate complications. Perez and colleagues undertook laceration of the serratus anterior, trapezius, and rhomboid major to place port sites and gain arthroscopic access, whereas Fukunaga and colleagues approached the ventral surface from the lateral border of the scapula, detaching the tendon of teres major in the process. Kwon and Kelly,[8] Fageir et al,[9] Esenkaya,[7] Tungdim et al[10] and Nercessian and Denton[3] reported single cases of open excision of ventral scapular osteochondromas. Comparison of these reports with our technique is presented in Table 1.

FIGURE 10. Removal of osteochondromas with osteotome. full color online

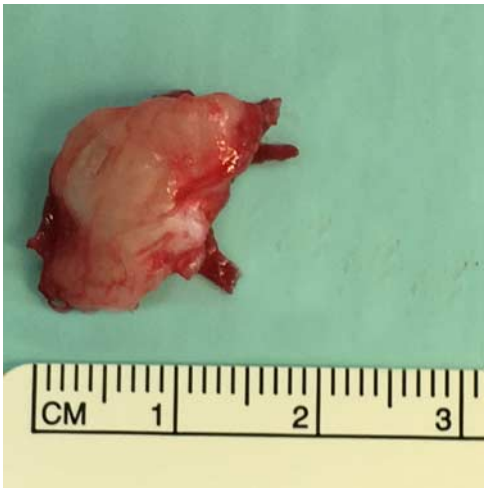

FIGURE 11. First osteochondroma excised from scapula. full color online

Kwon and Kelly[8] describe a parascapular skin incision along the medial border of the left scapula with 5 cm of the trapezius muscle being divided at the medial scapular border in the line of the skin incision. Fageir et al[9] also describe a parascapular skin incision along the medial border of the left scapula with 5 cm of the trapezius muscle being divided at the medial scapular border in the line of the skin incision. Esenkaya reported a parascapular incision parallel to the vertebral and superior border of the scapula. The trapezius and the rhomboideus muscles were sectioned in dieir mid substance to access the scapula.[7] Tungdim et al[10] described a 5 cm incision which was parallel to the lower half of the medial border of the scapula with trapezius incised along the skin incision. Nercessian and Denton reported an approach with a parascapular incision made between the spinous processes and the medial border of the scapula. In this approach the trapezius and the rhomboid major muscles were divided and retracted.[13]

The previous techniques described incision of the trapezius in its inferolateral substance to further gain access to the medial border of the scapula. This is followed by reflection of the rhomboid major muscle from the medial border of the scapula.

The trapezius-sparing technique is made possible by the skin incision made perpendicular to the medial border of the

FIGURE 12. Second osteochondroma excised from scapula. full color online

TABLE 1. Comparison of Published Surgical Techniques

References	Techniques	Muscles Detached or Incised
In the study	Open, incision perpendicular to medial border of scapula, trapezius-sparing	Rhomboid major
Tungdim et al[10]	Open, medial parascapular approach, trapezius-incising	Trapezius and rhomboid major
Fageir et al[9]	Trapezius-detaching	Trapezius and rhomboid major
Kwon and Kelly[8]	Open, medial parascapular approach, trapezius-incising	Trapezius and rhomboid major
Perez et al[16]	Thoracoscopic	Serratus anterior, rhomboid major, trapezius
Fukunaga et al[17]	Thoracoscopic	Teres major
Esenkaya[7]	Open, medial parascapular approach, trapezius-incising	Trapezius and rhomboid major
Nercessian and Denton[3]	Open, medial parascapular approach, trapezius-incising	Trapezius and rhomboid major

scapula centered on the triangle of auscultation. This triangle is manipulated with retractors to give increased working space without the need for incision of the trapezius muscle.

Frost et al[6] reported successful excision of 5 ventral scapular osteochondromas, representing the largest case series in the literature. A single surgical technique is not described in detail and > 1 surgeon was involved in the case series. In their series they did report that muscle fibers were either elevated in a subperiosteal manner or split in line with the fibers, depending on the location of the osteochondromas.

Although no complications were reported by the previuos authors, most patients with ventral scapular lesions present with problems related to scapulothoracic movement. It seems prudent therefore to preserve muscle attachments where possible to affect an expeditious and natural recovery in the postoperative period.

We are conscious of the potential for malignant transformation of osteochondromas, as detailed by Clement et al,[14] and malignant status is usually unknown at the time of resection. We believe that the preservation of muscle attachments when resecting these tumors may prevent possible direct seeding of tumor cells into different muscle compartments, and further allow meticulous hemostatic control to prevent risk of spread or recurrence.

Limitations of the Approach

The trapezius-sparing approach limits the surgeon to osteotome trajectories defined by the triangle of auscultation. If retraction of the trapezius muscle does not permit insertion of instruments such that osteochondromas can be accessed then extending the approach would involve incision of the trapezius muscle. The senior author (J.T.P.) has not found this to be necessary to date. We were able to identify and excise 2 osteochondromas from the ventral surface of the scapula, 1 being on the medial border and 1 more central. Being that the scapula is a large flat bone, safe exploration and excision of tumors and tumor-like lesions may require different approaches, especially if they occur superiorly or laterally.

CONCLUSIONS

This is the first description of an open trapezius-sparing approach to the ventral surface of the scapula. Our technique is safe, effective, allows early rehabilitation postoperatively, and respects the principles of tumor surgery for this presentation.

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