"Trapdoor" Medial Scapula Osteotomy for Resection of a Benign Subscapular Neoplasm

A Case Report

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Investigation was performed at Loyola University Medical Center, Maywood, IL

Abstract

Case: Neurofibromatosis type 2 (NF2) is an autosomal dominant condition characterized by the development of neoplasms, which infrequently arise in the subscapular fossa. Surgical removal of large subscapular tumors carries the risk of shoulder dysfunction due to muscle or nerve injury. We describe the case of a patient with NF2 who presented with a hybrid subscapular neurofibroma and schwannoma tumor that was completely resected through a muscle-sparing medial scapular osteotomy approach.

Conclusion: We describe a unique muscle-sparing scapula splitting surgical approach to the subscapular region that provides excellent exposure for tumor removal and clinical outcomes with minimal postoperative scapular dyskinesis.

Level of Evidence: IV (case report).

Neurofibromatosis type 2 (NF2) is an autosomal dominant condition characterized by the development of neoplasms such as schwannomas, ependymomas, and meningiomas[1]. Although intracranial involvement is common, spine and peripheral nerve tumors are less commonly reported. Peripheral nerve sheath tumors associated with NF2 may be plaque-like lesions or deep-seated nodular tumors. Periscapular or shoulder girdle region neoplasms are rare with NF2[2,3]. In addition, surgical removal of large subscapular tumors carry the risk of shoulder dysfunction due to musculoskeletal dissonance or neurological compromise[2,3]. More specifically, a muscle splitting approach is commonly used to access medial and ventral scapular masses with potential for iatrogenic injury to the dorsal scapular nerve. This may lead to medial periscapular muscle dysfunction, winging, or pain. We discuss a patient with NF2 found to have a hybrid neurofibroma and schwannoma tumor located in the right subscapular region and describe a medial scapular osteotomy approach that allowed complete resection of the tumor with no untoward effects on shoulder function. The scapular osteotomy obviated the need to split the medial scapular muscles and allowed excellent exposure with minimal morbidity.

The patient was informed that data concerning the case would be submitted for publication, and she provided consent.

Case Report

A mid-20s left-hand–dominant woman with mosaic NF2 presented with a right posterior chest wall subscapular mass first appreciated in 2014 on imaging. Over a period of 7 years, there was no significant change in mass size or quality. She presented with discomfort in the right shoulder and periscapular region. Her surgical history included resection of a left frontal meningioma, a left vestibular schwannoma, and a schwannoma of the lumbar spine. On examination, there was a palpable mass at the medial border of the scapula. She was neurologically intact with normal range of motion.

A magnetic resonance imaging (MRI) demonstrated a T2-hyperintense heterogeneously enhancing mass within the right posterior chest wall. The tumor measured approximately $7.2 \times 2.9 \times 6.6$ cm, deep to the rhomboid major muscle and the medial aspect of the scapula and superficial to the posterolateral ribs (Fig. 1-A). Surveillance imaging demonstrated minimal interval change in mass size over this 7-year period with clinical discomfort associated with scapulothoracic motion

Disclosure: The **Disclosure of Potential Conflicts of Interest** forms are provided with the online version of the article (http://links.lww.com/JBJSCC/C549).

Keywords neurofibromatosis type 2; scapular osteotomy; scapulothoracic dysfunction; benign subscapular tumor

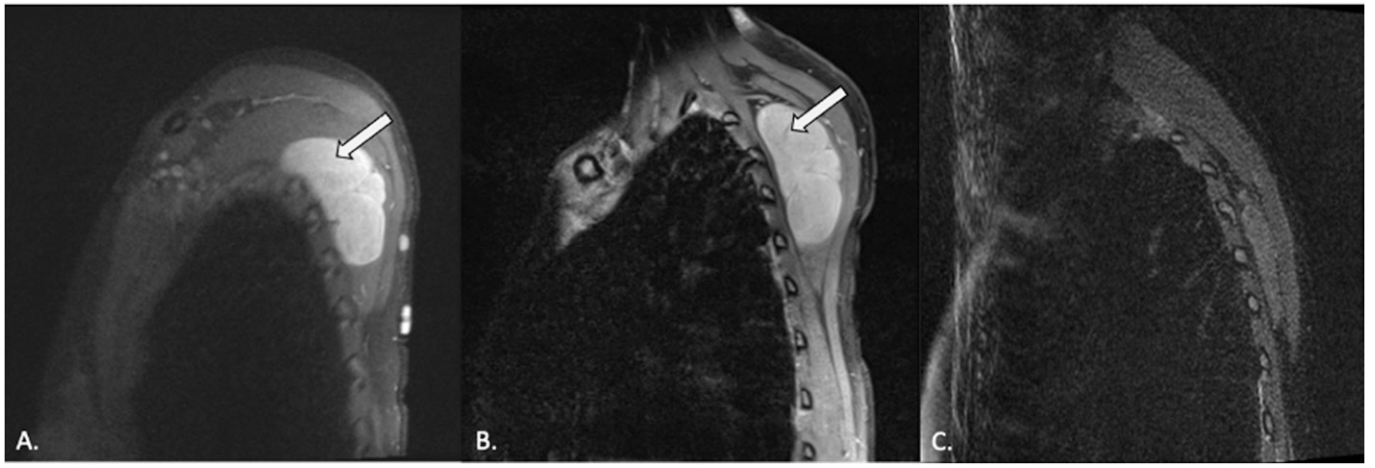

Fig. 1

MRI imaging with sagittal T2 sequences demonstrated a hyperintense heterogeneously enhancing mass within the right posterior chest wall and abutting the scapula (as highlighted by the arrow) (**Fig. 1-A**). Interval imaging demonstrated minimal change in size (as highlighted by the arrow) (**Fig. 1-B**). Postoperative MRI 6 months after surgery demonstrated a complete resection (**Fig. 1-C**). MRI = magnetic resonance imaging.

(Fig. 1-B). After discussing risks and benefits of surgery, a mutual decision to perform an en bloc resection of the tumor was made. Although benign peripheral nerve sheath tumors remained at the top of the differential and there was no clinical or interval radiographic concern for malignant transformation, a biopsy is recommended when assessing a tumor of unknown etiology with malignant or undifferentiated features.

To avoid potential shoulder muscle dysfunction from a medial periscapular muscle splitting approach, we elected to perform an osteotomy of the medial border of the scapula with subsequent repair to allow the advantage of bone-to-bone healing and to avoid detaching the rhomboid muscles and minimize the risk of injury to the dorsal scapular nerve. In addition, although it is certainly reasonable to perform the tumor resection by detaching or splitting muscles, the size of the tumor would have necessitated an extensive craniocaudal dissection.

The patient was positioned prone. An incision was marked along the medial border of the scapula (Fig. 2-A) and full-thickness skin flaps with enough exposure to the spine of the scapula (Fig. 2-B). The trapezius muscle was identified and elevated off the underlying rhomboid musculature. The trapezius insertion on the spine of the scapula was then identified and subperiosteally elevated for later repair. Next, the infraspinatus muscle was recessed 1 cm off the medial border of the scapula which opened a window for the planned osteotomy (Fig. 2-C).

An oscillating saw was used to perform an osteotomy along the medial third of the scapula just distal to the scapular spine (Fig. 3-A). We spread the osteotomy apart and used electrocautery to free subscapularis fascia off the anterior face of the scapula. Traction sutures and retractors were then placed within the osteotomy site, opening the "trapdoor" (Fig. 3-B). This provided excellent exposure to the tumor and posterior chest wall below (Figs. 3-C and 4). We dissected the mass from the posterior chest wall and the anterior aspect of the scapula. The tumor appeared to be well encapsulated. Proximal and distal tumor pedicles were identified and stimulated. No electrophysiological responses were noted. The pedicles were

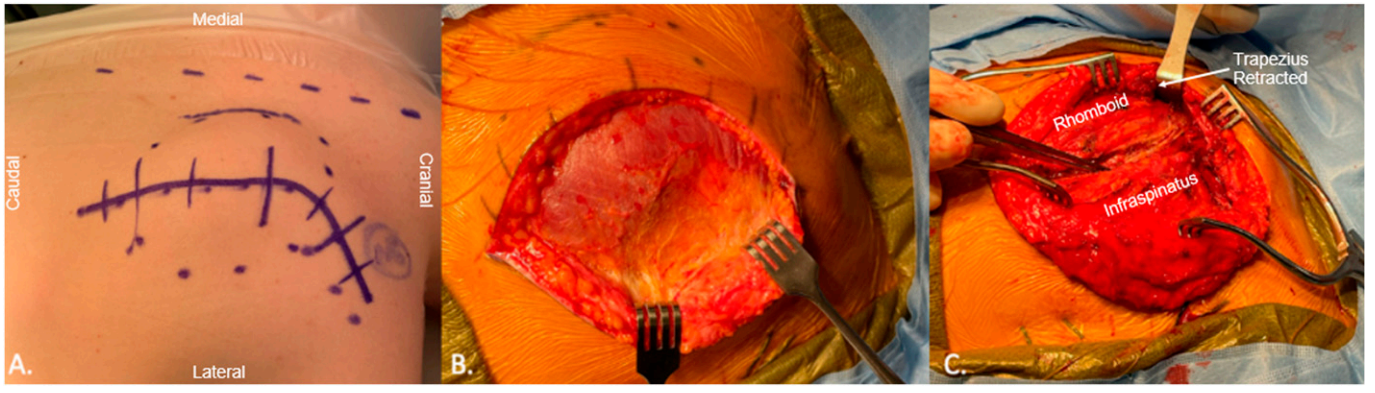

Fig. 2

The midline (dashed line), curved skin incision, and underlying tumor (dotted circle) were marked out (**Fig. 2-A**). Large full-thickness flaps were elevated (**Fig. 2-B**). The lower trapezius was elevated subperiosteally and infraspinatus fascia recessed ~1 cm to expose osteotomy site. (**Fig. 2-C**).

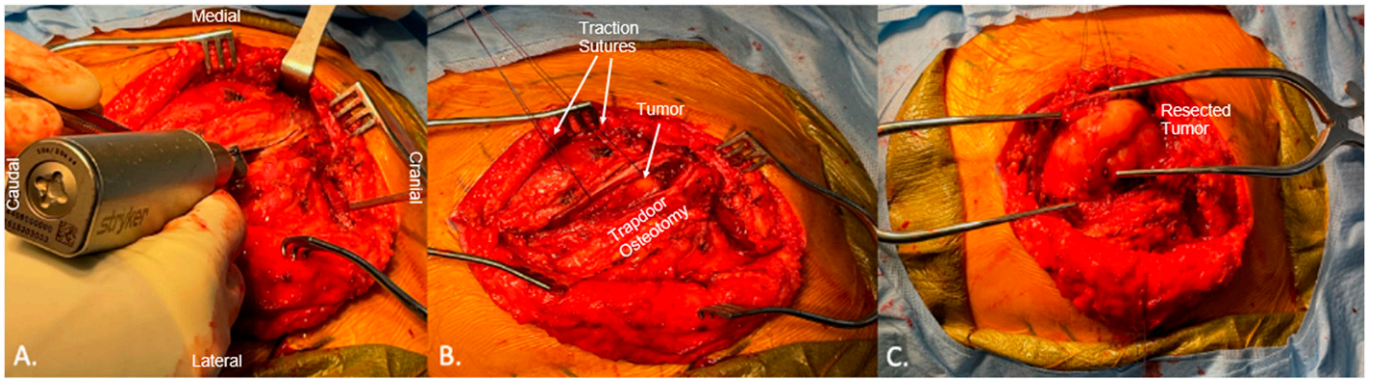

Fig. 3

The osteotomy was performed with a sagittal saw along the medial border of the scapula, just distal to the scapular spine (**Fig. 3-A**). The medial bone was then retracted with traction sutures, opening the "trapdoor" (**Fig. 3-B**). This allowed for excellent exposure to the underlying tumor bed (**Fig. 3-C**).

ligated, and the tumor removed en bloc. The tumor was then sent to pathology for analysis.

The osteotomy was repaired by making drill holes along the 2 edges of the cut bone, and #2 FiberWire suture (Arthrex) was passed through the holes to approximate the osteotomized scapula (Figs. 5-A and 5-B). The rhomboid insertion remained undisturbed. The sutures were sequentially tied down for excellent reduction and repair. Towel clips were used to make 2 small bone tunnels at the insertion of the lower trapezius tendon, and #2 FiberWire sutures (Arthrex) were passed through these tunnels and tied to reconcile the lower trapezius tendon to its original point of insertion. The superficial fascia was closed with a 0-Vicryl suture and the skin in a layered fashion (Figs. 5-C, 5-D and 5-E).

Postoperatively, the patient made an excellent recovery with minimal pain. She was allowed elbow, wrist, and hand range of motion and placed in a sling for 4 weeks. Passive motion was allowed with the start of active assist range of motion exercises at 4 weeks. The final pathology of the resected tumor was consistent with a hybrid neurofibroma and schwannoma on CD34 (Fig. 6-A), S100 (Fig. 6-B), and hematoxylin and eosin (Fig. 6-C) stains. A postoperative MRI at 6 months demonstrated complete removal of the tumor, and physical therapy was initiated (Fig. 1-C).

At her 1-year follow-up visit, she reported no surgery-related complaints. She had normal shoulder and scapular function and a normal neurological examination with a well-healed incision. Minimal winging of the inferior and medial border of the scapula was noted with extreme abduction of the right upper extremity and without associated pain. At her 3-year follow-up, she has been doing well with no known recurrence, revision, or shoulder dysfunction. Radiographs show a well-healed scapula (Figs. 7-A and 7-B).

Discussion

We report a case of a hybrid subscapular neurofibroma and schwannoma tumor in a patient with NF2 resected using a "trapdoor" medial scapula osteotomy. When assessing tumors in NF2 patients, the differential diagnosis should remain broad, including lipoma, neurofibroma, schwannoma, desmoid tumor or elastofibroma and, rarely, sarcoma[4-6]. Hybrid characteristics in PNSTs are common, with a review of 31 PNSTs from 14 patients

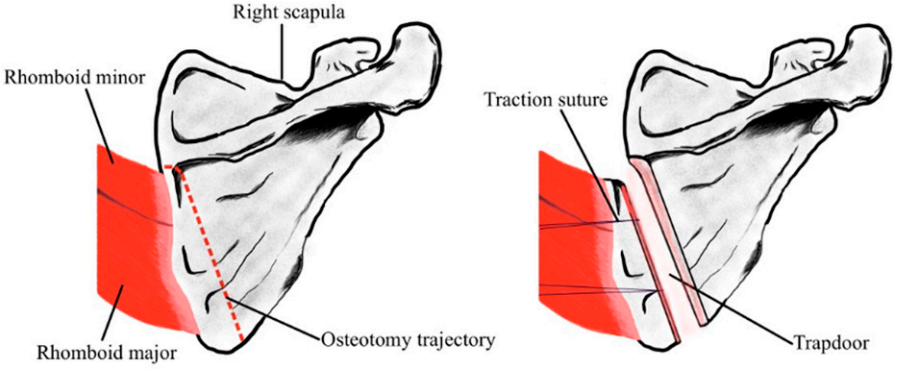

Fig. 4

Both illustrations show a posterior view of an isolated right scapula. The rhomboid major and rhomboid minor insertions along the posterior medial boarder of the scapula are depicted. The illustration on the left shows the projected osteotomy trajectory represented by the dashed red line. The illustration on the right shows the scapula after the medial osteotomy. All rhomboid muscle bellies and insertions remain inviolate and undisturbed. Traction sutures are in place allowing for "trapdoor" visualization.

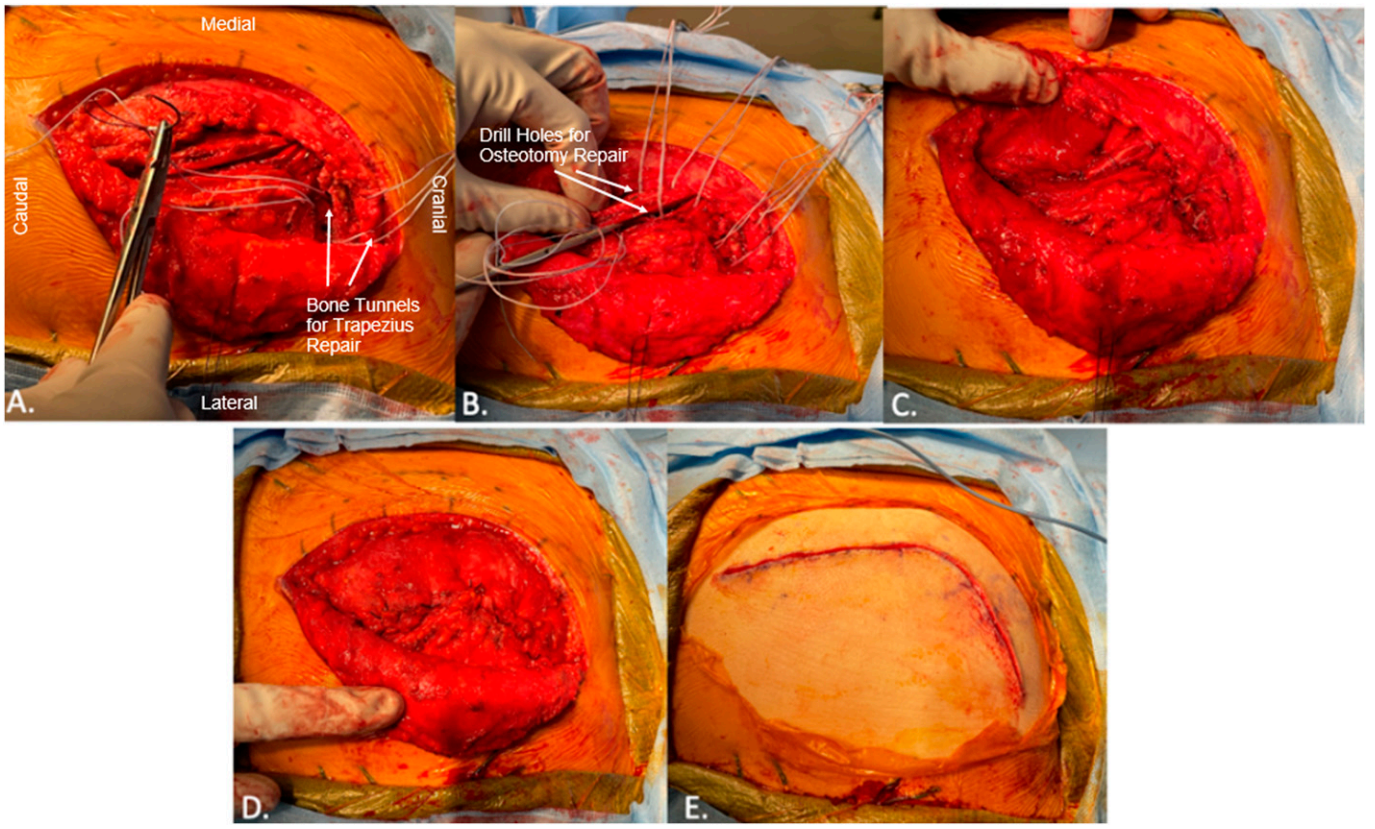

Fig. 5

The lower trapezius was prepared for repair to its anatomic insertion along the scapular spine using #2 FiberWire sutures tied across bone tunnels (**Fig. 5-A**). The repair technique used #2 FiberWire sutures tied across several bone tunnels drilled into the scapular body and medial osteotomized bone, reducing it back to its anatomic position (**Fig. 5-B**). The osteotomy FiberWire sutures were tied sequentially first, closing the "trapdoor", before tying down the lower trapezius repair sutures. The final repair after fascial closure was performed (**Figs. 5-C and 5-D**), and the skin was closed in layers (**Fig. 5-E**).

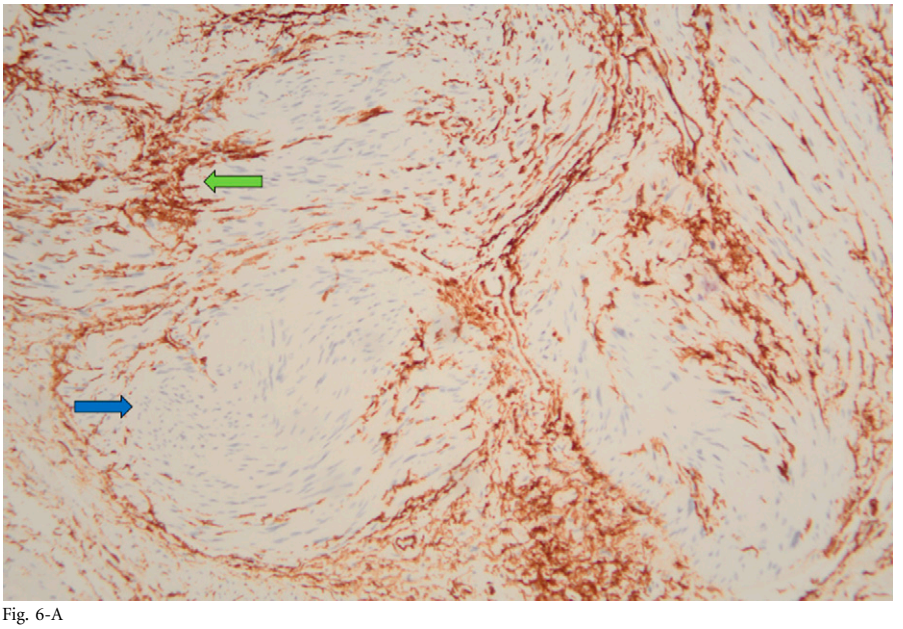

Fig. 6-A

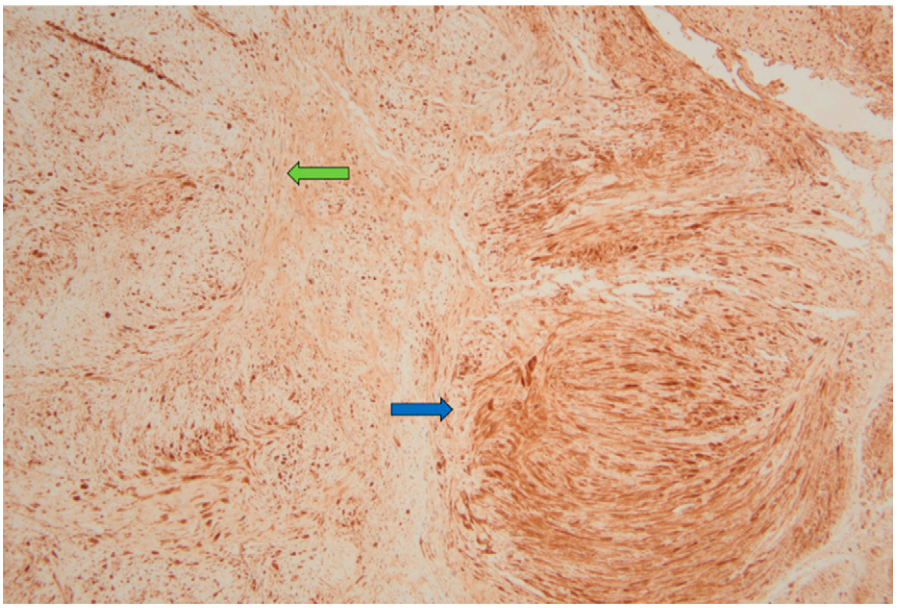

Fig. 6-B

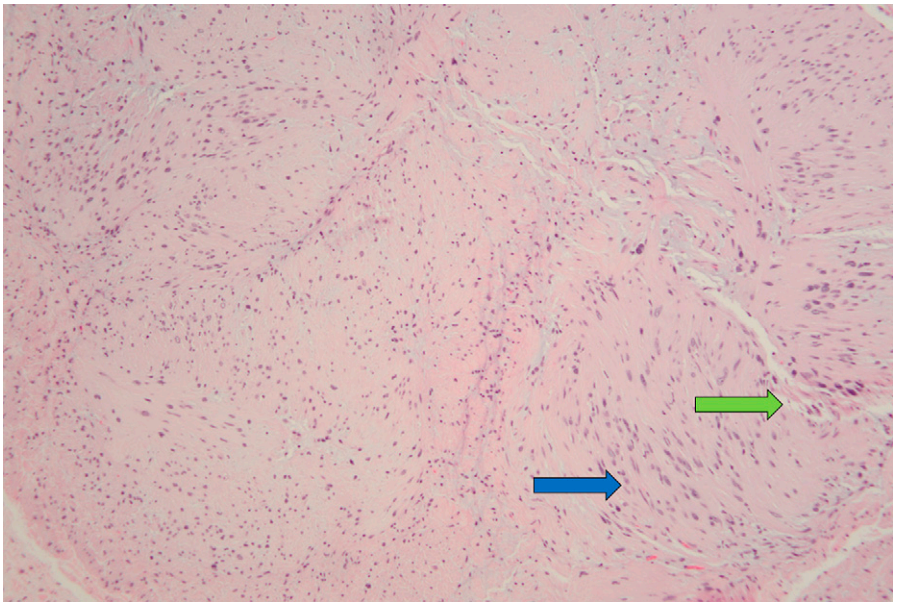

Fig. 6-C

Fig. 6-A 10× CD34 image showing positive staining in the neurofibroma-like areas (green arrow) and negative staining in the schwannoma-like areas (blue arrow). **Fig. 6-B** 10× S100 stain showing strong, diffuse staining in the schwannoma areas (blue arrow) and more scattered staining in the neurofibroma areas (green arrow). **Fig. 6-C** 10× H&E stain showing a benign nerve sheath tumor with biphasic morphology, where nodules of Schwann cells with fascicular architecture and occasional Verocay bodies (blue arrow) lie within loosely textured, myxoid tissue with elongated wavy cell nuclei and collagen bundles, characteristic of a neurofibroma (green arrow).

demonstrating 61% of tumors demonstrating hybrid characteristics[7]. Histologically, Feany et al.[8] describe hybrid PNSTs as having abundant collagen, elongated cells with wavy areas of myxoid tissue in the neurofibroma-like area, and closely arranged bundles of Schwann cells with spindle-shaped nuclei in the schwannoma-like portion. In addition, S100 and CD34 immunohistochemical stains were chosen since they are good markers for Schwann cells/melanocytes and neoangiogenesis, respectively, which is helpful for characterizing soft tissue and nerve sheath tumors. Analysis would demonstrate $CD34^{+}$, variable S100+ and S100+, and $CD34^{-}$ in neurofibroma-like and schwannoma-like components, respectively, as shown by

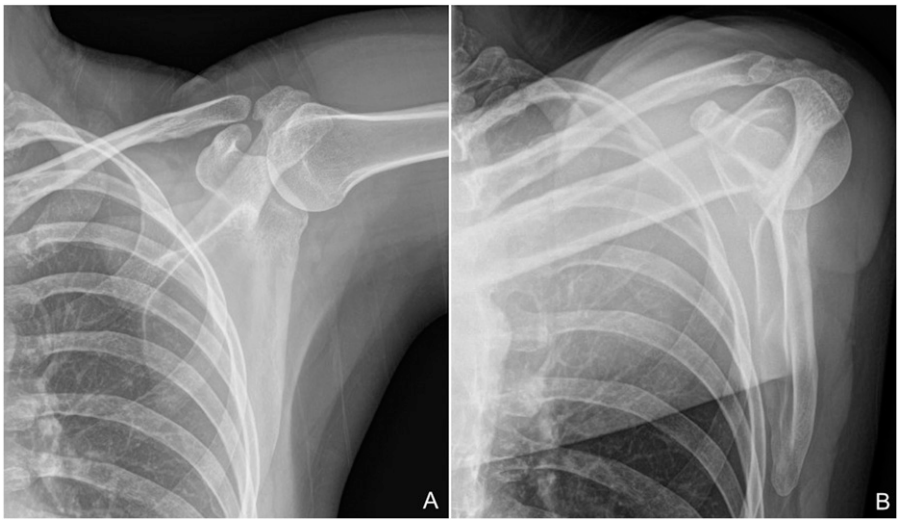

Fig. 7

Fig. 7-A Anteroposterior and (**Fig. 7-B**) lateral radiograph views of the scapula 3 years after the osteotomy procedure. The bone has healed with no clinical dysfunction.

the tumor in our case report.[8] We performed a periscapular muscle-sparing osteotomy of the medial scapular border after elevating the trapezius from rhomboids (major and minor), just distal to the scapular spine and recessing the infraspinatus fascia for adequate osteotomy exposure. An advantage to this technique is excellent medial exposure to the subscapular region without detaching the rhomboid or serratus anterior muscles, which are important for scapular retraction and protraction, respectively, elevation, and internal rotation of the scapula alongside other scapular stabilizers (Fig. 4)[9]. Rhomboid dysfunction through injury of the dorsal scapular nerve or muscle splitting can cause scapulothoracic dyskinesis, leading to weakness, asymmetric planes of motion, pain, or difficulty with overhead activities such as throwing[10]. Because the osteotomy was distal to the scapular spine, the levator scapulae muscle attachment was preserved as well. Other advantages include bone-to-bone healing, which in the scapula has a reported union rate of up to 99.4% in extra-articular fractures[11]. Disadvantages may include increased technical complexity, secondary iatrogenic or postoperative fracture, malunion, or delay of union in certain nonoptimized hosts. The clinical benefits were made apparent when the patient reported no shoulder dysfunction or pain along with a neurovascularly intact shoulder and unimpaired shoulder abduction on physical examination at long-term follow-up 3 years after the surgery. As a result, our described muscle-sparing osteotomy could be an effective and clinically beneficial surgical technique in certain patients presenting with masses in the medial region of the scapula requiring excision.

Conclusion

We describe a case report of a hybrid neurofibroma and schwannoma tumor resection in a patient with NF2 using a medial scapular osteotomy for excision of a medial subscapular mass. It provides excellent exposure to the medial subscapular space, while effectively sparing the insertion of the medial periscapular muscles. This may reduce the risk of postoperative scapular dyskinesis or dorsal scapular nerve injury when compared with other more invasive non–muscle-sparing or muscle-splitting techniques. ■

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