

[Orthopaedic Surgery]

Traumatic Avulsion of the Serratus Anterior Muscle in a Collegiate Rower: A Case Report

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A 19-year-old female collegiate rower presented with a new, painful mass along her right anterolateral chest wall after competition. The patient was diagnosed with a rupture of the serratus anterior muscle from its costal attachments, as confirmed by magnetic resonance imaging. The patient fully recovered after a period of rest followed by a graduated 2-month physical therapy regimen consisting of stretching and scapulothoracic and core strengthening. A traumatic rupture of the serratus anterior muscle should be suspected in athletes who present with a painful chest wall mass after exertion of large forces through the scapulothoracic region. Athletes can return to play after nonoperative management.

Keywords: serratus anterior avulsion; rowing mechanics; rowing injuries; scapulothoracic rehabilitation

The serratus anterior muscle originates from the superior border of the first 8 to 9 ribs (Figure 1). It inserts onto the anterior side of the medial border of the scapula in a predictable pattern. The insertion has 3 sections: the superior, medial, and inferior sections, each with its own associated muscle heads. The serratus anterior is responsible for protraction of the scapula and it allows full abduction of the shoulder while stabilizing the scapula.

Traumatic avulsion of the serratus anterior is very rare. The first case of such an injury was published in 1930 by Fitchet.² Most subsequent case reports describe patients who sustained an avulsion injury after accidental trauma.^{1,4,9} Only 2 known case reports present a traumatic avulsion from sports participation.^{3,7} The most common presentation is a painful mass along the lateral chest wall without scapular winging. We present the case of a collegiate rower who sustained a traumatic avulsion of the serratus anterior muscle during competition.

CASE REPORT

A 19-year-old female National Collegiate Athletic Association (NCAA) Division I rower presented to our clinic with a chief

complaint of right rib pain. Her pain began 6 weeks prior to presentation while rowing in a collegiate competition. She admitted to increasing the intensity of her training regimen in the days preceding her injury. She localized her pain to the right lateral lower chest wall where she also noted a new hard mass. She denied feeling a pop at the time of injury. Pain was exacerbated by the rowing maneuver, coughing, sneezing, and any rotational movements, such as rolling over in bed or changing positions in a chair. Her pain persisted for 7 to 10 days, after which she had a brief remission of pain before it returned at a higher level despite nonsteroidal anti-inflammatory drug (NSAID) treatment, stretching, and local modalities with the athletic training staff. She continued to intermittently participate in practices and competitions, yet this was increasingly difficult because of significant pain.

On physical examination, the patient had a localized firm mass approximately 3 cm in diameter on the lateral curve of the right eighth and ninth ribs (Figure 2). The mass was exquisitely tender to palpation. No crepitus could be felt along the rib cage. Pain was not exacerbated by tapping the rib or by direct compression of the rib cage. Any movement with trunk rotation exacerbated the pain. The patient had full range of motion of

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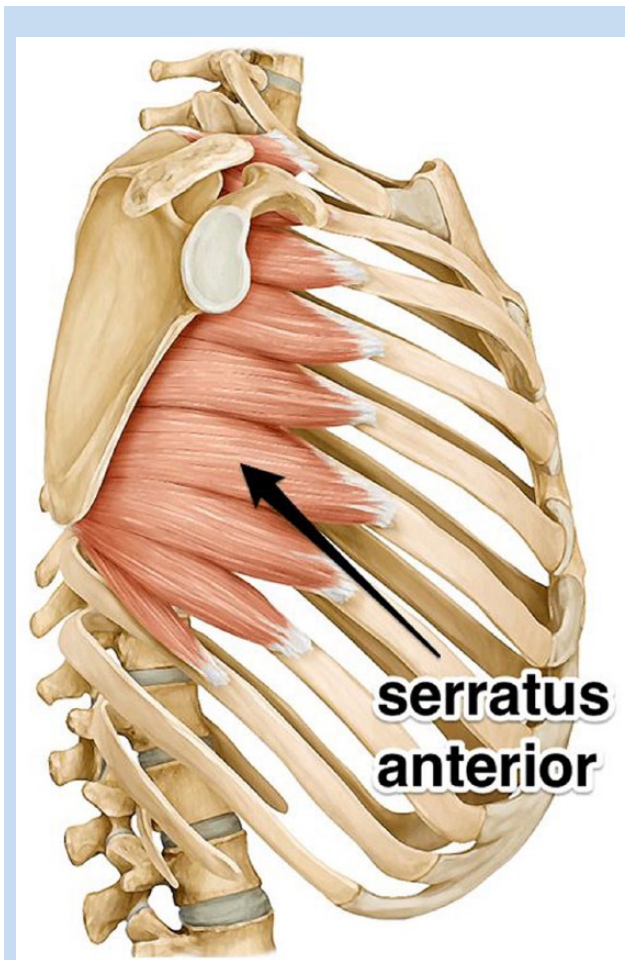


Figure 1. Anatomical drawing of the serratus anterior muscle demonstrating the costal origins from the first through ninth ribs and insertion onto the anterior medial border of the scapula.

the right shoulder despite right rib pain while moving the extremity. There was no scapular winging during a wall push-up.

A bone scan was obtained to investigate for a rib stress fracture, and the results were unremarkable for pathology. Because of her persistence of symptoms, the decision was made to obtain magnetic resonance imaging (MRI) of the chest with and without contrast. MRI revealed extensive edema along the right lateral rib wall with partial tearing of the serratus anterior muscle along the seventh through ninth ribs (Figure 3). No pathology was identified in the underlying ribs or in the surrounding musculature, including the latissimus dorsi, rotator cuff muscles, pectoralis muscles, or paraspinous muscles.

This athlete was treated with an initial period of rest from rowing along with avoidance of any aggravating motions. Physical therapy with the athletic training staff was continued, focusing on multiple local modalities, including low-pulse ultrasound and ice therapy. The athlete was started on a 2-month graduated regimen for return to rowing competition. The first 4



Figure 2. (a) Clinical photograph of a 19-year-old female collegiate rower who presented with a new painful mass (arrow) along the anterolateral chest wall in the region of the seventh through ninth ribs after increasing her training regimen. (b) Close-up photograph of the painful mass (arrow), which was later determined to be a traumatic avulsion of the serratus anterior muscle.

weeks of therapy included advancement of scapulothoracic and core strengthening along with stretching exercises. This phase avoided any strengthening exercises with lateral bending or rotation. She was only allowed to perform cardiovascular exercises that did not aggravate her pain, such as a stationary bike, stair climber, and jogging. The second month of physical therapy introduced rotatory exercises along with a graduated

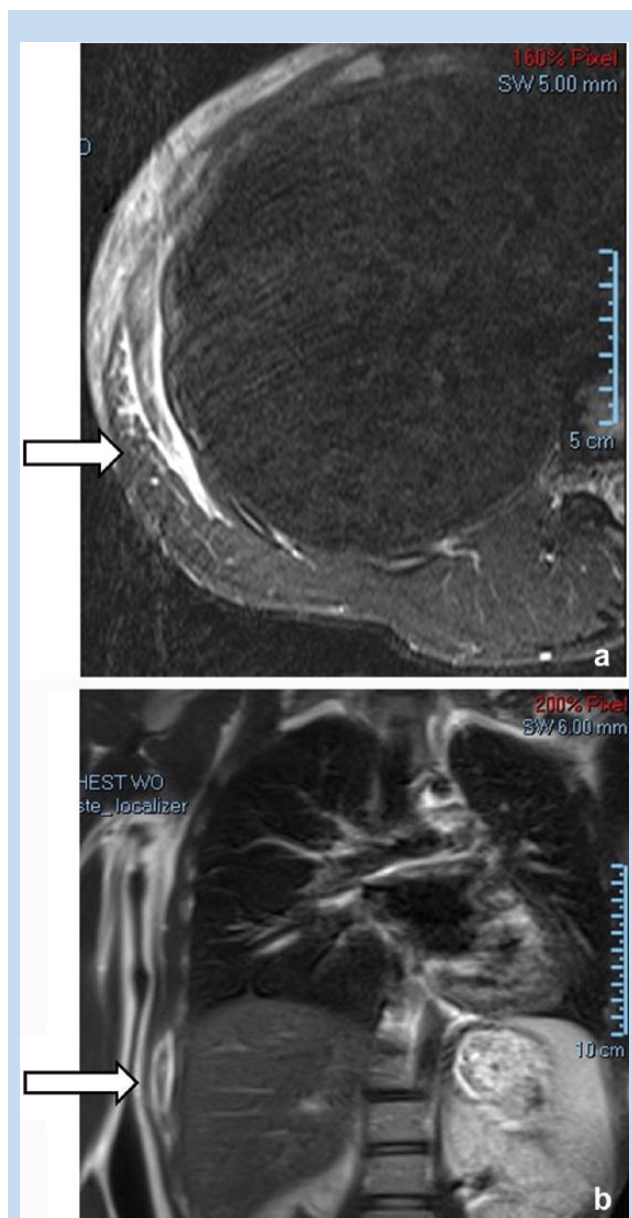


Figure 3. (a) Axial short tau inversion recovery (STIR) magnetic resonance image (MRI) revealing a large amount of edema with avulsion of the serratus anterior muscle from the right seventh through ninth ribs (arrow). (b) Coronal T2-weighted MRI redemonstrating the large amount of edema and associated serratus anterior rupture from its costal attachments (arrow).

rowing program on an indoor ergometer rowing machine. She was scheduled to return to full rowing activities after completion of the second month of physical therapy. However, prior to completion of the rehabilitation program, she decided to retire from rowing for personal reasons not related to her injury.

At 1-year follow-up, this athlete reported no limitations with physical activities. Specifically, she is able to perform all desired recreational activities, including distance running, ergometer

indoor rowing, and lifting weights without pain. She has full strength and range of motion to her right upper extremity. The mass along her chest wall is no longer present, and she has no tenderness to palpation along her rib cage.

DISCUSSION

This is the third known case of a traumatic rupture of the serratus anterior muscle from sports participation and the second known case report of a traumatic avulsion from rowing. In 1997, Gaffney³ reported a traumatic avulsion of the serratus anterior muscle in a 21-year-old male while using an ergometer rowing machine. He presented with a painful mass along the lateral thoracic wall, which was later confirmed by MRI to be an avulsion of the serratus anterior muscle bellies from the corresponding ribs. He returned to full activities after 4 weeks of physical therapy and restricted sporting activities. In 2007, Otoshi et al⁷ reported the case of a traumatic serratus anterior rupture in a 16-year-old male who was an underhanded baseball pitcher. The athlete presented with a new, midlateral chest wall mass that was tender to palpation, and MRI confirmed the diagnosis of a large avulsion of the serratus anterior muscle. He underwent successful surgical repair with nonabsorbable sutures, and he returned to competitive baseball 7 months after surgery.

Athletes who participate in rowing sports are particularly vulnerable to this type of injury because of the large force generated by the periscapular muscles during the rowing motion. These large forces require proper balance between strength and flexibility of the serratus anterior muscle as it stabilizes the scapula. An avulsion injury likely occurs from a mismatch of flexibility and strength, leading to muscle failure at the costal attachments.

Rowing mechanics have been extensively described by Mazzone.⁵ It is a cyclical movement that has 4 distinct phases: the catch, drive, finish, and recovery. The serratus anterior muscle is especially important during the drive and recovery phases because these phases involve scapular retraction and protraction, respectively. During the drive phase, the oar is pulled through the water as the rower progresses to leg extension and back extension while flexing the arms. The serratus anterior works eccentrically to stabilize the scapula while the rhomboids and trapezius act concentrically during this powerful motion. The serratus anterior then works concentrically during the recovery phase as it is the prime stabilizer and mover of the scapula. With repetitive load during the cyclical rowing cadence, it is paramount that rowers maintain adequate form to ensure proper support from the trunk and legs. Any variation from optimal technique may place undue stress on the serratus anterior muscle.

When evaluating a chest injury in rowers or other rotational athletes, the clinician must be familiar with the relevant anatomy and associated pathology. Rowers in particular are at risk for rib stress fractures, costochondritis, costovertebral joint subluxation, and intercostal muscle strain.⁸ Stress fractures of the rib are especially problematic for rowers, and this injury accounts for

the greatest amount of time lost on the water for training and competition.^{8,10} Rib stress fractures occur in 8.1% to 16.4% of elite rowers and 2% of university rowers, with 86% of these injuries occurring between ribs 4 through 8 along the anterolateral or lateral rib cage.⁶

Both rib stress fractures and traumatic serratus anterior avulsion injuries present very similarly with anterolateral and lateral rib pain. However, a traumatic avulsion of the serratus anterior can be distinctly identified by the presence of a tender, isolated mass along the rib cage. We are unaware of any instances of scapular winging from a traumatic avulsion of the serratus anterior from sports participation. This is likely because of preservation of the scapular insertions along with the ability of the remaining costal attachments to compensate for the avulsed muscle heads.

CONCLUSION

The serratus anterior muscle is very important for normal scapular kinematics. A traumatic serratus anterior avulsion injury from sports participation is exceedingly rare. In athletes who exert large forces through the thorax, the presence of a new painful mass along the anterolateral chest wall should alert the physician to the possibility of a traumatic serratus anterior rupture. Conservative management should be the mainstay of treatment initially. A graduated program for return to

competition should initially include rest from the inciting activity and from all rotational activities. This should be followed by multimodal physical therapy, stretching exercises, and progressive scapulothoracic and core strengthening over the course of 6 to 8 weeks. Return to rotational sport activities can progress when the patient has no pain to palpation of the chest wall or during rotational maneuvers.

REFERENCES

1. Burdett-Smith P, Davies MJ. A rupture of the serratus anterior. *Arch Emerg Med.* 1988;5:191.
2. Fitchet S. Injury of the serratus magnus (anterior) muscle. *N Engl J Med.* 1930;203:818-823.
3. Gaffney KM. Avulsion injury of the serratus anterior: a case history. *Clin J Sport Med.* 1997;7:134-136.
4. Hayes JM, Zehr DJ. Traumatic muscle avulsion causing winging of the scapula. A case report. *J Bone Joint Surg Am.* 1981;63:495-497.
5. Mazzone T. Kinesiology of the rowing stroke. *NSCA J.* 1988;10(2):4-11.
6. McDonnell LK, Hume PA, Nolte V. Rib stress fractures among rowers: definition, epidemiology, mechanisms, risk factors and effectiveness of injury prevention strategies. *Sports Med.* 2011;41:883-901.
7. Otoshi K, Itoh Y, Tsujino A, Hasegawa M, Kikuchi S. Avulsion injury of the serratus anterior muscle in a high-school underhand pitcher: a case report. *J Shoulder Elbow Surg.* 2007;16:e45-e47.
8. Rumball JS, Lebrun CM, Di Ciacca SR, Orlando K. Rowing injuries. *Sports Med.* 2005;35:537-555.
9. Singh VK, Vargaonkar GS. Winging of scapula due to serratus anterior tear. *Chin J Traumatol.* 2014;17:305-306.
10. Warden SJ, Gutschlag FR, Wajswelner H, Crossley KM. Aetiology of rib stress fractures in rowers. *Sports Med.* 2002;32:819-836.

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