

CASE REPORT

Muscle Strain of the Subscapularis Muscle: A Case Report

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Abstract. We report on a case of muscle strain of the subscapularis muscle in a baseball player. An out-fielder (throws right-handed and bats left-handed) hurt his right shoulder while playing baseball. He complained of right-shoulder pain just after he forcefully hit his right hand against the fence in an attempt to jump and catch a flying ball with a glove on the left hand during a baseball game. Fat-suppressed T2-weighted magnetic resonance images (MRIs) of the right shoulder joint revealed muscle strain in the middle part of the subscapularis muscle, and the injury was surmised to have occurred on account of eccentric contraction of the subscapularis muscle. The case was considered to have moderate muscle strain, because he had modest muscle weakness with a negative lift-off test. Active stretching exercises were begun just after his first visit to our clinic, and throwing exercises were started 3 weeks later, by when the right-shoulder pain had completely disappeared. Repeat MRIs of the right shoulder joint obtained 4 weeks after his first visit to our clinic revealed a significant reduction of the high-intensity lesions in the subscapularis muscle. Conservative treatment was effective for managing moderate muscle strain of the subscapularis muscle. Muscle strain of the subscapularis muscle should be taken into consideration in the differential diagnosis of shoulder injuries in athletes. (*Keio J Med* 56 (3) : 92–95, September 2007)

Key words: muscle injury, shoulder joint, MR images, baseball, sports

Introduction

Muscle strain is a common sports-related injury, and occurs most often in sprinters or athletes engaging in high-speed activities. It has been defined as an indirect injury of muscle caused by excessive stretch.¹ Muscle strains are more common in sports that require bursts of speed or rapid acceleration, such as track and field activities, football, basketball, rugby, and soccer, and are most commonly encountered in the gastrocnemius, hamstrings, quadriceps, adductor longus, and pectoralis major muscles.² To the best of our knowledge, no case of muscle strain of the subscapularis muscle has been reported until now. We report on a case of muscle strain of the subscapularis muscle encountered by us in an athlete. Informed consent was obtained from the patient for this case report.

Case report

A 30-year-old regular professional baseball player (throws right-handed and bats left-handed), playing as an outfielder, hurt his right shoulder when he forcefully hit his right hand against the fence in an attempt to jump and catch a flying ball with a glove on the left hand during a baseball game, with the right elbow joint fully extended and the right shoulder joint flexed, abducted, and externally rotated. He consulted our clinic 2 days after the injury. At the first consultation, the ranges of motions of the right shoulder joint including extension, flexion, abduction, adduction, and internal and external rotations were not restricted at all when compared with the non-injured side, but he complained of pain in the anterior shoulder during joint movement. Internal rotation of the right shoulder joint against resistance induced shoulder pain. Modest muscle weakness (manual muscle test: 4⁺) was found in the internal rotator muscles of the right

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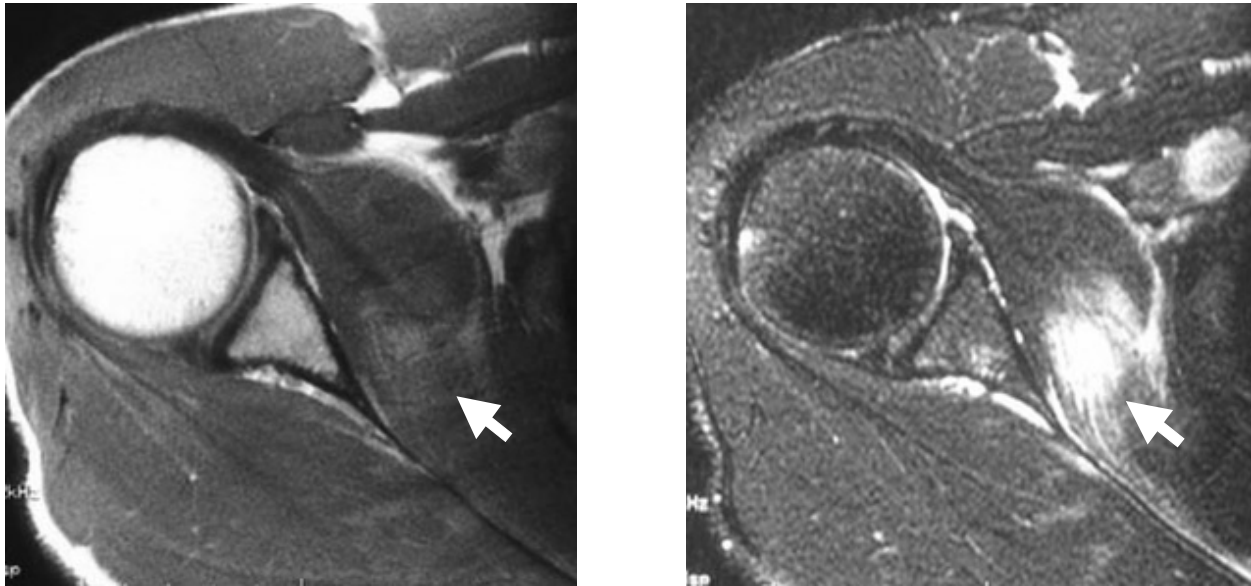


Fig. 1 MRIs of the right shoulder joint in the current case at the first visit to our clinic

Both the left proton density weighted MRI (TR/TE, 2500/18 msec) and the right fat-suppressed T2-weighted MRI (TR/TE, 3200/106 msec) of the right shoulder joint obtained at the first visit to our clinic show high signal intensity lesions in the middle part of the subscapularis muscle.

shoulder joint, however, the lift-off test was negative. The lift-off test was performed by placing the hand of the affected arm on the back (at the position of the mid-lumbar spine) and asking the patient to internally rotate the arm to lift the hand posteriorly off of the back.³ The test was considered positive if the patient was unable to lift the arm posteriorly off of the back or if he performed the lifting maneuver by extending the elbow or the shoulder.³ Although plain radiographs of the right shoulder joint showed no abnormal findings, proton density weighted and fat-suppressed T2-weighted magnetic resonance images (MRIs) of the right shoulder joint revealed high signal intensity lesions in the middle part of the subscapularis muscle (Fig. 1). T1-weighted MRIs were not obtained. Because no contusion was reported in his right shoulder joint, diagnosis of muscle strain of the subscapularis muscle was made. According to a carefully guided physical therapy program, active stretching exercises (10 times x 5 sets per day) were started just after his first visit to our clinic, and the volume of the exercises was increased gradually to 10 times x 10 sets per day. Isotonic exercises with a flexible rubber tube (10 times x 5 sets per day) were started 2 weeks after his first visit to our clinic, by when the right-shoulder pain on internal rotation against resistance had disappeared, and the volume of the exercises was gradually increased to 10 times x 10 sets per day. Throwing exercises were started 3 weeks after his first visit to our clinic, by when the right-shoulder pain had completely disappeared, and the volume of the exercises was gradually increased according to the instruction of his coach. Repeat fat-suppressed T2-

weighted MRI of the right shoulder joint obtained 4 weeks after his first visit to our clinic revealed disappearance of high signal intensity lesions in the subscapularis muscle (Fig. 2).

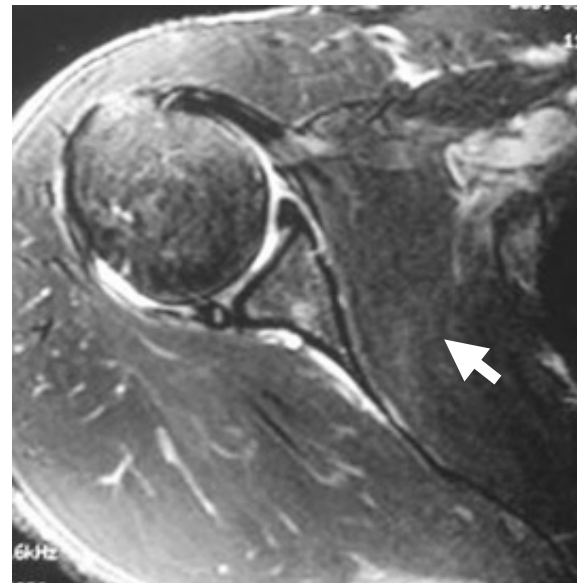


Fig. 2 MRI of the right shoulder joint in the current case four weeks after his first visit to our clinic

The fat-suppressed T2-weighted MRI (TR/TE, 3800/86 msec) of the right shoulder joint obtained 4 weeks after his first visit to our clinic revealed disappearance of high signal intensity lesions in the subscapularis muscle.

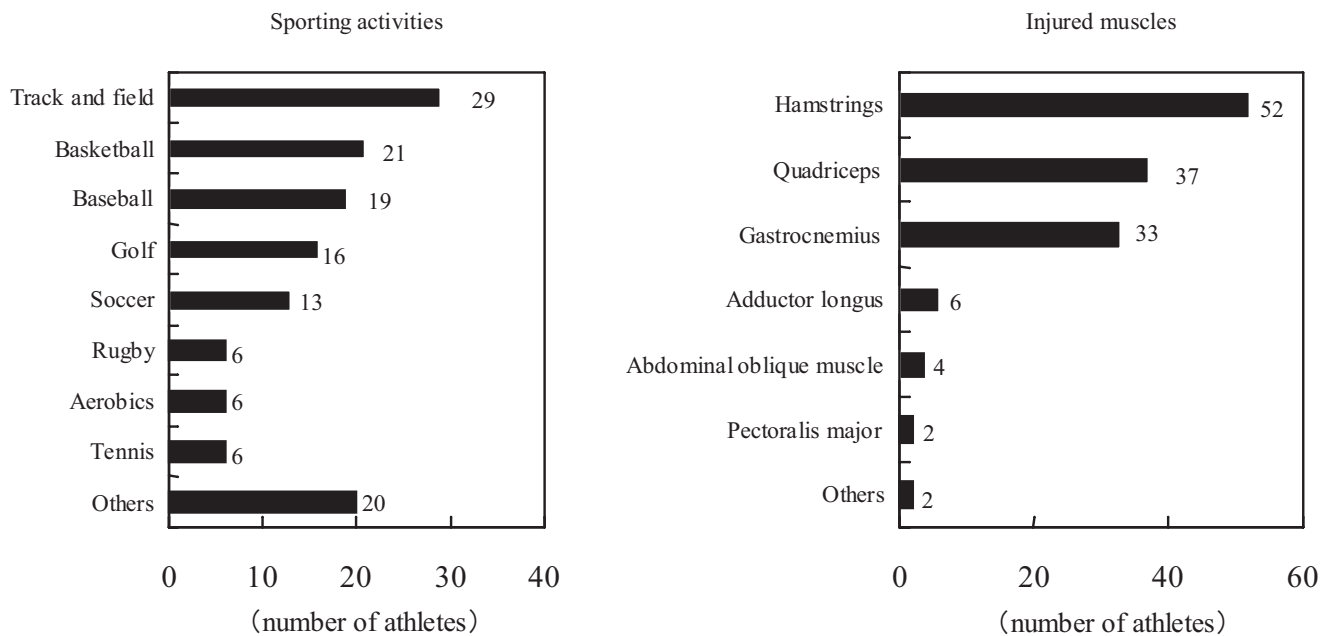


Fig. 3 136 cases of muscle strain in our sports medicine clinic

Besides the two current cases, we have encountered 136 cases (117 males and 19 females) of muscle strain in Japanese athletes at our clinic over the past 13 years. Muscle strain occurs most commonly in people engaging in sports activities, such as track and field activities, basketball, baseball, golf, soccer, rugby, aerobics and tennis, and most commonly involves the hamstrings, quadriceps and gastrocnemius muscles, followed in frequency by the adductor longus, abdominal oblique, and pectoralis major muscles.

Discussion

Besides the current case, we have encountered 136 cases of muscle strain in Japanese athletes at our sports medicine clinic over the past 13 years. Fig. 3 shows the sporting activities and the injured muscles in these subjects. Muscle strain occurs most commonly in people engaging in sports activities, such as track and field activities, basketball, baseball, golf, soccer, rugby, aerobics and tennis, and most commonly involves the hamstrings, quadriceps and gastrocnemius muscles, followed in frequency by the adductor longus, abdominal oblique, and pectoralis major muscles. These data in the Japanese population are consistent with those reported from Caucasian populations.² In our experience, muscle strain of the adductor longus during pitching, and strain of the abdominal oblique muscle during pitching and batting have the most common types of strain peculiar to professional baseball players, and until now, no case of muscle strain of the subscapularis muscle has been reported.

Because most muscle strain injuries resolve with conservative management within 3 – 4 weeks, the pathogenesis of muscle strain has not been adequately examined. However, the recent widespread use of computed tomography (CT) and MRIs have allowed us to clarify the characteristics of muscle strain in detail.^{4,5} Firstly, only certain muscles are susceptible to strain injury (that is, muscles that cross multiple joints or have a complex

architecture, *i.e.*, multipennate architecture). Secondly, eccentric contraction of the muscle is a frequent occurrence. Thirdly, muscle strains occur near the muscle-tendon junctions rather than within the muscle belly.

The subscapularis muscle fibers extend from the anterior surface of the scapula, with insertion of the muscle tendon into the lesser tubercle of the humerus. The function of the subscapularis muscle is to assist in internal rotation of the shoulder joint. It certainly has a multipennate architecture (complex architecture). Basically, pennate muscles are generally powerful, because their organization allows a large number of fibers to work in unison.⁴ Furthermore, because pennate muscles contain short fibers in an oblique arrangement, the maximum velocity of shortening is low and the work performed can be considerably remarkably little.⁴ Consequently, pennate muscles resist elongation and have a steep length-tension slope.⁴ Powerful stretch of the pennate muscles by eccentric contraction can lead to either a muscle-tendon junction injury or a more disabling injury involving avulsion of the tendinous origin. Because the subscapularis muscle has a multipennate architecture in terms of multiple muscle-tendon junctions, muscle strain could occur at any site in the muscle.

Basically, muscle strain occurs when the muscle is either stretched passively or activated during stretch. Thus, it is speculated that in the current case, eccentric contraction of the subscapularis muscle against excessive

external rotation of the right shoulder joint in an attempt to catch a flying ball with a glove on the left hand might have forced a powerful stretch on the muscle-tendon junctions of the subscapularis muscle, resulting in the muscle strain. The current case was considered to correspond to acute muscle strain injury that resulted from a single violent force applied to the muscle.⁶

Muscle strain of the subscapularis muscle is characterized by difficulty in diagnosis by physical examination of the shoulder, unlike muscle strains in the hamstrings, quadriceps and gastrocnemius muscles, probably because this muscle is located deep in the anterior shoulder, the sites of injury are not consistent due to the multipennate architecture of the muscle, and there are no distinctive features. Therefore, CT or MRIs are necessary to identify muscle strain in the subscapularis muscle.

Muscle strain can be classified into three categories of severity; mild (pulled muscle), moderate (partial tear), and severe (complete tear).^{1,7} According to this classification, if weakness is absent, the strain is mild, and is believed to represent injury in the absence of myofascial disruption. In order to be categorized as mild strain, pathologic findings must be restricted to mild inflammatory cell infiltration, edema, and swelling.⁷ In moderate strains, weakness is associated with a variable degree of separation of muscle from tendon or fascia.⁷ In severe strains, myofascial separation is complete and there is an associated lack of muscle function.⁷ Muscle strain can be revealed by high signal intensity on conventional and fat-suppressed T2-weighted MRIs according to its pathogenesis. Muscle strain should be differentiated from muscle bruise, because both are characterized by similar findings on MRIs. However, it is easy clinically to differentiate between the two, because muscle bruise is usually caused by direct damage injury, such as contusion. In the current case who showed high signal intensity lesions on MRIs in the subscapularis muscle, however, no contusion was reported in the right shoulder joint.

Thus, diagnosis of muscle strain of the subscapularis muscle could be made. The current case was considered to correspond to moderate injury, because of the detection of modest muscle weakness in the internal rotator muscles including the subscapularis muscle with a negative lift-off test. The subject could start throwing exercises by 3 weeks after his first visit to our clinic, with a significant reduction of the high signal intensity lesions on repeat MRIs. Thus, conservative treatment was effective for the management of moderate muscle strain of the subscapularis muscle.

In conclusion, to the best of our knowledge, this is the first report of muscle strain of the subscapularis muscle, encountered in the athlete. The condition was rarely diagnosed clinically, probably on account of the absence of any distinctive clinical features, prior to the era of MRI assessment of injuries. Thus, muscle strain of the subscapularis muscle should be considered in the differential diagnosis of shoulder injuries in athletes.

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