
IOP - Images

Resolution of the case

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Diagnosis

“Degloving” type tear of the rectus femoris muscle.

Discussion

The rectus femoris muscle is the most anterior and superficial one in the quadriceps muscle group. The other portions of the quadriceps muscle are the vastus medialis, the vastus intermedius and the vastus lateralis. In the distal third of the muscle, the tendons of these four bellies fuse and form the tendon of the quadriceps muscle that is attached distally to the upper pole of the patella. Since it is a bi-articular muscle, the rectus femoris muscle acts upon two joints: not only does it extend the knee, but it is also synergist to the iliopsoas muscle in hip flexion, direct antagonist to the tendons of the knee hollow. It is innervated by the posterior division of the femoral nerve (L2, L3, L4) and irrigated by a branch of the lateral femoral circumflex artery, branch of the deep femoral artery.

The proximal attachment of the rectus femoris muscle is made up of two portions: a direct tendon and a reflected—indirect—tendon. The first one is attached to the lateral aspect of the anterior inferior iliac spine, whereas the second one is attached to the supra-acetabular groove and the lateral area of the hip joint capsule (some descriptions report on a third origin represented by the so-called recurrent tendon, none but a small fibrous chord that, since the indirect tendon, gets the most anterior fibers of the tendon of the gluteus minimus muscle by a tendinous expansion). Slightly below its origin (approximately 2 cm), the direct and indirect tendons form a single tendon. The direct head contributes mainly to the superficial component of the single tendon and is mixed with the anterior fascia of the muscle. On the other hand, the indirect head contributes to the fibers of the deep intramuscular component of the single tendon and forms a deep musculotendinous junction that spreads distally involving the two proximal thirds of the muscular belly of the rectus femoris muscle. This intramuscular tendon is initially medial and “comma”-shaped. As it goes downwards, the tendon gets flattened adopting a lineal shape with sagittal-main axis and migrating laterally within the muscle (Figure 3). This central tendon (also called central fascia, intramuscular wall or septum), gives origin to the muscular fibers that provide this muscle with a bipenniform shape. In turn, the direct tendon develops a superficial expansion that upholsters frontally the proximal part of the muscle, which also gives muscle fibers. All muscular fibers go attached to the posterior fascial expansion, on the dorsal aspect of the muscle, which distally gives the anterior layer of the quadriceps tendon. To sum up, there is a bipenniform structure that stems from the central tendon and is distinctly different from another structure that surrounds it, which in turn stems from the superficial expansion and is unipenniform. This type of configuration has been called “muscle within muscle”.

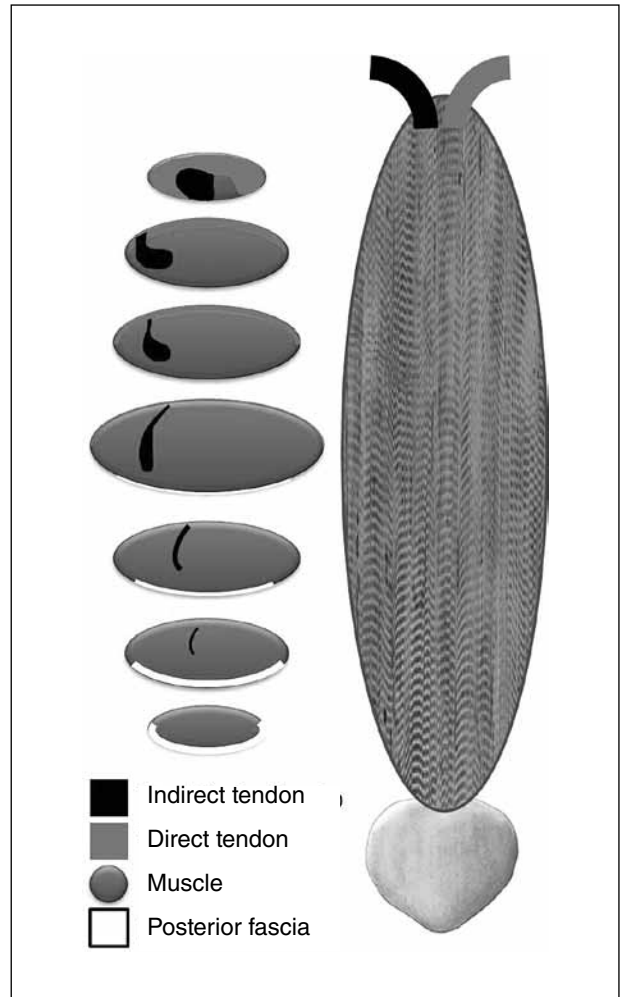
Due to this complex anatomy, the spectrum of injuries is wide, and classifying some of them comes as a challenge, since a number of injuries may not fit in well with the traditional classification of muscle injuries into 3 degrees.

The injuries of the rectus femoris muscle are more frequent among middle-aged men, and they are usual in athletes—they are only outnumbered by hamstrings injuries among those in the lower limbs. It is the lower limb’s muscular injury most frequent among football players.

Injuries can be caused by a direct (contusion, laceration), or indirect mechanism (stretch of the fibers beyond normal elasticity by sudden and forced muscular contraction). With respect to its topography, they can occur in the tendinous portion, in the musculotendinous junction (most frequent tear location) or in the miofascial junction.

Presentation of the case on page 92.

Figure 3. Schematic drawing of the musculotendinous junction in the rectus femoris muscle. The direct head (grey) and the indirect head (black) form a single tendon in the upper part of the thigh. As the direct head migrates distally, it remains anterior to the thigh and blends with the anterior fascia in the middle third of the thigh. The indirect head turns from a horizontal position to a more vertical position and goes medial as it goes downwards.



Regarding those injuries caused by indirect mechanisms, the rectus femoris muscle is vulnerable to injury, since it crosses two joints, it has a high percentage of fast-twitch fibers—type II fibers— and because, while kicking in sports (football, rugby, martial arts), it is subject to strong eccentric contraction. Moreover, there are other risk factors such as a recent or remote injury in the muscle. Recurrence in muscle tears usually occur in a different area from the one already affected or, if in the same place, they occur in the margin of the scar area. Other risk factors that have been set out are low muscular resistance, muscular imbalance, limited flexibility, muscular fatigue, inadequate muscle warm-up and inadequate technique.

Patients show pain and an oppression feel on the anterior aspect of his or her thigh during the play or entertaining activities. Moreover, they might show unmatched thighs in their anterior aspect or a bulge associated with retracted muscular fibers. As prognosis in the injury of the rectus femoris muscle depends on both the injury degree and the location, precise spotting by image techniques has come to the front, and MRI gives the best results. All the studies that have been published conclude that the most frequent injury in this muscle occurs in the deep musculotendinous junction, proximally, and there is an MRI signal's increase surrounding the central tendon and configuring quite a characteristic pattern (which can be seen in up to 65% of the patients)—the bull's eye, that can be seen in both acute and chronic injuries. The increase in the MRI signal, in acute stages represents muscular fibers edema, whereas in the chronic cases it can be attributed to an increase in vascularization and to fibrosis development.

These types of injuries are similar to others in different locations where there are long musculotendinous junctions (e.g. the hamstrings). However, the musculotendinous complex of the rectus femoris muscle's indirect head is susceptible to a particular kind of injury more longitudinally oriented, which causes not only a musculotendinous injury, but also separation and dissociation of the inner bipenniform component from the unipenniform component that surrounds it. Sometimes, such dissociation results in the proximal retraction of the medial musculotendinous complex, like a finger off a glove. Therefore, these types of intramuscular injuries have been called "degloving".

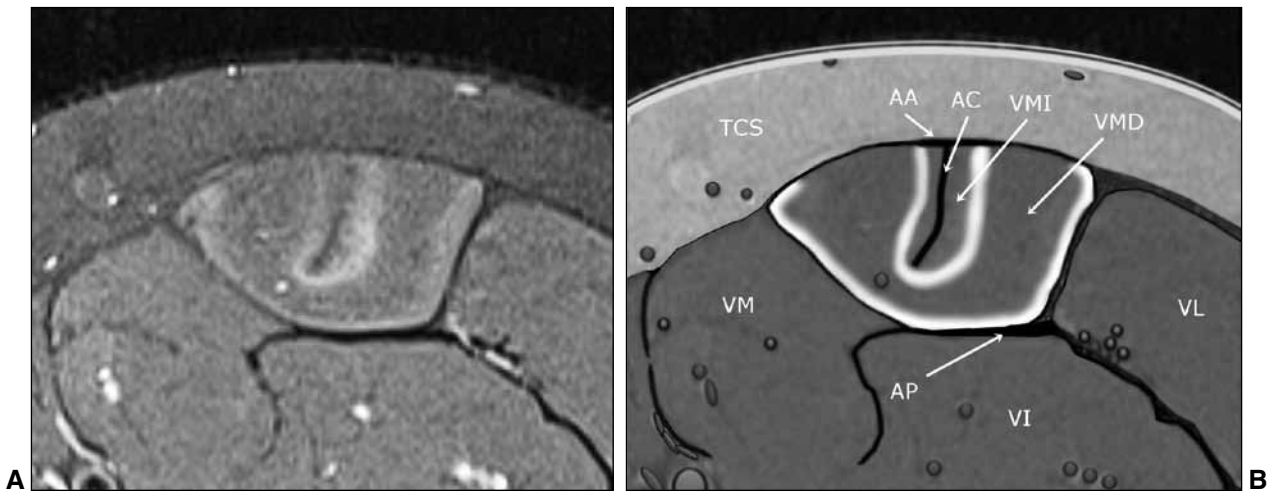
The length of the dissociation of the central bipenniform component from the more superficial unipenniform component may vary, and it is usually 4 to 18 cm long. Moreover, dissociation seems to occur around the fibers of the inner bipenniform muscle belly, opposite to the musculotendinous junction. Therefore, it may be more appropriate to consider these injuries as involving the inner muscular belly and not the musculotendinous junction (some authors have called them mio-muscular injuries).

According to the publication that described this special type of muscle tear, retaking of sports was between 28 and 58 days after the injury (38.7 days on average).

Conclusion

Injuries in the rectus femoris muscle are frequent in both recreational and professional sport people, and also in elite sport performers. The special and complex anatomic configuration of the rectus femoris muscle (with “muscle within muscle” shape) makes it susceptible to diverse types of injuries. Among them there is a particular type of injury, hardly frequent, that of “degloving” configuration in which there is dissociation of the direct muscular belly from the indirect muscular belly, and this is very important to recognize. The dissociation of the muscular belly of the inner muscle (indirect portion) from the external muscle (direct head) can be partial or complete and be associated with muscular retraction or not (Figure 4).

As patients with injury in the rectus femoris muscle show highly variable symptoms, imaging diagnosis methods (especially MRI) play a key role at the time of determining accurately type of muscular tear, topography and seriousness.



▲ **Figure 4.** **A.** MRI transverse section with proton density weighted sequence with fat suppression, DPFS (3300/55). MRI magnified image of the rectus femoris muscle showing delimitation of the direct and indirect components by edema bands. When there is no fluid between both heads or there is no retraction, some authors called this one the forerunner injury of “degloving”. **B.** Scheme showing the different anatomic structures in the anterior area of the thigh. IMB= indirect muscular belly, DMB= direct muscular belly, CF= central fascia, AF= anterior fascia, PF= posterior fascia, VM= vastus medialis, VL= vastus lateralis, VI= vastus intermedius, ST= soft tissues covered by the skin.