

# Does a third head of the rectus femoris muscle exist?

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Current anatomical texts describe only two tendinous origins of the rectus femoris muscle. The authors identified one older reference in which a third head of the rectus femoris muscle was briefly described. In order to confirm the existence of this head, 48 adult cadavers (96 sides) underwent detailed dissection of the proximal attachments of the rectus femoris muscle. Of these sides 83% were found to harbour a recognised third head of the rectus femoris muscle. This additional head was found to attach deeply to the iliofemoral ligament and superficially with the tendon of the gluteus minimus muscle as it attached into the femur. This tendon attached to the anterior aspect of the greater trochanter in an inferolateral direction compared to the straight head. The mean length and width of the third head was 2 cm and 4 cm, respectively. The mean thickness was found to be 3 mm. Most commonly this third head was bilaterally absent or bilaterally present. However, 4.2% were found only on left sides and 5.2% were found only on right sides. The angle created between the reflected and third heads was approximately 60 degrees. Two sides (both left sides with one female and one male specimen) were found to have third heads that were bilaminar. These bilaminar third heads had a distinct layer attaching to the underlying iliofemoral ligament and a superficial layer blending with the gluteus minimus tendon to insert onto the greater trochanter. Although the function of such an attachment is speculative, the clinician may wish to consider this structure in the interpretation of imaging or in surgical procedures in this region, as in our study it was present on the majority of sides.

**Key words:** anatomy, quadriceps femoris, tendon, origin, anterior thigh

## INTRODUCTION

In man the rectus femoris muscle originates from the anterior inferior spine of the ilium (straight, anterior, or direct tendon) and the cranial surface (superior acetabular ridge, [4]) of the acetabulum (reflected, posterior, or indirect tendon). The reflected

head has been found to be the larger proximal tendon and to develop embryologically prior to the straight head [15]. However, some authors have stated that the straight head is the larger of these two tendons [6]. Variations of the rectus femoris and particularly its proximal part are apparently rare

[3, 12, 13] although we have reported a femoral head of the rectus femoris muscle [13]. The insertion of the rectus femoris is in concert with the remaining parts of the quadriceps femoris musculature via the patellar ligament into the tibial tuberosity. The rectus femoris is the most frequently injured part of the quadriceps femoris musculature and this injury is often seen in sports such as football [7]. Injury to the rectus femoris muscle is most often found distally but proximal involvement may also occur with forceful hip extension and usually involves the straight tendon of this muscle [2]. In radiography avulsion injuries involving the proximal rectus femoris may demonstrate displaced bony fragments from the anterior inferior iliac spine or superior acetabular region. In order to verify the existence of the so-called third head of the rectus femoris the present study was undertaken.

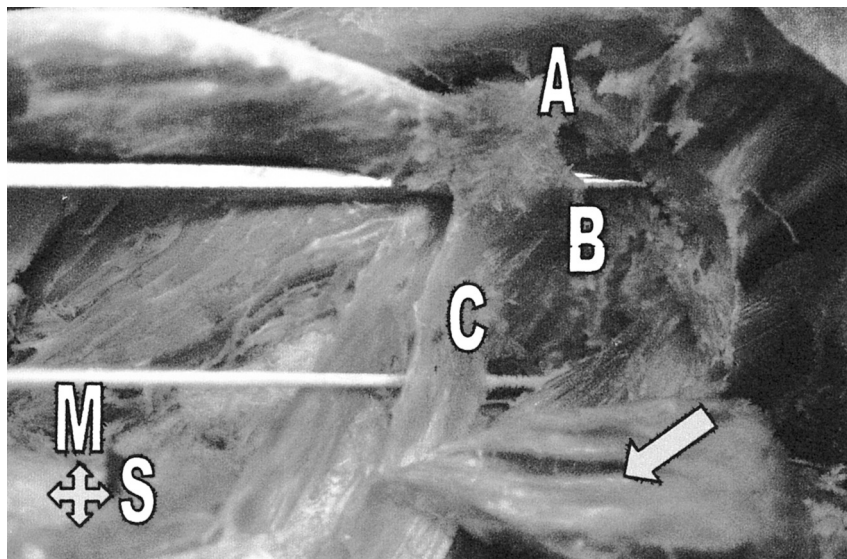
### MATERIAL AND METHODS

Forty-eight formalin-fixed adult human cadavers aged 58–94 years (mean 78 years) were dissected. Of these 21 specimens were male and 27 were female. Specimens that had obvious scars over the proximal thigh or were found to have internal hardware (such as prosthetic hip joints) were excluded from this study. These were cadavers used as part of the gross anatomy courses followed at our institutions. In the supine position cadavers underwent detailed dissection of the proximal anterior thigh with

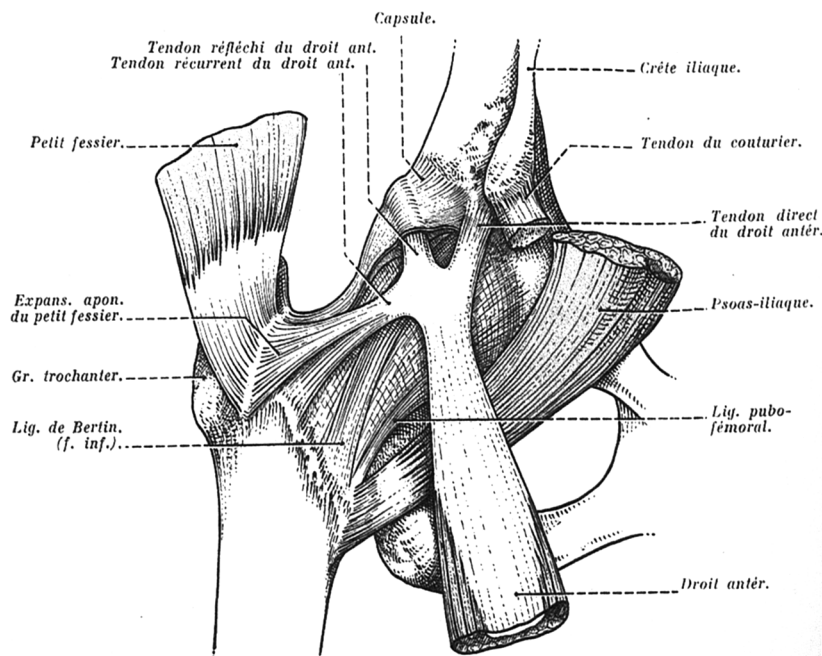
special attention to the attachment of the rectus femoris muscle. The proximal sartorius was removed and the proximal rectus femoris carefully uncovered. The tensor fascia latae muscle was resected and the gluteus minimus exposed and cut from its attachment onto the ilium. Next, the gluteus minimus was dissected laterally and the proximal rectus femoris exposed where it bifurcated into straight and reflected parts. Measurements were made of the third head of the rectus femoris muscle, when this was identified. Student's t-tests were used to identify statistically significant differences in the presence of the third heads.

### RESULTS

We identified 83% of sides as harbouring a third head of the rectus femoris. This additional head was found to attach deeply to the iliofemoral ligament and superficially with the tendon of the gluteus minimus muscle as it attached into the femur (Fig. 1). This tendon attached to the anterior aspect of the greater trochanter in an inferolateral direction compared to the straight head. Most commonly, this third head was bilaterally absent or present. However, 4.2% were found only on left sides and 5.2% were found only on right sides. The length and width of these heads ranged from 1 cm to 3.5 cm (mean 2 cm) and from 2 cm to 5 cm (mean 4 cm). The mean thickness of this band was found to be 3 mm (range 1.5 mm to 4.5 mm). These third heads



**Figure 1.** Left cadaveric dissection of the proximal thigh. Regarding the proximal rectus femoris muscle, note the straight head (A), reflected head (B) and third head (C). The probe and wooden stick are deep to the reflected and third heads, the cut is visible and the reflected gluteus minimus muscle is seen at the tip of the arrow. For reference, note that the iliopsoas muscle is seen primarily between the probe and wooden stick; M — medial, S — superior.



**Figure 2.** Illustration of a right third head (*tendon recurrent du droit ant.*) of the rectus femoris muscle from [9] (with permission). Note also the relationship between this head and the gluteus minimus muscle (*petit fessier*).

were found to originate near the inferior edge of the reflected head and travelled inferolaterally to attach onto the anterior aspect of the greater trochanter. The angle created between the reflected and third heads was approximately 60 degrees. Two sides (2.1%), both left sides with one female and one male specimen, were found to have third heads that were bilaminar. These bilaminar third heads had a distinct layer attaching to the underlying iliofemoral ligament and a superficial layer blending with the gluteus minimus tendon to insert onto the greater trochanter. No statistically significant differences ( $p < 0.05$ ) were found when comparing genders or sides.

## DISCUSSION

The rectus femoris is analogous to the extensor ili-otibialis seen in reptiles [8]. In both *Papio* and *Pan* there is a single proximal head of this muscle that attaches just inferior to the anterior inferior iliac spine [11]. It is of note that until the sixth foetal month only the reflected head can be distinguished in man [15]. Hasselman et al. [4] reported that the proximal conjoined tendon of the rectus femoris muscle appears to have superficial and deep parts. These authors described a superficial anterior fascia that followed the anterior part of the superior one third of this muscle and attached proximally to the straight head. When the reflected head was followed, its attached

muscle fibres were deep to the fibres attached to the straight head. These deeper fibres were initially in the medial part of the rectus muscle but with caudal descent they moved laterally to end up in the anterior part of the distal rectus femoris. Bordalo-Rodrigues and Rosenberg [2] have stated that the straight head of the rectus femoris is used in the initiation of hip flexion and the reflected head is primarily used once hip flexion has begun.

Henry [5] described fascial webs that are found in the layers that occupy "the space between the origins of the rectus femoris and tensor fasciae muscles, uniting the deep aspects of their sheaths". This author further stated that "these webs deserve a study which I found no time to give them". Paturet [9] described a recurrent or third head of the rectus femoris. In his text on anatomy this head was depicted as including a superficial portion that joined the insertion of the gluteus minimus onto the greater trochanter and a deep portion that attached with the iliofemoral ligament onto the intertrochanteric line (Fig. 2). Neither of these two aforementioned authors, however, commented further on the incidence or potential function of such a third head of the rectus femoris muscle.

As all of our specimens with a third head of the rectus femoris were found to have an attachment with the gluteus minimus onto the greater trochanter, the suggestion might be made that this

arrangement provides for synergy between the gluteus minimus and rectus femoris muscles. Beck et al. [1] found that the gluteus minimus acts as an abductor and flexor of the hip and also as an internal or external rotator, depending on which position the thigh is in when this muscle is contracted. Interestingly, some authors have also described an additional capsular attachment of the gluteus minimus and have speculated that these fibres may retract the capsule during hip joint movement, thereby preventing capsular impingement [1, 14]. Two sides (2.1%) in our study were found to have third heads of the rectus femoris that were bilaminar in nature. It might also be considered that the iliofemoral ligament bears remnants of the third head of the rectus femoris muscle in those specimens found not to have such a distinct tendon, as this band travelled in a more or less similar line to that of the lateral part of the iliofemoral ligament. Because the reflected tendon is relatively fixed, the third head of the rectus femoris may simply provide additional stability to the anterior hip joint.

The present study demonstrates that a third head of the rectus femoris does exist, and in our study it was found in the majority of specimens. This muscular attachment may not be well known owing to the area that it occupies, which can be labour-intensive to dissect. Although the function of such an attachment is speculative, the clinician may wish to consider this structure in the interpretation of imaging or in surgical procedures in this region [10].

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