THE QUADRATE TUBERCLE OF THE FEMUR

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Reference to descriptions in current textbooks of anatomy concerning the relationship of the quadratus femoris muscle to the quadrate tubercle reveals a condition which differs from that usually found by dissection, whilst the gross anatomy of the tubercle itself receives very little attention. Thus in Gray(3) it is stated that "a little above its middle (trochanteric crest) it presents a low rounded elevation, sometimes termed the quadrate tubercle. The tubercle itself, and a portion of the bone below, receive the insertion of the quadratus femoris muscle". Morris(5) makes the statement that "above the middle of this line (intertrochanteric crest) is an elevation termed the tubercle of the quadratus for the attachment of the upper part of the quadratus femoris" whilst on p. 464 the quadratus femoris is said to insert "into the vertical ridge which terminates above on the inferior dorsal angle of the great trochanter". Cunningham(1) says: "The low, rounded swelling on or alongside the crest, on the back of the trochanter major is called the quadrate tubercle because part of the quadratus femoris muscle is inserted into it." The muscle is also said to be inserted into the quadrate line of the femur below the tubercle. Poirier & Charpy(6) illustrate the quadrate tubercle but do not describe it. Of the quadratus femoris they say, "De là, les fibres se dirigent transversalement en dehors pour aller s'insérer non à la ligne intertrochantérienne postérieure, mais à une ligne rugueuse qui, continuant l'interstice de la ligne âpre du femur, aboutit au tubercule de l'angle postéro-inférieur du grand trochanter." "Quelquefois, le muscle se dédouble près de son insertion fémorale: ses fibres postérieures, les plus nombreuses, vont à l'insertion que j'indique, tandis que les antérieures s'arrêtent à la ligne intertrochantérienne." Frazer(2) associates the tubercle and the muscle in the following manner: "The posterior intertrochanteric line is part of the trochanteric system and marks the pull of the quadratus." "The quadrate tubercle is that part of the trochanteric mass on which the pull of the muscle is directly exerted, and it is thus of the nature of a primary marking." Macalister(4) has described the condition thus: "Between the trochanters posteriorly is a rounded intertrochanteric line, at the middle of which is a small roughness from which a faint, short line descends vertically to the level of the lesser trochanter. This is the linea quadrati, which receives the insertion of the quadratus femoris."

Routine dissection of the region concerned showed that none of the above descriptions was a true representation of the commonest condition found. On account of these discrepancies, the anatomical features of this bony marking were investigated in a series of 100 adult femora whilst the relationship of the muscle to the tubercle was ascertained from a study of the soft parts in 10 foetal and 20 adult dissections. The investigation was carried out in three parts. In the first part the situation and the characteristics of the tubercle in the adult bone were determined; in the second the relationship of the epiphyseal line of the greater trochanter to the tubercle was ascertained, and in the third the relation of the tubercle to the quadratus femoris was determined by dissection. The adult bones examined were those of Australian aboriginals as were four of those possessing epiphyseal lines; the dissections, however, were made on white material. This unfortunately, though definitely, prevents any direct comparison and correlation between the various parts of the investigation.
THE TUBERCLE

The tubercle was present on the intertrochanteric crest in every femur of the above series and was so well developed that no doubt was left as to its actual presence. The summit of the tubercle, however, was not on the crest but just lateral to it. In an attempt to determine the site of the tubercle more accurately the following measurements were taken. The distance between the point where the crest joined the upper border of the trochanter and the summit of the lesser trochanter was divided by the distance between the summits of the lesser trochanter and quadrate tubercle and the ratio so obtained compared in the various femora of the series. Such measurements were obviously only approximate, yet the ratio obtained in all cases was relatively constant. In sixteen specimens the ratio was 1.4, in thirty-two, 1.5, in thirty-five, 1.6, in nine, 1.7, and in four, 1.8, thus giving a mean of 1.5. In four specimens destruction of the lesser trochanter prevented the necessary measurements from being made. From these measurements it is certain that the tubercle is always situated above the mid-point of the intertrochanteric crest and that it is to be found at approximately the junction of the upper one-third with the lower two-thirds of the crest. The tubercle varies in size and is not always localized to the crest. In the majority of cases the elevation involved the adjacent area of the posterior surface of the greater trochanter and in a few cases it actually passed over on to the adjacent portion of the neck of the bone. It is to be noted that these extensions medially and laterally always take place along the site of the epiphyseal line.

RELATIONSHIP TO THE EPIPHYSEAL LINE OF THE GREAT TROCHANTER

In the only three sets of bones available for study showing this epiphyseal line, the line passed directly through the tubercle, which thus forms by far its best landmark on the posterior surface of the adult bone.
Anatomical Note

RELATIONSHIP TO THE QUADRATUS FEMORIS MUSCLE

The tubercle was present in the foetus though, compared with its condition in the adult, it was ill defined. In all the cases dissected it was situated close to, if not at, the mid-point of the intertrochanteric crest. The main mass of the muscle was found to be inserted, without exception, along the intertrochanteric crest. The upper fibres ceased a short distance before the point where the crest joined the superior border of the trochanter but the lower fibres passed down along the posterior margin of the upper half of the lesser trochanter, where they blended inferiorly with the upper fibres of insertion of the adductor magnus. The insertion also extended medially into the fossa overlapped by the crest whilst some of the fibres were traced as far up as the posterior surface of the digital fossa where they were closely associated with the fibres of the obturator externus muscle. In one case the insertion of the main mass was so far medial to the crest that it was liable to confusion with the obturator externus. Laterally, fibres passed over on to the tubercle and as far down as the lesser trochanter; these lateral fibres had the weakest attachment and could be separated quite easily from the bone: the remainder of the muscle was strongly attached by muscle fibre. In the adult the tubercle was again present in all members of the series and could be detected without difficulty. The ratio taken in five specimens gave a value of 1.5 in one and 1.4 in the remainder. The insertion of the muscle was relatively constant and took the following form: The main mass of the muscle inserted by a fine admixture of muscle and tendon along the intertrochanteric crest, but inferiorly it passed off the crest on to the shaft of the bone as far down as the level of the lesser trochanter. Superiorly the muscle never reached the postero-superior angle of the trochanter, but fibres left the deeper surface of its upper portion to insert into the inner lip of the crest and to come into close contact with the obturator externus tendon as it passed upwards and outwards to insert into the digital fossa. Inferiorly fibres from the deep surface inserted as far medially as the lateral margin of the lesser trochanter. At the level of the tubercle tendinous fibres from the superficial surface of the main mass passed out constantly to insert by a thin tendinous sheet into the inner aspect (rarely the summit) of the tubercle. In only three cases did the main muscle mass pass so far laterally as to involve the summit of the tubercle, and even in these cases deeper fibres were inserted along the crest as far down as the lesser trochanter. In no case in this series was the main mass inserted lateral to the tubercle although, in a few, dissection revealed isolated tendinous fibres passing out over it to be inserted into the posterior surface of the trochanter. Thus in this series the double muscle described by Poirier & Charpy is found to be the one which is normally present, though here the deeper portion, which is their accessory insertion, forms the main part of the muscle. In no case did the tubercle form the upper limit of the insertion of the muscle which, on the contrary, was constantly found above it. The condition found certainly suggests that the muscle is responsible for the formation of the crest as stated by Frazer, though his statement that “the tubercle is that part of the trochanteric mass on which the pull of the muscle is directly exerted” received no confirmation from this investigation, in which the tubercle was associated, not with the main portion of the muscle, but with a lateral offshoot from it. However, it is extremely likely that changes peculiar to, and taking place at, the epiphyseal line are also responsible for some of the prominence of the tubercle. This receives confirmation from the fact that, in the series demonstrating epiphyseal lines, limited though it was, the tubercle was intimately associated with that line. Moreover in those cases in which extensions of the tubercle from the crest were present they were always found along the path of the growth line, and again, the tubercle is often larger than can be accounted for by the site and nature of the muscle insertion. There seems little doubt, however, that the muscle is responsible for the early appearance of this bony elevation.

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Summary

1. An investigation into the nature of the quadrate tubercle is described in which that bony marking is found to be constantly present, and to occur at a relatively fixed point along the intertrochanteric crest.

2. The tubercle is found to be a reliable landmark to the epiphyseal line of the great trochanter.

3. The relationship of the quadratus femoris muscle to the tubercle and the intertrochanteric crest is described, whence it is concluded that the tubercle is a muscular marking due, not to the main muscular mass, which is responsible for the crest, but to a smaller offshoot from it.

Reference