

OBSERVATIONS ON CERTAIN STRUCTURAL DETAILS OF THE
NECK OF THE FEMUR. By THOMAS WALMSLEY, M.B., *Demon-
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THE neck of the femur is a flattened arc of bone connecting the head with the upper extremity of the shaft, passing inwards, upwards, and forwards from the shaft at an angle of individually varying magnitude. The flattening of the neck is from before backwards, and it is narrowest at its middle part, expanding at both extremities, but more so at its outer end where it becomes continuous with the shaft. The vertical diameter of the outer end derives its increase, partly from the manner in which the lower border of the neck passes downwards into the inner border of the shaft (Adams' arch),

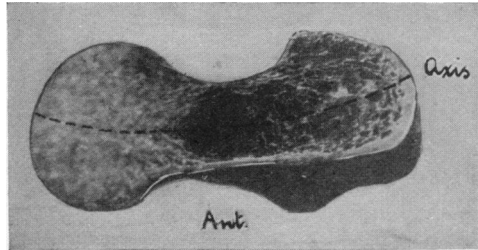


FIG. 1.—Horizontal section of neck and head of femur, showing convexity forwards.

though in addition the whole neck here undergoes an enlargement in all its dimensions. The inner extremity of the neck is more circular in conformity with its attachment to the base of the head, the demarcation being best defined by what is hereinafter termed "the base-line of the head" (*vide post*). Taken as a whole, and as seen on horizontal section (fig. 1), the neck has a slight curvature with the convexity forwards—that is, opposite in direction to the curve which is found at the junction of the base of the neck with the upper end of the shaft.

The anterior surface of the neck extends from the base-line of the head anteriorly to the external limit of the anterior intertrochanteric roughness. For descriptive purposes this surface is here divided into two parts, an outer smooth area, and an inner usually rough area, separated from one another by a hitherto undescribed ridge (figs. 2, 3, and 4). This ridge is

absolutely constant in position in all adult bones, though it varies within wide limits as regards its degree of evidence. In direction it is transverse to the long axis of the neck, parallel to the anterior intertrochanteric line, and distant from that line about 1 to 1.5 cms. It is best marked towards the upper extremity of the neck, beginning, as a rule, abruptly just below the superior border, passes downwards and inwards, with a concavity directed upwards and inwards, and terminates below by gradually fading away into the general contour of the bone about half way down the neck.



FIG. 2.—Proximal extremity of femur, anterior aspect, showing “capsular ridge” in a slight degree of development.

It is thus early to be insisted on that this ridge is not merely the external limit of the medial rough area, but represents the internal boundary of and belongs to the lateral smooth area. The whole evidence of its causation demonstrates this fact. This lateral smooth area is almost comparable to the pulley on the lesser sacro-sciatic notch over which the tendon of the *m. obtur. inter.* plays at its exit from the pelvis; indeed, in many specimens examined in the recent condition, the whole formation of the superficial structures presents an almost identical appearance. On this smooth area there plays the supero-lateral part of the anterior capsule. In full extension of the limb—the position of greatest tension of its fibres—this part of the

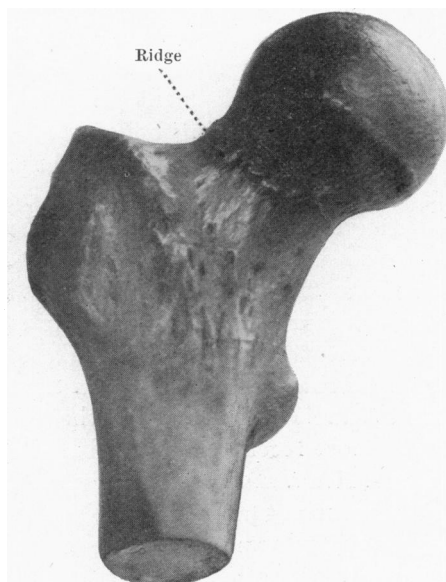


FIG. 3.—More advanced development of “capsular ridge.”



FIG. 4.—Well-marked “capsular ridge.”

capsule acts in such a spiral manner as to produce this "capsular groove," concave inwards. A cartilage covering was never noted in this position. An examination of a series of fresh specimens shows how close is the relation between the capsular development and the degree of evidence of the "capsular ridge," and the marking off of the capsular groove. In young bones no such ridge is to be found, nor for that matter is there any indication of an anterior intertrochanteric line. It is about the age of eighteen years that the roughness at the anterior capsular attachment begins to appear; it is progressive in development, yet varies with the amount and strength of the capsular fibres; only subsequent to that period can evidence of the capsular ridge be found, and it is always best marked when the capsule and its attachment are well developed. Bertaux (*L'humérus et le fémur*, Lille, 1891) held that the roughness on the anterior face of the femoral neck was due to partial attachment of the fibrous capsule, a view somewhat similar to that more recently advanced by Frazer ("Some Minor Markings on Bones," *Jour. Anat. and Phys.*, vol. xl. p. 270), who holds that the roughness is due to recurrent fibres from the anterior circular set of capsular fibres. Now, it may be dogmatically insisted on that in the position of this groove there is no recurrence of capsular fibres back on the neck, neither in the foetus nor at any subsequent period. No matter into how many layers the capsule be split, each layer which has a femoral attachment at all is fixed in the region of the anterior intertrochanteric line, the retinacula being placed in their entirety either proximally or distally to this area. This lateral area, then, devoid of vascular foramina, is a pulley on which there plays the upper and outer part of the anterior capsule, and contact is closest when the limb is in full extension. These facts are made clearly evident if the finger be placed on the groove through a slit in the complete capsule, and the limb slowly extended from the position of flexion.

For the consideration of the significance of the medial area, reference must be made to the articular margin of the head of the femur. This margin is undulating, but in a regular and constant manner as regards the incidence of the causes of the unevenness, though in degree variation does occur to a considerable extent. The undulations are excursions outwards of the articular cartilage, and between these are recessions inwards, or, more correctly, recessions where the excursion of the cartilage over the neck is more limited in extent. The most marked inward concavity is placed opposite the great trochanter towards its posterior part, and bounding this concavity are two outward eminences, one towards the back and one towards the front of the neck of the femur. Of these the posterior is more localised and angular than the anterior, which is more diffuse and rounded, while in size the posterior is much the more constant. This is

proved by the fact that a series of femora may be found, even among European races, in which the anterior of these excursions is continued for some considerable distance over the neck of the femur. This variation was described by Henke (*Handb. d. Anat.*, p. 176), but no special significance was attached to it. Fick (*Handb. d. Anat. u. Mech. d. Gelenke*, Bd. i. S. 318) describes it as the "eminencia articularis colli femoris." Charles ("The Head of the Femur," *Jour. Anat. and Phys.*, vol. xx. p. 1), writing on this same structure from a study of Hindu bones, attributed the condition to an adaptive variation dependent on continuous over-flexion of the joint such as occurs in the "squatting" position. He claimed the condition as essentially Asiatic, and described the European femur as having an even articular margin when looked at from above. Neither of these conclusions can be held as correct; indeed, Parsons ("The English Thigh-Bone," *Jour. Anat. and Phys.*, vol. xviii. p. 238) has been able to find evidences of marked unevenness in over 60 per cent. of English femora. Poirier and Charpy (*Anat. humaine*, vol. i. p. 220), in discussing this structure, point out that the head is continued down on to the neck anteriorly and posteriorly, while on the anterior face of the neck there is a rough impression, "d'empreinte iliaque," which is occasionally present as a continuation of the articular cartilage of the head. These authors explain the condition as being due to the contact of the neck of the femur with the superior part of the acetabular margin in the position of extreme flexion; but, as Fick has pointed out, considerable abduction combined with internal rotation would also be necessary before this contact could take place, and Parsons' figures emphasise the incongruity of the correlation, when heed is taken of the unnaturalness of the required position.

The medial area of the femoral neck may be found to exist in three different structural conditions, rough in about 70 per cent., almost smooth in about 20 per cent., and in the remaining 10 per cent. more or less cartilage-covered. While the anterior cartilage excursion thus varies to a considerable degree, yet its lateral margin will never be found beyond that definitely marked ridge on the neck of the femur, previously termed the capsular ridge. Now, on closer examination of this excursion in its extreme degree, it is clear that it is not in physiological continuity with the articular surface from which it springs, being curved in one direction only, antero-posteriorly, but perfectly flat in the latero-medial plane. In addition to this fact, I have never been able to find an absolutely smooth surface on one of these extreme excursions. They have never presented themselves in the young subject, and always, in my series, they have been associated with strong bony ligamentous markings, and with powerful capsular bands. Further, in no possible natural position of any of the joints could

this excursion, in any of the specimens in which it was present, be made to enter the acetabular cavity: in other words, when the anterior excursion of the cartilage from the head over the neck is present to an extreme degree, the lateral part of that excursion is never intra-articular in the sense of lying within the acetabulum. It must therefore be concluded that this condition is simply a variation of the more commonly found roughness, which, as already indicated, is placed medial to the capsular ridge. In considering what the cause of this roughness may be, it is

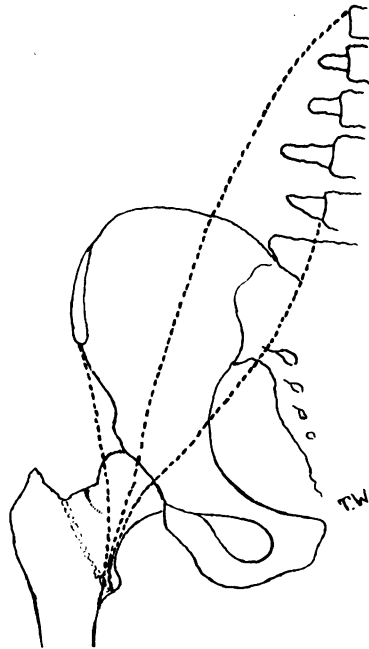


FIG. 5.—To show the usual relationship of the ilio-psoas mass to the proximal extremity of the femur.

necessary first to define the usual relationship of the tendon of the m. ilio-psoas to the proximal extremity of the femur, and especially in the position of full extension (fig. 5). The tendon of the m. psoas is certainly medial to the vertical limb of the ilio-femoral band above, so that when the bursa under that tendon communicates with the cavity of the hip-joint it does so medial to that ligament, and exposes the lateral part of the anterior cartilage of the head of the femur. The iliacus muscle, laterally placed, lies much more on the femoral neck over the vertical limb of the ilio-femoral ligament, and it will be noted that the direction of the concavity of the combined mass is upwards and outwards. Thus

any action which the ilio-psoas may have on the production of markings on the neck of the femur would not only be confined to the lower part of the femoral neck, but there only after acting through a structure more powerful and of greater extent than itself, the medial part of the ilio-femoral ligament. The ilio-psoas, therefore, cannot be made responsible for the marking in question. It is also clear from its extent that this medial rough area, or its variations, does not result from bony contact with the margin of the acetabulum, and the conclusion seems justifiable that the structural condition of this whole area rather represents the amount of contact of this portion of the neck of the femur with the vertical limb of the ilio-femoral ligament in the position of complete extension.

In addition to the two outward eminences already indicated, there was described by Goodsir (*Anat. Memoirs*, vol. ii. p. 508) a third, situated in the inferior shallower concavity at the intersection of the ridge prolonged from the lesser trochanter with the articular margin of the head. In my series, a little anterior to the above-defined position, a very slight outward projection was found in less than 10 per cent. of 200 bones examined on this particular point—a frequency not greater than that of a small outward eminence in the middle of the superior concavity.

Two other markings at the margin of the head of the bone are constant in the series of femora I have examined. First, on the inferior wall of the anterior cartilaginous excursion there is an oval area of fairly smooth, roughly polished bone, abutting against the margin of the head, but belonging to the neck, never cartilage-covered, yet sharply demarcated from the surrounding bone, and differentiated by the absence of vascular foramina. This imprint is undoubtedly produced by bony contact with the margin of the acetabulum. It is intra-synovial in position—that is, the synovial membrane ceases at its lateral border. Contact takes place between this portion of the neck and the articular margin at the anterior part of “the pubic protuberance of the acetabular rim,” in the position of complete extension. In this position, extension is combined with a certain degree of internal rotation which takes place primarily to allow the most complete reception of the head of the femur within the acetabulum, and to produce secondarily the locking of the knee-joint. When the femur is thus extended and rotated the anterior excursion of the articular cartilage of the head is in firm contact with the lower part of the iliac area and with the pubic area of the acetabulum, while the imprint described is forced to rest on the latter area at its marginal part. It is therefore proposed that this “facet of rest,” or “pressure facet,” should be termed the “pubic imprint.” In extent the pubic imprint varies a good deal, but

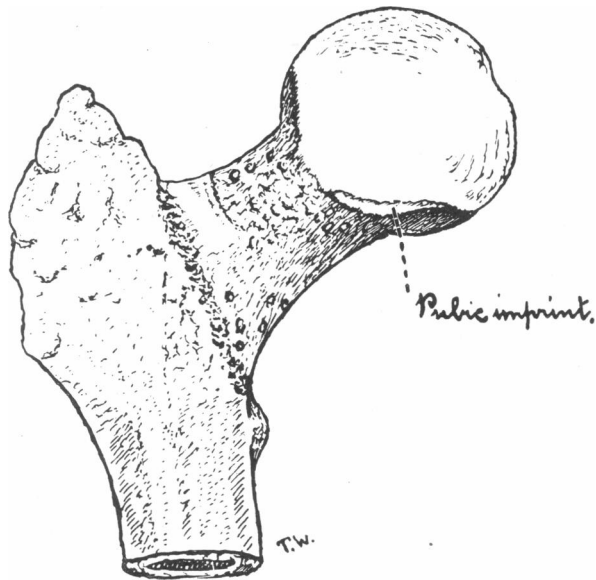


FIG. 6.—The incidence and shape of the "pubic imprint" is diagrammatically shown.

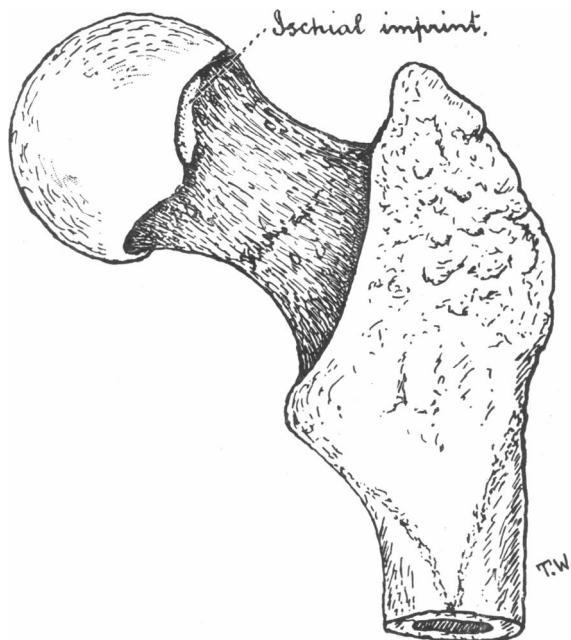


FIG. 7.—To show "ischial imprint"—diagrammatic.

a well-marked bone would show it as about 1.5 cms. long, about .8 cm. at its broadest part, of oval form but tapering away inferiorly, an incidence in conformity with its incidence of action. At twelve years of age this marking is perfectly distinct, though it is relatively smaller in size than in the adult; but previously to this period it cannot be determined with any degree of accuracy, and is certainly absent up till the sixth year.

Second, the excursion over the posterior part of the neck is, as previously stated, more constant in size than the anterior excursion. It is wholly acetabular in position when the limb is completely extended, occupying in that position the "ischial projection" of the acetabulum. By its upper border it bounds the superior concavity posteriorly, and the bone lying lateral to this boundary corresponds in structure to the pubic imprint. Thus it is proposed to describe another pressure facet on the femoral neck, also constant in position, and, though varying a little in size, of dimensions on the average very comparable to those of the pubic imprint. This facet, differentiated by similar structural characteristics, is produced in like manner to the pubic facet—that is, by contact with the acetabular margin. It is probably differentiated at a later period of life. In respect that the contact takes place with the ischial part of the acetabular rim, the facet may be termed the "ischial imprint."

These two imprints, pubic and ischial, represented in figs. 6 and 7, are most evident in the recent specimen.