DISLOCATIONS OF THE THIGH:

THEIR

MODE OF OCCURRENCE AS INDICATED BY EXPERIMENTS
AND THE ANATOMY OF THE HIP-JOINT.

BY

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RECENTLY, whilst making various dissections of the hip-joint, the usually accepted doctrine that dorsal and ischiatic dislocations of the femur occur when the thigh is in a position of adduction appeared to me as very improbable, on anatomical grounds alone, and I was, therefore, led to test the truth of it by means of experiments on the dead body.

I propose in the following remarks to prove by anatomy, experimental results, and clinical facts—(1) that all kinds of dislocations at the hip-joint *can* take place while the thigh is abducted; (2) to give reasons for believing that abduction is the position in which all dislocations of the thigh happen; and (3) to show that in any given case the dislocation will be backwards, downwards, or forwards, according as flexion with rotation

inwards, or extension, or extension with rotation outwards, is associated with abduction at the moment of accident; or is provoked by the same violence which produces the displacement.

First, I will state briefly the anatomical features which bear upon the question.

The *acetabulum* looks forwards as well as outwards and downwards, and receives the head of the femur, which also looks forwards. The thickest and strongest part of the innominate bone is that which forms the upper and posterior wall of the acetabulum; it is this part of the bone which enters into the formation of the weight-bearing arches of the pelvis, viz. of the pelvic brim, along which the weight is transmitted to the heads of the thigh bones in the upright and stooping positions, and of the vertical or ischial arch, along which the weight is transmitted to the tuberosity of the ischium in the sitting posture. This same part of the innominate bone forms by far the deepest portion of the acetabulum, the articular surface of which is fully an inch wide in its iliac portion, and nearly as wide in the ischial. Along the lower part of the acetabulum, on the other hand, the articular facet, so far as it exists at all, is very narrow; while the cotyloid notch intercepts the rim for nearly one inch.

The *head of the femur* presents a much larger articular surface above the transverse plane through its centre than below it. The measurement (in a horizontal plane), from a vertical line skirting the dimple for the round ligament to the outer limit of the articular surface on the *upper* aspect of an average femur, is an inch and two thirds; whereas to the outer border of the articular surface *below* is only three eighths of an inch. The notch for the round ligament is in the lower and posterior quarter of the head; the most prominent point in the head is below this notch, while the part above slopes off from within outwards. As a consequence of all this, when the thigh is flexed and adducted, the most projecting part of the head

passes into the deepest part of the acetabulum and presses against the broadest and strongest part of its wall; whereas in abduction this prominent part of the head of the femur projects beyond the lower part of the socket at the cotyloid notch.

THE LIGAMENTS.—It is only necessary to refer to two of the four ligaments of the joint, viz. the capsular and the round ligament.

The *capsular ligament* is large and loose, so that in every position of the limb some portion of it is relaxed. In thickness and strength it varies greatly in different parts; thus if two lines be drawn, one from the anterior inferior iliac spine to the inner border of the femur near the small trochanter (Plate VIII, fig. 1), the other from the upper border of the tuber ischii to the digital fossa (Plate VIII, fig. 2), the ligament above and behind these lines, is very strong; whereas all below, except along the narrow pectineo-femoral band, is very thin and weak, sometimes permitting the head of the bone to be seen through it. There are three bands auxiliary to the capsule, or more correctly speaking, three portions of the capsule, which have received separate names, and which for the sake of description are called ligaments, although it would be erroneous to suppose that either of these bands or ligaments are structures separate from the capsule. The best known of them is the *ilio-femoral* ligament, a large triangular mass of coarse, well-marked fibres, the broadest end of which is at the femur (Plate VIII, fig. 3). Its fibres are somewhat accumulated both along the outer and inner sides of the femoral attachment, while several curved intercolumnar fibres, which spring from the centre of the capsule, pass to the femur with the inner set.

This arrangement of the fibres has led to the ligament being called by some the “inverted Y-shaped ligament,” and exaggerated representations of it, in accordance with this name, have been drawn. Such, for instance, are the diagrams of the ligament in Bigelow’s work and in the works of those who have copied therefrom. The name is,

however, inappropriate, for although the double accumulation of fibres may be made, by dissection, to show somewhat the appearance of an inverted Y, there is not any natural interval between the two imaginary arms of the ligament beyond a small aperture for the entrance of a branch of the external circumflex artery into the joint. Except for this small opening, the strong central fibres which take a straight course to the femur are not interrupted, and are of considerable thickness. The mistake has arisen, I imagine, from the presence of two well-marked bands connected with the surface of the capsule along the upper and outer border of the ilio-femoral ligament. One of these, the shorter and posterior, passes to the tendon of the gluteus minimus from the middle of the capsule; the other, not hitherto described, but generally well marked, extends from the vastus externus to the long head of the rectus femoris, and moves with both these tendons (Plate VIII, fig. 3). The latter especially gives the appearance of a superadded outer arm to the ilio-femoral ligament, while the more oblique direction of the inner fibres completes the supposed Y-shaped outline.

The *ischio-femoral* ligament extends from the ischial border of the acetabulum to the upper and back part of the neck of the femur, just internal to the highest part of the digital fossa. When the thigh is flexed the fibres of this ligament pass almost straight to their femoral insertion, and are spread out uniformly over the head of the femur, but in extension they wind upwards and outwards to the femur in a zonular manner (Plate VIII, fig. 2), and form quite a thick roll along their lower border. The upper and back part of the capsule between the ilio-femoral and ischio-femoral ligaments is very strong and thick, although not so strong and thick as the ilio-femoral itself. The latter is as stout as the tendo Achillis, and is often more than a quarter of an inch in thickness; the rest of the strong part of the capsule varies down to one eighth of an inch or a little less in thickness.

The third auxiliary band is the *pectineo-femoral* liga-

ment (Plate VIII, fig. 3), a distinct but narrow set of fibres, extending from the pubis and pubic border of the cotyloid notch to the lower and back part of the neck of the femur just above the small trochanter.

The effect of these bands on movements of the hip-joint is as follows: The *ilio-femoral* supports the trunk in the erect posture by limiting extension; it is made tense throughout in every position of extension, except when extension is combined with abduction, and then the outer fibres are relaxed.

The *ischio-femoral* band does not limit simple flexion, but is tight during flexion combined with adduction, and flexion combined with rotation inwards. In extension, in flexion with rotation outwards, and in abduction, it is quite loose. The part of the capsule between the ilio- and ischio-femoral ligaments assists the former in limiting simple extension; it is also made tense in extension with adduction, but is most tense in adduction combined with slight flexion,—the stand-at-ease position.

The *pectineo-femoral* ligament is stretched in every position of flexion and of extension when associated with abduction. It is the structure which limits abduction, and is especially tight during abduction combined with slight flexion, and also when marked flexion with outward rotation accompanies abduction.

The *ligamentum teres*, so far as its attachments are concerned, needs no notice here, but its action and use require a word or two. Without discussing the differences of opinion which have been expressed on these points it will be sufficient to state, as the result of several examinations, that the ligament is most tight during flexion combined with adduction and rotation outwards, but that it is also tight, though to a less degree, during flexion with rotation outwards, as well as during flexion with adduction. As the thigh passes from a position of adduction with flexion to one of adduction with extension it becomes less and less tense, and is quite lax when full extension is

reached. In every position of *abduction* it is loose, while in *abduction* associated with simple flexion it is at its loosest, and the ligament is then folded upon itself so completely as to have its femoral and acetabular attachments on the same level and opposite to one another.

From a consideration of these anatomical facts, it is evident that no conditions of the joint can be more favorable to rupture of the capsule and dislocation of the thigh than those of *abduction*. In *abduction* the head of the femur is more than half out of the acetabulum, bulging over the transverse ligament; the cotyloid notch being filled with soft compressible fat allows the ligament to yield a little as the head of the bone is forced over it; and the most prominent part of the head of the femur is resting hard against the thin portion of the capsule. This part of the capsule is strengthened somewhat by the pectineo-femoral ligament it is true, but it derives no appreciable support from muscles as does the rest of the capsule. The ligamentum teres, being quite loose, is absolutely powerless to resist force, but is most favorably situated to snap under a sudden jerk. Finally, in *abduction* all the strong portion of the capsule is relaxed, excepting during complete extension, when the innermost fibres of the ilio-femoral ligament become tense. *In fact, it may be said that there is a natural tendency for the head of the femur to be displaced during abduction of the thigh.*

Nor is there any other position so favorable to dislocation as *abduction*. It is quite unnecessary to discuss the improbability of dislocation in positions of simple extension, when the ilio-femoral ligament is the resisting structure; it is only in the rarest, *i.e.* the so-called irregular dislocations, that this part of the capsule is ever ruptured, and even then only by the extension of the laceration commenced elsewhere, and the peeling off of the ligament from its bony connections.

There is, however, a pretty prevalent opinion that dorsal dislocations take place during adduction through a rent in the upper and back portion of the capsule, and that the

use of the round ligament is to resist forces which tend to drive the bone out in this direction. Now, as dorsal dislocations are more common than all the others put together, it is most likely that they occur through some strain upon the weak part of the capsule, and it is necessary to state the anatomical provisions against their occurring during *adduction*. It is only during *flexion with marked adduction*, and *flexion with rotation inwards*, that the head of the femur presses firmly against the upper and back part of the capsule, and even in these positions the most prominent part of the head is against the strongest and deepest side of the acetabulum. During *flexion with adduction* the ligamentum teres is on stretch, and therefore in action to resist displacing forces, so far as it ever can do so. The portion of the capsule against which the head of the bone is bulging is strengthened by various muscles, and these during adduction and inward rotation lie stretched over it; the most important of them is the obturator internus, which, when stretched, acts much like a ligament on account of the several tendons into which the muscular tissue is inserted and the connection of some of the ultimate fibres of these tendons with the bony origin of the muscle; the power of resistance of this muscle is increased too by the play of the tendons of the trochlear groove of the ischium, whereby the strain on the muscle is diminished. Finally, the close connection between the external rotator muscles, as they pass to their insertions, and also of the gluteus minimus, with the capsule, must strengthen and support the upper and back part of that ligament.

Thus, the anatomy of the joint, it seems to me, points to *abduction* as the *only position* in which dislocation of the thigh can possibly occur. Experiments upon the dead body confirm the conclusion suggested by anatomy. They also establish the fact that all the regular varieties of dislocation of the hip can be produced and reduced after the head of the femur has been displaced in *abduc-*

tion. It will be best at once to state that the only way in which I have been able to dislocate the thigh is by forcibly abducting it. I have tried, standing over the body, the pelvis of which has been firmly fixed by two men, to force the bone out of the acetabulum through the back of the capsule; I have removed all the muscles and tried the same thing when only the capsule and wall of acetabulum were left to resist, and when, by previously flexing and adducting, or flexing and rotating inwards the thigh, the strain upon the capsule is at its greatest. I have also tried, by bringing the legs across one another, and jerking and forcing the thigh with the whole leverage of the limb to assist me, as well as by striking with a heavy block the front and outer side of the knee, to dislocate the flexed and adducted thigh; but by none of these means have I ever once succeeded.

As soon, however, as the limb is abducted and jerking force is applied to it while in that position, the head of the femur bursts through the capsule, and the dimple for the round ligament can be felt beneath the skin of the perinæum. After the head has left the acetabulum it can be made to pass either towards the dorsum ilii or the ischiatic notch by *flexing and rotating the limb inwards* more or less; or on to the pubis by *extending and rotating it outwards*.

The following statements are based on *fifteen* experiments:

The results in all these cases were so similar that it seemed unnecessary to record the notes of more. Except when specially stated to the contrary all the dislocations were effected before any dissection whatever was commenced.

1. The rent in the capsule varied with the degree to which the upward displacements had been carried previous to dissection, but it was always limited to the thin portion of the capsule. In none did it involve the ilio-femoral or the ischio-femoral ligament, or the strong part of the capsule between them. In most cases it commenced at the pubis, ran obliquely downwards and backwards to the

neck of the femur, and then extended upwards to a greater or less distance towards the digital fossa, either peeling the capsule from the back of the neck of the femur or tearing it through at a short way from its attachment to that bone (Plate VIII, figs. 1, 2). In some cases the periosteum was torn away with the ligament from the pubic part of the acetabulum, and in one the whole of the under and inner side of the capsule was separated from the acetabular margin; but in all, the rent took the same general course along the femoral insertion of the capsule.

2. The ligamentum teres was ruptured in every case by the dislocating force, and not by the subsequent movements whereby the dorsal or other positions were obtained. This was ascertained by feeling for the dimple in the head through the perinæum. In all but three the ligament was detached from the femur, and with it, in some instances, a scale of articular cartilage. In three cases it was torn asunder, once near the femur and twice near its middle.

3. The pectineus, quadratus femoris, and external obturator muscles were ruptured, the two former in every case, the latter each time it was examined. The gemellus inferior was generally torn asunder.

4. The obturator internus was ruptured in two instances, and the adductors longus and brevis in one and the same case. In none was the neck of the femur embraced by the small rotator muscles (*viz.* gemelli, obturator internus, and pyriformis); nor could the head of the bone be made to pass upwards beneath the obturator internus tendon, *i. e.* between it and the capsule of the joint, but it could be forced upwards on to the dorsum over the posterior surface of the muscle.

5. In no case was the ilio-psoas or the gluteus minimus ruptured. In one of the cases in which the obturator internus was torn the pyriformis and the lower border of the gluteus medius were also lacerated.

6. In three cases the great sciatic nerve was lying in front of the neck of the bone, and was not seen in the dissection of the gluteal region until the dislocation was

reduced. In one case the nerve was carried before the neck and retained there after reduction.

7. In three cases the dislocation was compound,¹ so that the head of the femur protruded through the skin of the perinæum.

In order to ascertain if the head of the femur could be displaced through a "button-hole" opening of the capsule three experiments were made in the following manner:—A muscular flap was dissected up so as to expose the small rotator muscles and the sciatic nerve; these were next cut and the capsule was thus fairly exposed. An oblique incision was then made through the capsule along the line of the pyriformis muscle, reaching from the acetabular margin to the digital fossa, then by flexing the thigh to a right angle with the trunk and adducting it the head of the bone was displaced on to the dorsum ilii with very little trouble. But though the length of the incision varied, according to the size of the joint, in the three cases, from one and a quarter to two inches, in no instance did the head of the bone pass out of its socket without further rupturing the capsule to the extent of from seven eighths to one and three eighths of an inch further. The direction of the rent in each case was downwards from the incision, through the back of the capsule at a short distance from its attachment to the femur. Thus, the head of the femur escaped through no "button-hole" opening at the back of the capsule, but by tearing up a large flap in the back and lower portion of it.

These several experiments have convinced me of the

¹ Two of these three cases of compound dislocation occurred in subjects who had died of cancer of the uterus attended with great emaciation, the other in a tall, thin lad, æt. 17, who had died of diphtheria following immediately upon typhoid fever. No rigor mortis was present in either case, and it was thought at the time that no better subjects could be selected for obtaining dislocation by *adduction*. Yet, with three men holding the body steady, varied, prolonged, and very forcible efforts to dislocate in this manner failed; but as soon as the limb was abducted and a moderate degree of jerking force was applied, the head of the bone, in each instance, started through the skin of the perinæum.

importance, which Von Pitha and Bigelow have pointed out, of the ilio-femoral ligament in determining the characters of hip-joint dislocations, and that without a knowledge of this ligament we cannot understand the modes of their reduction by manipulation. But they also prove that more than the ilio-femoral portion of the capsule remains untorn; that, in fact, all the strong part of the capsule is uninjured, even when the rent extends along the back of it as high as the digital fossa. That this may be so will at once appear evident if the direction of the ischio-femoral fibres, which pass obliquely upwards and outwards to the upper border of the neck of the femur, is borne in mind. I cannot, however, agree with Bigelow in thinking that the obturator internus is either specially or "materially concerned in one variety of hip-joint dislocation." To say that the head of the femur when displaced towards the sciatic notch is below the tendon, but if on to the middle of the dorsum ilii is above it, is apt to convey an entirely wrong impression; while it affords no explanation whatever of the difference in the dislocations in question, or of their mode of occurrence.

It is not necessary, as I have proved, that the internal obturator should be ruptured in order to get a dislocation with all the appearances ascribed to the dorsal; and on the other hand, Bigelow's own drawing of a sciatic dislocation, or, as he calls it, "dorsal dislocation below the tendon," shows the head of the femur so clearly above the upper border of that muscle that it is a perversion of terms to describe it as a dislocation below the obturator internus. It is a dislocation above the tendon so far as the new position of the head of the bone is concerned, but it is, like all the other ordinary dislocations, below the tendon as regards the point of exit of the head of the femur from the acetabulum. If the acetabulum were fractured and the femur displaced directly on to the dorsum ilii, the tendon of the obturator internus muscle would not be necessary to support it there; the untorn part of the capsule and the upward pull of the muscles

would be quite sufficient for the purpose. But even muscular action is not required, for in the experiments on the dead subject and with all the posterior muscles cut, there was no tendency for the bone to slip from the dorsum into the sciatic notch. If, on the other hand, the head of the bone escapes at the lower part of the acetabulum, and reaches the dorsum by ploughing its way around the margin of that cavity, it may either tear through the obturator internus and gemelli, or mount over them, and in doing so drag up the obturator tendon.

The obturator, though it cannot prevent the head from rising above it, may undoubtedly oppose its further ascent on to the highest part of the dorsum, but so does the untorn part of the capsule, and the sciatic nerve may offer more effectual resistance to the upward passage of the femur than any of the small muscles at the back of the joint. I have seen the nerve not only checking the progress of the bone while these muscles were intact, but after they were all divided, so that the head of the femur could not be made to reach the dorsum ilii by employing any ordinary amount of violence.

What determines whether in any particular instance the dislocation shall be dorsal or ischiatic is *the degree of flexion and inward rotation* existing at the time of the accident or produced by the violence which dislocates the bone. If the *flexion and inward rotation* be *extreme*, the bone will plough its way more directly backwards, and less upwards, around the rim of the acetabulum, and *sciatic* dislocation will be the result. Similarly in the forward luxations, if *extension is associated with extreme outward rotation* the head of the femur will be thrown on to the symphysis pubis, whereas, if there is less rotation and more extension—hypertension, in fact—the femoral head will be drawn on to the upper border of the pubis. In the posterior dislocations the trunk is bent upon the thigh at the moment of luxation; rotation inwards gives the posterior direction to the head of the femur, while the extensors of the hip and the hamstrings

carry it backwards, and are assisted by the adductors in pulling it upwards towards the sciatic notch or dorsum ilii.

In the anterior dislocations the femur leaves the acetabulum during extension, rotation outwards gives the anterior direction to the head, while the ilio-femoral ligament, the ilio-psoas muscle, the tensor fasciæ, and the adductors, draw the bone upwards in front of the pubis.

Besides the *à priori* proofs of anatomy, and the results of experiments on the dead body, the nature of the accidents which cause dislocations of the hip, when carefully inquired into, support the view that they all occur when the thigh is *abducted*.

Dislocations, unlike fractures, arise from violence which strains by twisting rather than by direct force, hence the frequency of luxations of ball-and-socket joints. Almost every injury to a joint is accompanied by some twisting movement of the body upon the limb, or of the limb upon the body, produced either by the violence itself, or instinctively by the injured person.

Some of the positions of the body when such twists would act on the *abducted* thigh are the following: the limb advanced as in walking, running, or pushing; the extended attitudes of fencing and boxing; mounting a ladder, climbing a wall; kicking high; standing on one leg, with the other foot raised on a chair and the body inclined over the bent knee; sitting with knees apart as when one leg is thrown over the arm of an easy chair; sitting with one foot resting on the opposite thigh; stooping with the legs wide apart; crouching in the half-sitting half-kneeling posture; riding on horseback, when the horse falls, or, if he rears and comes over with the rider; the sudden turning of the body by a heavy crane; striking out while swimming; striding from one steamboat to another just as they are "yawning" apart. That these and such like have been the positions in which dorsal as well as other dislocations have happened the reports of many cases show; yet while it is universally

admitted that the forward dislocations occur during *abduction*, the posterior are always stated to happen during *adduction*. I feel sure, however, that it will be found, on carefully inquiring as to, and interpreting the description given of, the accidents which produce dorsal dislocations, that the thigh was *abducted* at the time. Since making the foregoing experiments, a case of dorsal dislocation has come under my care which justifies this statement, and is worthy of notice on account of the age of the patient. An intelligent boy of 7 years was admitted into the Middlesex Hospital on December 20th, 1876, with dorsal dislocation of the right thigh, and one and a half inch shortening of the right extremity. He was at once placed under chloroform and reduction was attempted, but without success, by the house-surgeon. On my arrival I was told that *nothing could be made out as to the position of the limb at the time of the accident*, but on questioning the boy I ascertained the following account. He was walking along Union Street on the right hand side, and was in the act of crossing over to the left. When his left foot was in the roadway and the right on the curbstone, the right slipped backwards from under him; he then fell upon the front of his right knee with his body inclined forwards and to the right side, so that he struck the ground with his right arm.

Interpreted, this means that while his legs were abducted (in the act of walking) the right became forcibly more abducted by his foot slipping, and this caused the dislocation; then, as the pelvis was already rolled backwards on the right side (which corresponds to inward rotation of the right thigh) in the act of walking, and as moderate flexion and a little more inward rotation was produced by the inclination of the trunk, the *dorsal* direction was given to the head of the bone.

The age of the patient makes the case a rare one. Mr. Holthouse in Holmes' 'System of Surgery,' states that only one out of fifty-one dislocations at the hip-joint happened in a person under ten years; Bryant refers to

one case, the youngest of fifty-four, in a child of six years ; and Erichsen, who remarks that "in children dislocation is rare, as the shaft will generally give way," gives one case of dorsal dislocation, in a boy of six years old. Sir Astley Cooper mentions one case in a girl of seven ; Mr. Powdrell reports a case of obturator displacement in a child six months old, in the 'Lancet' of May 16th, 1868 ; Hamilton refers to nine others below the age of eight years, which he had collected from various sources ; and Fayrer states that two out of twelve cases which came under his care in Calcutta were in children six years old, one a male and one a female. Reduction in my own case was effected by flexing the leg on the thigh, and the thigh on the pubis, circumducting outwards, then rotating outwards and bringing the ham at the same time down upon the table. As soon as the limb was rotated outwards the head returned with a very audible noise.

Finally, the great success which attends the methods of reducing by manipulation supports the idea that all dislocations occur during *abduction*, or what is the same thing differently stated, that the head of the bone escaped through the *lower part* of the capsule. In posterior dislocations, after flexing the thigh, the plan is to circumduct outwards, and rotate outwards ; and in anterior dislocations, after flexing the thigh, to abduct slightly and circumduct and rotate inwards strongly ; that is, in each set of cases reduction is effected, after first abducting the thigh, by rotating the head of the femur in the opposite direction to that in which it was rotated during dislocation, and in all cases the leg is flexed to relax the hamstring muscles and sciatic nerve. In this way the head of the bone is brought below the acetabulum and rotated back again into that cavity, not simply on the side where the acetabular margin is less prominent, *but where, also, a passage exists through the capsular ligament.*

If the adducted thigh had been displaced directly through an opening in the back of the capsule the

manipulation so successful in dorsal dislocations would be difficult and destructive; more of the capsule, and the small rotator muscles, including the quadratus femoris, would have to be broken down before the head could be guided round the acetabular rim to the cotyloid notch, while the conversion of a dorsal or sciatic into a thyroïd or pubic dislocation, often described as having happened without force, could not be effected without still further violence. Certainly, in such a case, the rule laid down by Hamilton for reducing by manipulation, viz., "to carry the limb, in the first trial, in those directions only in which it is found to move easily," could not be carried out by the *ordinary method*, for the mere statement of the rule implies that the head of the bone, by following an unimpeded course should be made to retrace the one along which it was displaced. Many of the methods of extension aim at the same object as manipulation, viz. to get the head of the bone below the cotyloid notch, where it will most readily return into its socket, not because the resistance of the rim is there less, but because this is the neighbourhood in which the capsule is torn.

In the experiments above quoted, after pushing the head of the femur through an incision in the upper and back part of the capsule, it was found easy to drag it back again over the rim of the cavity through the same opening in the capsule; so that the resistance offered to reduction by the border of the acetabulum, even at its most prominent part, is not very great. Tedious attempts to reduce dorsal dislocations by extension would seem to contradict this, but they do not actually do so, and for the following reason, that the resistance is due to a different cause. In the posterior dislocations the untorn ischio-femoral part of the capsule lies between the front of the femur and the acetabular margin, and has to be untwisted by manipulation, or torn away by violent extension, before the head of the bone can regain its socket.

Accurate descriptions of the pathology of hip-joint dislocations are much wanted: hitherto it has been seldom

if ever specified which part of the *back of the capsule* has been torn, viz. whether it was the thick acetabular or the thin femoral portion.

The femoral part of the back of the capsule is ruptured whenever the dislocation happens during *abduction*; but if dislocation ever occurs during *adduction* the strong pelvic part of the ligament, which receives the strain of the head of the femur in that position, must either be ruptured or torn away from its attachment, so as to allow of the thigh-bone being displaced *directly* on to the dorsum ilii or behind the acetabulum—an accident which, I believe, is always complicated by fracture at the joint and especially of the rim of the acetabulum.

A case of this sort, in which both the head of the femur and the rim of the acetabulum were fractured, has been described and figured by Mr. Birkett in the fifty-second volume of the 'Medico-Chirurgical Transactions.'

The inferences to be drawn from the preceding remarks may be stated to be the following :

1. That the ilio-femoral ligament is a thickened triangular or fan-shaped area of the capsule of the hip-joint, but not a Y-shaped ligament; nor is it a structure distinct or separate from the rest of the capsule.

2. That the thickened portion of the capsule determines the kind of manipulation necessary for reduction, and that the ilio-femoral ligament especially ought to be relaxed by flexion of the thigh in attempting reduction, either by manipulation or by extension.

3. That the degree of flexion or extension, and of inward or outward rotation of the thigh at the time of luxation; and, subsequently, the bridling of the thick portion of the capsule of the hip-joint, determine the situation of a dislocation.

4. That the anatomical construction of the hip as well as the results of experiments show that dislocations of the thigh, *posterior as well as anterior* (uncomplicated by fracture at the hip-joint), always occur while the limb is in a state of abduction.

5. That the *posterior* dislocations result when flexion and rotation inwards accompany abduction, and the *anterior* when extension with rotation outwards accompany abduction, while the downward or thyroid variety occurs during abduction unaccompanied by rotation.

6. That by the movements of successful manipulation the head of the femur is reduced through the same opening through which it was dislocated, and that the head is thus brought by flexion, abduction, and *reverse* rotation, to this opening, which is at the lower and inner side of the joint.

7. That the new position of the head of the bone in sciatic dislocations, as in dorsal dislocations, is above the obturator internus, although in both varieties the head of the femur leaves the acetabulum through a rupture in the capsule below that muscle, and that for these reasons the division of the posterior dislocations into "dorsal above" and "dorsal below" the obturator internus is misleading, if not invariably incorrect.

8. That dislocation through a "button hole" is *not possible*—owing to the inelasticity of the capsule, and the large size of the head of the femur as compared with the width of the capsule—and that in the reputed cases of impossible reduction on this account the obstacle to reduction has really been either a portion of muscle or of the capsule itself, which has been carried before the head of the femur into the acetabulum; or a fragment of the head of the femur left in the acetabulum.

9. That the rim of the acetabulum of itself offers no real resistance to reduction.

10. That in the exceptional case of a *direct* dorsal dislocation the muscles and untorn capsule would resist reduction by manipulation as usually performed, and that this resistance would be appreciated by the surgeon.

11. That direct dorsal dislocations can only be produced by immense violence and are always associated with fracture of the acetabulum, or of the head of the femur, or of both.

12. That violent pain in dislocations at the hip-joint is caused by the sciatic nerve being pressed upon, or looped up by the femur, and that pain or paralysis after reduction is due to the nerve being dragged forward upon the neck of the femur, or lacerated in the act of reduction.

13. That in reducing such cases it would be well to lift the head of the bone away from the os innominatum, during the movements of flexion and abduction, so as to disengage the bone from the sciatic nerve.

In conclusion, I feel it due to myself to state that the above inquiry was not commenced with a view to publication, but merely to satisfy myself upon certain points, the working out of which, I have been led to hope, may interest others. I wish also to acknowledge my thanks to my friends, Mr. Lyell and Dr. Charnley, for their valuable assistance in the performance of the experiments; and to Mr. F. Steele, for the great trouble he has taken in making the drawings which accompany the paper.

APPENDIX.

July 5th 1877.—I have to offer my thanks to the Council of the Royal Medical and Chirurgical Society, for allowing me the opportunity of strengthening the arguments advanced in the preceding paper on "Dislocations of the Thigh" by publishing, as an appendix thereto, the following case and the accompanying illustrations (see Plate IX).

"Dorsal dislocation of the head of the femur."

Between one and two o'clock in the early morning of June 20th, 1877, a hansom cabman, aged 29 years, was running on the *near* side of his horse, which was "bolting" east-

ward along Oxford Street. The man was endeavouring to stop the horse by tugging at the bit, but the horse, swerving to the near side of the road, got on to the pavement, ran against a shop window, and crushed the man between the cab and the shutters, seven or eight of which were torn down.

A police constable, who saw the accident throughout, and from whom I obtained the above account of it, says that as he approached the spot the man was lying on his back, motionless and groaning, and was dead before he could be taken to the hospital. The dislocation was first noticed in the post-mortem room, and no attempt whatever was made to reduce it previous to dissection.

At 2 p.m. on June 20th, that is, a little more than twelve hours after the accident, Dr. Finlay performed the post-mortem examination and from his report I extracted the following notes :—"There was a moderate degree of rigidity. The body was muscular and well nourished.

"The diaphragm was found to be ruptured in its tendinous part; behind and to the left of the pericardium the rent was transverse, four inches in length, and large enough to admit the hand. The left lung was compressed upwards, and the heart displaced to the right, so that its apex lay just beneath the sternum; the lower part of the left thorax was occupied by the stomach, a portion of the omentum, and about nine inches of the colon. The fourth left rib was fractured just outside its angle, and the seventh, eighth, ninth, and tenth ribs were fractured about two inches further forward. The right lung was adherent to the chest wall and to the diaphragm throughout its whole extent, its substance was engorged and œdematous. The heart was healthy, and contained a little fluid blood; the left ventricle was firmly contracted. The peritoneal cavity contained several ounces of bloody fluid. The spleen was ruptured at its upper part. There was a considerable quantity of blood effused into the loose cellulo-fatty tissue around the left kidney. The kidneys were healthy; the liver large and fatty.

“ The right lower limb presented all the appearances of a dorsal dislocation of the head of the femur. On the outer aspect of the right thigh, about four inches above the knee, was a superficial bruise, extending in an oblique direction from above downwards and across ; it was about six inches in length, and one inch and a half in breadth. There was a similar bruise about five inches below the knee.”

The following is a description of the dislocation as seen upon dissection. For this I am myself responsible. When the gluteus maximus was reflected the head of the bone was found uncovered by its capsular ligament lying behind the acetabulum and between it and the great sciatic foramen. From the os innominatum and the capsular ligament the head was separated by the gemelli, obturator internus, and part of the pyriformis, all of which retained their normal cellular and fibrous connection with the capsule. The gluteal muscles were uninjured.

The quadratus femoris had sustained only slight injury, a few fibres at the upper border alone being lacerated. The obturator externus was not divided, though many of the muscular fibres near their insertion into the tendon were ruptured ; the tendon was tightly stretched over the back of the neck of the femur.

The gemellus inferior was completely ruptured and much contused, and so also were a few of the lower fibres of the obturator internus.

The tendon of the latter was tightly stretched beneath (*i. e.* in front of) the displaced head of femur.

The gemellus superior was ruptured and contused. The pyriformis was considerable damaged, a good half or more of the muscular fibres being divided ; it was chiefly the lower half of the muscles which had suffered, but some few of its upper fibres were also torn.

The sciatic nerve was not involved.

The capsule was ruptured on its lower and inner side, and was cleanly peeled up from off the back of the neck of the femur as far as the digital fossa. The rent commenced

below the pectineo-femoral band, midway between the acetabulum and the femur, and ran (1) outwards and backwards to the neck of the latter, which it reached just above and behind the small trochanter, and (2) inwards and backwards across the thin portion of the capsule towards the acetabulum, which it nearly reached a little behind the ischial border of the cotyloid notch. It thus formed two sides of a large opening, which was made quadrilateral in form by the detachment of the flap from the back of the femoral neck (*vide* Plate IX, fig. 2).

There was a comminuted fracture of the acetabulum, and an oblique fracture of the ramus of the ischium. The fracture through the acetabulum extended along the line of union of the pubis with the ilium, and in addition, a triangular-shaped piece of the floor of the cavity, passing inwards from the cotyloid notch, was quite detached though not displaced.

The cotyloid cartilage, together with the thin adjacent portion of the capsule upon which rests the ilio-psoas muscle was torn away from the pubic portion of the rim.

The direction of the fracture of the ramus of the ischium was obliquely backwards and inwards, immediately in front of the tuberosity. A small quantity of blood was effused along the sartorius and rectus muscles below the level of the great trochanter.

Remarks.—The laceration of the capsule and the mode of occurrence of dorsal dislocations described in the foregoing paper are illustrated completely by this case.

The rent is confined entirely to the thin portion of the capsular ligament. The capsule is torn through at the lower and inner side of the joint, and a loose flap is formed by the peeling off of the thin posterior portion from the back of the cervix femoris, just as I have stated was the case in the dislocations which I experimentally produced in the cadaver.

With regard to the accident I submit the following explanation as being consistent with facts and as probably correct. While running near the head of his horse and

on the *near* or left side of it the man was thrown with violence against the shutters almost at the same moment in which the horse first struck the window. In this way his trunk was jammed between the shutters and the horse, and the left ribs were fractured. At the same time the spleen and the diaphragm were ruptured and blood was effused about the left kidney. The contraction of the muscular fibres of the diaphragm during the few expiring efforts at breathing would have had the effect of opening the rent in the tendon of the diaphragm, and of thus allowing the passage upwards of some of the abdominal viscera during their compression in inspiration. So far the injuries received were all on the left side of the body, but now the horse staggered onwards and drew the left wheel of the cab against the right side of the pelvis and the upper end of the right thigh, and in so doing forced the head of the right femur downwards and inwards through the inner and lower part of the capsule, and at the same time fractured the right side of the pelvis. As the right leg was stretched outwards (*i. e.* abducted) in front of the advancing wheel, the wheel made a partial revolution against the limb and produced the superficial abrasion on the outer aspect of the thigh, which, be it noticed, Dr. Finlay described as "extending in an oblique direction from above, downwards, and across." In the same manner the thigh was pressed forwards and turned inwards, whereby the head of the femur was directed backwards. This done, the wheel next revolved against the right limb below the knee and caused the second bruise referred to in Dr. Finlay's report, and increased the displacement of the limb. Meanwhile the man's trunk was gradually falling backwards as his thigh was being pushed forwards from under him and rotated inwards. Thus, can we at once account for the characters of the dislocation, for the position of abduction during which it occurred, and for the position of the body after the accident.

The dissection suggested some of the difficulties which may attend the efforts at reduction by manipulation.

If the obturator externus be not ruptured by the dislocating force, the tendon of that muscle being tightly stretched over the back of the femoral neck will be likely to act as a strap upon the bone, which must be relaxed by strong rotation outwards before reduction can be obtained.

Again, when the acetabulum is fractured, the want of resistance in the fractured part might make it very difficult to accomplish reduction, more especially when, as in this instance, both pubis and ischium are broken. Though no serious effort was made to reduce the femur, because of the rigor mortis and of the desire to complete the dissection without disturbing the relation of parts, yet from one very gentle attempt I am led to think that the mobility of the fractured bone during manipulation would possibly have interfered with the immediate success of the process. The difficulty, in all probability, would have been overcome by getting an assistant to hold the pelvis firmly between his hands, while the surgeon manipulated the limb.

In conclusion, I should like to emphasize the fact that no attempt whatever had been made at reduction in this case, so that dissection revealed to us the exact condition of things as they were caused by the accident and by it alone. It has been urged against my paper that experiments on the dead subject cannot be made the complete test of the mode of occurrence of dislocations in the living subject, and the justice of this I admit. But the rarity of opportunities of examining dislocations of the thigh as the result of accident, is so great that almost our only means of testing opinion is by experiment. Some idea of this rarity may be conveyed by stating that neither the Hunterian Museum nor the museums of King's College, University College, St. Thomas's, Charing Cross, St. George's, the Westminster, or the London Hospital, contain a single specimen of recent dislocation of the head of the femur, and that the only specimens in all the public museums of the metropolis are *one* at the Middlesex Hospital, *two* at Guy's, and four at St. Bartholomew's.

The specimen of the case here described has been presented to the museum of the College of Surgeons.

I have again to thank Mr. Frank Steele for his drawings, from which the lithographs were taken ; and my colleague, Mr. Nunn, who, being surgeon of the week when the case was brought to the hospital, kindly gave me permission to make what use I desired of the preparation.

DESCRIPTION OF PLATES VIII AND IX.

Dislocations of the Thigh; their mode of occurrence. By HENRY MORRIS, M.A., M.B., F.R.C.S.

PLATE VIII.

- Fig. 1. The capsule ruptured in dislocation. Front.
2. Ditto. Back.
3. Front of capsule, showing (*a*) the ilio-femoral ligament and (*b*) pectineo-femoral ligament.

PLATE IX.

- Fig. 1. Recent case of dorsal dislocation of the head of the femur.
a. Pyriformis. *b*. Obturator externus. *c*. Obturator internus and gemelli, passing beneath head and neck of femur.
Fig. 2. Rupture of capsule in the case of dorsal dislocation.
d. Femur flexed and abducted. *e*. Line of fracture between pubis and ilium. *f*. Symphysis pubis. *g*. Line of fracture of ischium.

Fig. 1.

Fig. 2.

Fig. 3.