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Thesis for the Degree of M.D. Edin.  
1908.

" The Differential Diagnosis of Some Conditions  
of the Hip Joint with a few observations on the  
condition known as Coxa Vara."

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I certify that the following has  
been written by myself without  
any assistance & that it has been  
entirely compiled from cases belonging  
to Mr Robert Jones during the time  
I have been House Surgeon to him



S. Alwyn Smith

✓  
Royal Southern Hospital,  
Liverpool.

30. 3. 08.

The Secretary  
The Senatus Academicus  
University of Edinburgh

Dear Sir

I enclose a thesis for the  
degree of M.D. I wrote to you  
about 10 months ago concerning  
the title, as it is a Surgical  
subject, but was assured  
that the Senate would  
accept it as I had been

doing orthopaedic work with  
Mr Robert Jones.

Tours. Truly

S. Humphreys

"The Differential Diagnosis of Some Conditions of the Hip Joint with a few observations on the condition known as Coxa Vara."

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The hip joint is, by reason of its unique structure and arrangement peculiarly liable to disease and malformation, and by reason of its deep-seated position these conditions produce certain difficulties in diagnosis.

With these difficulties we propose to deal, by comparing and contrasting coxa vara with other conditions simulating it. For the purpose of a brief survey it is necessary to enter into several points of the anatomy of the hip - especially with the ossification of the acetabulum and upper end of the femur and also into the architecture of these bones.

The articulation of the hip is a ball and socket joint formed by the reception of the head of the femur into the cup-shaped cavity of the acetabulum. The articular surfaces are covered by cartilage, that covering the acetabulum being thicker at the circumference than at the centre, and is shaped like a horse-shoe, as it is deficient below where there is a rounded depression which contains a mass of fat which is covered by synovial membrane,. The cartilage covering the

head of the femur is thicker at the centre than at the edges and covers the entire surface except for a depression just below its centre for the ligamentum teres.

The acetabulum is developed from three sources, from the ilium ischium and pubis. Ossification begins in the ilium at the 9th week of foetal life - at the 4th month the centre for the ischium appears, and the centre for the pubis makes its appearance about the 5th or 6th month.

At birth the form of the ilium is well defined - the body and part of the tuberosity of the ischium is ossified, as is also the horizontal ramus and part of the body of the pubis.

All the three parts enter into the formation of the sides of the acetabulum, and at about the 3rd year have converged to form the bottom of that hollow, being separated from each other by a T shaped piece of cartilage, in which about the 12th year, independent ossific centres appear. These centres may or may not become fused with the adjacent bones, the ossification being generally completed at about the 16th or 17th year.

The development of the acetabulum is interesting from the investigation of the causation of congenital hip in which the acetabulum may be shallower than usual, or in some cases may be deficient at its superior or posterior parts, or it may even be somewhat triangular in shape. Developmentally however, there is nothing to which we can attribute the condition.

The shaft of the femur begins to ossify in the second month of foetal life and at birth shows enlargements at each end which are capped with cartilage. A centre for the head appears at the end of the first year and the neck ossifies as a direct extension upwards from the shaft - this extension forming the lower circumference of the articular head: but about the 18th year the separate epiphysis for the head overlaps it and unites with it.

At the 8th month of foetal life the head and neck of the femur together with the great trochanter consist of a single mass of cartilage separated from the shaft by a line of ossification which is nearly transverse and which by its growth adds to the length of the shaft. At birth, this line of ossification has become a little higher and slightly oblique, bone now extending into the lower part of the neck - this alteration becoming more evident during the 1st and 2nd years. The lower half of the neck now consists of bone, the upper half constituting a cartilaginous bridge connecting the head to the great trochanter. It is only when the age of four years is attained that the line of ossification centrally reaches the upper surface of the neck, thus completely separating the original single mass of cartilage into the epiphyses of the head and great trochanter.





AT 2 3/4 YEARS



AT 4 YEARS



AT 5 1/2 YEARS

The epiphysis of the great trochanter unites with the shaft and a neck at the age of 18 or 19, while that for the trochanter minor which as a rule makes its appearance in the 12th or 13th years is completely fused at 18.

The fact that the epiphysis for the head does not join the neck till the 18th year is important, in that it accounts for some if not most of the cases of traumatic coxa vara where the epiphysis as a result of external violence is separated from the articular head and shifted upwards.

The head of the femur as it fits into the acetabulum is pointed upwards, inwards and slightly forwards. The head is supported by the neck, which as a rule forms, with the shaft an angle of  $125^{\circ}$ . Variations of this angle are common, the normal variation being considerable in many cases. The angle in the foetus and infant is greater than the above figure. The angle decreases with adolescence owing to the superincumbent body weight pressing upon the neck. Vertically the neck is broader than it is antero-laterally. It is constricted at its middle and it expands internally to join the head, while externally where it joins the shaft, its vertical diameter is much increased.

Architecturally, the osinnommatum and the femurs are both strengthened in various places to withstand the great strain put upon them. The osinnomatium is greatly thickened and the cellular tissue is more compact round the ilio pectineal line and the floor of the iliac fossa. This is to preserve in the line of pressure the strength of the bone, and the same features are also noticed in the structure of the head and neck of the femur. The arrangement of the cancellous tissue at the upper end of the femur is interesting in that it shows the strength of the neck to be almost entirely due to its formation.

The compact tissue which is so thick in the shaft gradually thins as it merges to the head and neck. The cancellous tissue which in the shaft is loose and very porous changes its character at the upper part of the femur.

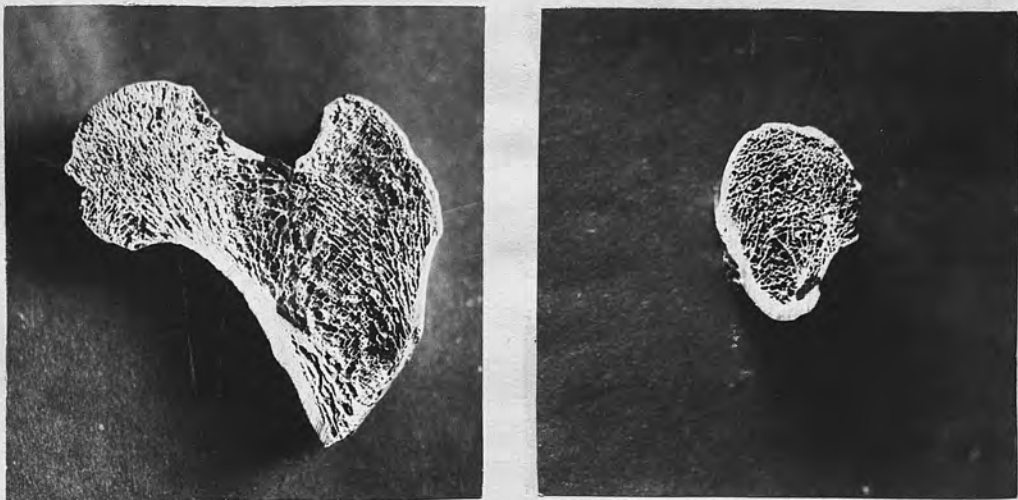
It has been shown by Merkel that the trabeculae of the cancellous tissue are arranged in two sets each of which has a different action. One set spring from the inner side of the compact tissue internally, about the level of the upper and middle thirds of the femur. These are called the pressure lamellae and they ascend radiating inwards to the head and outwards to the great trochanter and as a rule those passing to the head are very dense.

These Pressure lamellae are crossed at right angles by the other set of striae which arise from the



corresponding portion of the compact tissue on the external side,- these are termed the Tension lamellae and they arch upwards and inwards to the head and inner side of the neck. The tension lamellae are denser on the uppermost part of the neck and they here form the so-called "tension Bow".

The concave undersurface of the neck is further strengthened by a nearly vertical plate of compact bone called the calcar femorale. This arises from the inner surface of the inner side of the neck just in front of, and above, the trochanter minor.



The photographs of sections of the normal femur show the arrangement of the lamellae in longitudinal and transverse section - the latter are also showing the calcar femorale.

The disposition and arrangement of the lamellae is described by Quian as being like that of the lattice work of a Gothic window, as the tension and pressure striae cross one another at right angles. Von Meyer has called attention to the fact that the trabeculae

of the upper end of the femur bear a striking resemblance to the trajectories in the graphostatic diagram of the Fairburn crane as drawn by the mathematician Culmann. This analogy makes clear the use of the tension trabeculae forming the tension bow - proving them to be mathematically arranged to the best advantage for sustaining the body weight. Any further calculations to prove the simile, regarding the weight resisting properties of the neck of the femur, are considered nearly impossible. This is because, in the calculations mentioned, the great trochanter is not included, nor can it be so without altering the analogy.

Other factors which cannot be determined are the variations of strength and consistency of the spongiosa of the femur.

However, in the calculations which Culmann worked out for Von Meyer, he proved that with the weight of 30 kilograms, which he took as the approximate body weight, the diagram of the crane, worked out to scale, bore a striking resemblance to the normal femur.

The angle of the crane best suited for the load was about the angle the neck makes with the shaft in a normal femur.

The ligaments of the hip joint are five in number, of which the most important is the Capsular. This ligament is a strong capsule which embraces the

margin of the acetabulum above and the neck of the femur below. The capsule is strongest at the upper and anterior part of the joint, where the greatest amount of resistance is needed, and it is here strengthened by the ilio femoral ligament or Y shaped ligament of Bigelow which is an accessory band of longitudinal fibres running obliquely in part of the joint.

#### COXA VARA.

Coxa Vara is a term applied to that deformity of the upper end of the femur, by which the normal angle formed by the neck and shaft of the bone is lessened. The normal angle varies considerably and can range from about  $10^{\circ}$  to  $140^{\circ}$  in a healthy femur.

The condition, as a distinct deformity, has only been recognised as such in recent years. Cases were reported as early as 1843 by Roser and later by Zeis, Richardson and Monks, but it was only in 1881 that Fiorani first described it as a distinct condition from morbus coxae.

Hofmeister claims the credit for its nomenclature as also does Kocher. Keetley described a case in 1888 in which he recognised the condition as a softening of bone of the neck of the femur. He

removed a wedge from the trochanteric region and abducted the limb - the deformity being much reduced and the condition relieved. It was first, however, thoroughly described clinically by Muller in 1889 when he reported four cases of the adolescent type, proving the condition to be entirely separate from hip disease.

There are various forms of disease, it has on rare occasions been found congenitally, sometimes it is found in early childhood, but more generally in late childhood. The latter constitutes the adolescent type and this as a rule is found to occur between the ages of 12 and 17, but more usually about the age of 14 or 15. From time to time theories have been set forth to explain the causation, but several of them are only applicable to one or other of the types of the disease to which they refer.

#### 1. Congenital Theory.-

States that the condition is due to malformation in utero. This applies only to the very rare cases of the congenital type.

The only position which might cause the condition as far as one can make out, is, that when the foetus lies in utero, the thigh on the affected side is not only flexed on the abdomen and crossed over the other flexed thigh, but it is adducted more than the other one. This adduction would tend to strain the

neck and the lines of tension and the whole thigh would be pressed upwards from the uterine wall contracting against the knee in a delayed second stage of labour. This however, is highly problematical.

2. Pathological theory.-

Some writers consider that the condition is caused by a local disease in the neck of the femur such as osteomalacia, osteomyelitis, rickets, osteitis deformans &c and that as the result of the weakness condition any increase in weight it is required to carry results in the bending of the neck.

3. Static theory.-

is one of structural weakness. In some cases there is said to be an inherited delicacy in the structure of the support without any organic lesion in the bone. This theory refers to the type of small boned children who have 'outgrown their strength'.

4. Inherent Weakness Theory.-

States that the deformity is due to overburdening and that it is sometimes associated with rickets, infantile or adolescent, but that sometimes the rickety element is absent.

5. Traumatic Theory.-

This form is shown in those cases where the deformity is caused by a diastasis, this occurring in the epiphysis between the head and the neck. Some

authorities hold that all types of the condition may be explained by a slipping of the epiphysis, either due to some pathological condition of the bone which favors this occurring or that it may be always due to injury. More rarely it is due to a fracture through the neck itself.

6. Anatomical Theory.-

This theory was first propounded by Sudeck. It depends on the formation and development of the bony lamellae at the upper end of the femur. The development of these lamellae and of the *calcar femorale* has already been described. Sudeck holds that if any excessive force is brought to bear upon the neck of the femur - that is to say - upon the 'tension bow' at the upper part of the neck, the neck must bend with its convexity upwards.

Likewise any disease or condition of the bone, local or general, which weakens the neck will also cause the same deformity.

The usual deformity of the neck in this condition is downwards and backwards, but it is only the downward deformity we can attribute to the stretching and consequent bending of the 'tension bow.'

The backward deformity is due to downward pressure, the bone giving in the line of least resistance. The centre of gravity passes through the centre of the

acetabulum, with the patient standing at attention, and as the line of the neck is outwards downwards and backwards from this point, it follows that the bone bends away from the line of pressure there is on the other hand a bending of the neck with its concavity upwards, but this type is not so common. In others the neck remains unbent but its angle with the shaft of the femur is more or less reduced, as is seen in senile coxa vara due to osteo arthritis. All these variations tend to show some slight discrepancy in Sudecks theory.

The theory however, does conclusively show the reason of the bending of the neck in those cases where the convexity is upwards. The other variations must be discussed on their merits and it is probable that they can all be explained by excess of superincumbent body weight following on a sprained epiphysis.

#### Pathology.-

Some authorities hold that the term coxa vara should not be applied to those cases of depression of the femoral neck occurring as secondary results of destructive disease, such as epiphysitis, arthritis deformans, osteomalacia &c, but should only be applied to those cases where there is a purely local deformity. Other writers state, on the other hand, that these

diseases are etiological factors of the condition.

In most instances the condition attacks the neck as a whole and to this class of case the term 'cervical coxa vara' is given.

In other cases mainly traumatic the change is at the epiphyseal junction between the head and neck. As before mentioned this epiphysis begins to unite at the 18th year, so it is usually in cases where there is a history of trauma or strain in children up to this age that this type of epiphyseal coxa vara, as it is termed, is found.

For the pathology of all types of coxa vara we have to trust almost entirely to radiographic evidence,. It is only in a very limited number of cases that microscopic evidence has been used.

There are two cases on record where the histological sections have been made. In both cases the head of the femur was resected - in one instance by Hoffa and in the other by Robert Jones for complete disability due to infantile coxa vara, a pseudarthrosis being performed. The slide from the latter case has been kindly placed at my disposal and I introduce a microphotograph of the decalcified section.





(Description) The chief features are the extreme irregularity of the bony laminae and the great excess of fibrillated tissue, traversed by large dilated vessel constituting the medulla. There is no evidence of any rapid absorption process, such as the presence of an abundance of Howship's lacunae - there is no round-celled infiltration around the walls of the vessels. No granular change is evident, excluding tubercle and syphilis. There is no epiphyseal cartilage present, but from the general aspects of the cancellous tissue, we think that the changes may be due to an old ricketty lesion.

It is perhaps advisable not to follow too closely nor to pay too much attention to the histological features of coxa vara, as it is proved by the various German monographs that have been written on the pathology of the condition that the microscopic appearances are very contradictory and confusing. It is probable that the appearances may be explained

as the result of the deformity and have nothing to do with its causation, as has been pointed out by Mr. Elmslie in his Erasmus Wilson Lecture on coxa vara.

The etiology of coxa vara has raised great controversy amongst the authorities on the condition.

Some, including Hoffa, Robert Jones, Bradford and Lovett seem to be of opinion that the cause is either infantile or adolescent rickets, producing infantile or adolescent coxa vara.

Others, including Hofmeister and Whitman refute this view.

Hofmeister is of opinion that the two varieties are quite separate and calls the infantile type 'coxa vara adducta' or 'coxa vara gesunder kinder' or the coxa vara of healthy children.

He considers that these cases are due to displacement of the epiphysis between the head and neck which occurs at an early age. This displacement occurs when the head is only connected to the shaft by an osseo-cartilaginous bridge. As will be seen by the previous diagrams this cartilage remains until the age of five years. If this be the case the head may be displaced downwards and the lower part of the separated fragment, which is osseous, will be retained in position by its periosteal covering, while in the upper portion a V shaped gap will occur, owing to the parting of the cartilaginous portion of the neck.

This displacement it is stated may be due to injury or as the result of deficient ossification due to rickets, but it is not considered a rachitic deformity.

Some authorities state that the adolescent type is only due to a slipping of the epiphysis of the head, the lesion being situated close on the neck side of the epiphyseal line.

In the majority of cases this is due to some slight injury, often undetected, but in a small minority of cases, especially in the bilateral type, which in itself is very rare, there is supposed to be some defective ossification at the epiphyseal line. From the cases I have seen I cannot but think that rickets does play a most important part in the causation of both the infantile and adolescent varieties. To the radiographs of all cases of coxa vara we must turn for the investigation of the pathology and this varies with the type with which we have to deal.

In the cervical cases of any severity we find that there is an increased radiability of the femoral neck.

The lamellae in the convexity at the upper part of the neck appear thin and far apart and the whole part of the bone involved appears to be lacking in lime salts and to be undergoing an osteoporosis.

In the X-ray print of a case of this kind, evidently due to delayed rickets this state of affairs is seen. The patient in point is still under my care and from a thorough investigation there was no history

of rickets obtainable up to the onset of the first symptoms three years ago.

The patient is now 16 years old and since he has been in hospital under operative treatment, the epiphyses of the radius and ulna at the wrists, tibiae at the ankles and femora at the knees have all enlarged. The boy, though suffering from slight genu valgum on admission, is now much worse although he has not been out of bed. This according to Mr. Jones is a typical case of adolescent or delayed rickets.



A

In old standing cases of this type, the bone undergoes change as in all rachitic conditions, becoming hard and sclerosed and the X-ray shows a much deeper shadow than it would do at an earlier stage. (A & B)



B

The epiphyseal type shows a very different state of affairs pathologically.

There is nearly always a history of strain followed by a varying period, sometimes weeks, sometimes months in which there is no inconvenience felt. After this lameness and discomfort come on till there may be complete disability.

This is due to the fact that the slight strain has weakened the upper part of the epiphysis between the head and neck and this begins to separate. The separation begins as a solution of continuity at the upper border of the neck and at first may appear as a slight crack in the radiograph. As time goes on the separation enlarges owing to the continual pounding of the bone while walking and the consequent increase of cross strain. The gap increases until it becomes a V shaped infraction on the plate.

A softening of the bone surrounding the infraction occurs and this softening sometimes extends right away to the trochanter. Whether this osteitis is due to the initial injury or to the altered condition of the epiphysis is difficult to say. The softening continues as the separation enlarges and at this time there is a throwing out of fresh bone material all along the upper portion of the neck and this may cause the upper edge of the neck to appear quite convex. With suitable treatment the separation will close up

but as a rule the neck is carried upwards a little so that in time the X-ray appearance is quite like that of a case of cervical coxa vara.



If the case be seen early enough the beginning of the separation can be made out.

A case which came under the care of Mr. Jones gave the following history.-

A boy of 16 slipped on a piece of orange peel and his left leg went from under him, but he did not fall. The hip was painful at the time but was all right the next day and for some days he felt nothing but a little stiffness, but as he thought he had injured himself he came to hospital where he was X-rayed.

A small crack was seen at the upper end of the epiphysis between the head and neck and so the patient was told to walk on it and came again in a week when he was again X-rayed.

The second X-ray showed the crack to have

increased and the edges to have separated more widely. The patient was kept in bed for some weeks and then walked in a suitable support and the radiograph then taken showed the separation quite closed up. Since then there have been no recurrent symptoms.

Besides the changes in the bone described there may be prearticular adaptive changes in the soft parts.

#### Classification.-

The best classification is one which divides the condition at the outset into congenital and acquired traumatic and non traumatic.

It is now established without doubt that congenital coxa vara does exist and in all 7 cases are on record, - Kredel describing the first case in 1896. It has never been my fortune to see an undoubted case of this type but I have seen cases which probably are authentic. One a child with a congenital hip on one side and a coxa vara on the other who had never walked when the skiogram was taken. Another case in a girl of 7 shows congenital dislocation and coxa vara in the same hip. The latter case may have been an acquired one but it is quite probably congenital



I append the following classification

Coxa Vara.

1 Congenital

2 Acquired

- |             |                |   |                                 |
|-------------|----------------|---|---------------------------------|
|             |                |   | (a Infantile                    |
|             |                | (1. Rachitic                                | (                               |
|             |                | (   | )b Adolescent                   |
|             | (Non traumatic |   |                                 |
|             | (              |   | (a. Due to static condition     |
|             | (              | (2. Nonrachitic                             | (                               |
| 2. Acquired | (              |   | (b. Due to destructive disease, |
|             | (              |   |                                 |
|             | (Traumatic     | (1. epiphyseal                              |                                 |
|             | (              | (2. Non epiphyseal - fractures of neck &c., |                                 |

Symptoms.

The character of the symptoms may be explained by the distortion of the neck and its effect upon the joint. When the neck is depressed the trochanter is elevated a corresponding distance above Nelatons line and it is most noticeable as a large projection which is more obvious than in the normal hip. This projection becomes even more marked when the limb



is flexed, adducted and rotated inwards.

As has been before stated, the neck is as a rule bent backwards and downwards causing the centre of the convexity to look forwards and upwards so, as the head remains in the acetabulum, the trochanter is thrown backwards and the limb is rotated outwards,.

The pelvis is tilted upwards on the affected side and there is slight flexion of the thigh which accentuates the deformity. The ability to abduct the thigh depends upon the length and upward inclination of the neck of the femur and when this angle is decreased abduction is lessened. This limitation in abduction is due in part to the tension exerted on the lower part of the capsule, in part to the direct contact of the neck and great trochanter with the rim of the acetabulum, and partly to general adaptive contractions which always accompany displacements of this character.

The distortion of the neck downwards and backwards changes the relationship of the acetabulum to the head so that either abduction or flexion tend to displace the head from its socket.

As a rule it will be seen that the range of movement of abduction, flexion and internal rotation are limited and that external rotation may be apparently increased. It is obvious that all these physical signs vary according to the deformity which the neck has undergone, - thus if there is no backward dis-

placement the relationships of the neck and acetabulum rim are normal regarding inversion and eversion of the thigh. The systems usually come on insidiously especially in the cervical variety and in the epiphyseal type where there is gradual yielding of the epiphysis there may be a period of many months before symptoms begin to get severe.

As a rule the patient begins to walk slightly lame to begin with, and this lameness is accompanied by a feeling of awkwardness and distrust of the affected hip. There is stiffness and pain which becomes worse if exercise has been taken such as walking for some time or prolonged standing. The enlargement of the great trochanter begins to become more apparent about this period. The limb as a whole becomes slightly atrophied through disuse.

Some cases, and they are comparatively few in number, exhibit the depression of the neck directly downwards or even downwards and forwards. The reason of this is hard to explain but the type is said to undoubtedly occur.

There is the same limitation in abduction as there is in the common type but internal rotation replaces external rotation and extension is limited instead of flexion. This type is as a rule bilateral. It is accompanied generally by some degree of permanent

flexion of the hips and the lumbar lordosis is increased.

Coxa Vara is more often unilateral than bilateral and more than 75° of all cases occur in males. In 109 cases collected from literature quoted from Whitman 83 were males, 26 females and 85 were unilateral and 24 bilateral.

The bilateral cases clinically present no difficulty as regards diagnosis.

On account of the inability to abduct the thighs the patient crosses one leg over the other when walking, assuming the so called 'Scissors Gait'. In cases of this nature the deformity may be downwards or occasionally downwards and forwards, so that the patient cannot kneel unless the legs are crossed and for the same reason, sitting on a stool is impossible and stooping to pick up anything on the floor without bending the knees is difficult.

This is easily shown by our voluntarily limiting abduction and rotating the hips outwards and then bending forwards keeping the knees extended. We find that standing in this way it is a difficult matter to touch the floor, and then it is due to mobility of the spine.

Fracture through the neck of the femur in children does occasionally occur, despite the fact that it has

been denied in various standard works.

Whitman has collected twenty cases which are on record.

The symptoms produced differ considerably from the same injury in the adult and the disability produced is of far less severity.

The condition is nearly always produced by a fall from a height and in many cases the child can walk about within a few days of the injury.

It is probable that there is a bending and breaking of the neck without actual separation of the fragments. During the period of repair it may be mistaken for morbus caroe.

There is shortening of the limb and restriction of movement is noticed in flexion internal rotation and abduction due to the contraction of muscles.

The deformity tends to increase in later years. Fracture through the neck in the adult is very common and complete disability follows.

The symptoms are well known and I only append the notes and radiographs of the following case because of their similarity to other conditions and the fact that traumatic coxa vara is produced.

The division of this fracture into extra and intra capsular is incorrect.

Annie Madden. X-ray. Abducted; extended; calliper.

SEE NEXT PAGE



↑  
ANNIE MADDEN

### Diagnosis.-

The diagnosis of coxa vara is in a good many cases not fraught with difficulty, but there are many cases of hip joint trouble which are not easy from the point of view of differential diagnosis.

The X-ray is absolutely indispensable in work of this kind and one may say that it is only since 1896 when Roentgen made his famous discovery that definite diagnosis have been able to be made in obscure cases of derangement of the hip joint.

In examining a patient complaining of hip trouble it is necessary to proceed with the investigation in a certain routine manner, otherwise various salient points are most certainly liable to be overlooked. To begin with it is well to always have the patient stripped and as a preparatory measure to watch him walk if he is able to do so, as various hints may be gathered from the gait and posture,. It is necessary to examine the back thoroughly to exclude spondilitis in all its forms, scoliosis and sacroiliac disease, all of which conditions may simulate hip trouble, especially the latter, but cases illustrating all these conditions will be discussed in their turn.

The posture, contour and gait having been noted, it is well to see if the gluteal fold of the

affected side is raised, lowered or effaced.

The family history, mode of onset and symptoms must be most carefully taken down and after this is done, the patient must be stripped and placed upon his back on a couch or bed.

The movements of the affected hip must be compared and contrasted with the normal one and the cause of limitation of movement discovered. If there is movement in the hips it is necessary to find out if the limitation is due to reflex spasm of muscle or to blocking of the joint by the apposition of one to another of its bony components. If ankylosis is present by palpation one discovers its nature, whether bony or fibrous.

The relationship of the top of the great trochanter to Nelaton's line is the next fact to be ascertained in the examination.

The patient is laid on his sound side and the ischial tuberosity of the affected side is found and one end of a string or tape measure is put on the skin of the buttock over its position - the tape is now carried to the anterior superior spine of the ilium of the same side in a direct line i.e. as the crow flies. The top of the great trochanter should be in this line. The relationship of the hip of the of the great trochanter to Nelaton's line has great bearing on the differential diagnosis of conditions of the hip, as

will be shown later.

When the above facts have been gathered one applies the Thomas flexion test to discover the angle of flexion deformity in the affected hip.

The sound limb is gently flexed (the patient remaining supine) till the thigh is touching the abdomen and all lordosis of the spine disappears. It is here necessary to keep the pelvis fixed to prevent any rocking on its part due to flexion of the lower lumbar vertebrae.

When the sound limb is flexed on to the abdomen it will be noticed that the affected thigh becomes flexed to a varying angle. The resultant angle that the diseased hip makes with the horizontal plane is called the angle of flexion.

The angle of flexion may be estimated by carrying a line from the table along the long axis of the femur, not of the lower limb as a whole, for any convenient distance. A perpendicular is now dropped to the horizontal plane of the table and its measurement taken. The decimal formed by the division of the perpendicular by the arbitrary length chosen, constitutes the sine of the angle of flexion. This angle can be readily obtained by consulting any mathematical table of sines. The angles of abduction or adduction must now be obtained, with observations regarding any obliquity of the pelvis.



The first measurement taken is from the anterior superior spine of the ilium to the internal malleolus of the same side, the limb being in the fully extended position - this is called the 'real' measurement and is graphically expressed by R.

The limb being in the same position, the second measurement is from the umbilicus to each internal malleolus and this is termed the 'apparent' measurement and expressed by A.

It is from the relationship of the actual to the apparent shortening that enables us to calculate the degree of abduction and similarly from the relation of the true measurement to the false lengthening that the degree of abduction is expressed.

A limb may be really shortened but by being abducted it may be apparently lengthened. Practical or apparent shortening is due to adduction or flexion or both. The distance between the anterior superior spines of the ilia is next taken and the degree of adduction or abduction can then be estimated by a table which Lovett of Boston has propounded upon mathematical lines.

If the practical shortening is greater than the real shortening the limb is adducted, if less than the real shortening it is abducted.

To quote measurements of a case.-

B.M.	L.R.	$30\frac{1}{4}$ ins.	R.R.	$30\frac{1}{2}$ ins
	L.A.	$31\frac{1}{2}$ ins.	R.A.	35 ins.
		A S S to A S S	10 ins.	

Real shortening  $\frac{1}{4}$  inch. Apparent shortening  $3\frac{1}{2}$  ins.  
 The difference is  $3\frac{1}{4}$  ins and by the table we find  
 $19^{\circ}$  of adduction. As in the case of adults, infants  
 must be examined in a routine manner. It is advisable  
 to lay the child on its back and the flexion test hav-  
 ing been used, to hold a flexed knee in each hand and  
 invert and evert each hip simultaneously to discover  
 if there is reflex muscular spasm present. This is  
 necessary as it is often found that the mother will  
 state that the diseased hip is the normal one and vice  
 versa.

If the movements of both hips are free and **morbus**  
 coxae has thus been eliminated it is necessary to find  
 out the relationship of the great trochanter to Nel-  
 son's line and should it be found to be raised above the  
 line one must differentiate between congenital disloca-  
 tion and coxa vara. The latter diagnosis is made by  
 feeling for the head of the bone on the dorsum ilii.

The routine examination as described is very  
 necessary as is also a careful observation of the X-ray  
 which should always be taken when practicable as it  
 will clear up any difficulties encountered in the  
 diagnosis. In small children an anaesthetic is

usually administered to ensure the production of a good negative. The main conditions from which coxa vara in all its forms must be differentiated are morbus coxae, lumbar spondylitis sacroiliac disease, hysterical hip, congenital dislocation, pathological dislocation, traumatic dislocation and fracture of the femoral neck. Perhaps the conditions which simulate it most closely are morbus coxae, congenital dislocation and fracture of the femoral neck. The differential diagnosis of cervical and epiphyseal coxa vara is usually made by means of the radiograph.

The causes of hip disease are tuberculosis acquired or inherited, inherited syphilis, injury from blows, falls, or strains, from the infectious diseases of childhood and other various causes which lead to chronic inflammation in and about joints.

Whatever the initial infection may be, the condition presents ultimately the characteristic symptoms of tuberculous arthritis and for all practical purposes may be regarded as such, although from the history and clinical signs we can sometimes differentiate the nature of the infection.

As a rule the primary location of the pathological lesion cannot be determined, but symptoms of chronic synovitis, supposing the primary focus to be in the synovial membrane are so obscure that no diagnosis can ever be made until the bone is involved through the

destruction of the cotyloid ligament.

When the condition begins as an osteitis it is not possible to say whether the head, neck or great trochanter is first infected or whether the condition is articular or periarticular.

The condition of morbus coxae almost invariably begins with a limp. This comes on before there is any pain or other symptom. The limp is due to the inability of the patient to extend the thigh more than to any sensitiveness of the joint to weight bearing although naturally when the condition is more advanced there is great pain on direct pressure on the joint. The limp is one of impaired function and is quite characteristic, coxa vara begins also with a limp but not of the same nature.

A patient with an early tubercular hip walks with both hip and knee slightly flexed and seems to bend forwards at the waist. The coxa vara patient on the other hand walks erect unless there are complications of the condition and one leg is obviously shorter than the other. The limp too in coxa vara gets more marked when more walking has been done or for some little time on the resumption of walking after a period of rest. These variations are not applicable to the limp of morbus coxae.

In tubercular disease the patient as a rule early in the condition becomes restless and cries in his sleep or without being fully awake. These night cries are characteristic and consist of a sharp sudden frightened scream and they generally come on early in the condition -and as a rule precede and invariably accompany periods of pain in the day time.

These night cries never occur in coxa vara and although they are presumably indications of osteitis, in epiphyseal coxa vara, there is often concomitant epiphysitis, so it is probable that the phenomena is due to the formation of pus in or around the joint. the same beginning rapidly and under tension (Jones & Ridlon). Pain may or may not occur in hip disease, but as a rule it does make itself known although I have seen two or three cases where there is much destruction of bone to be seen in the X-ray photograph and clinically 30° of flexion, with much muscular spasm, where there was not and never had been any pain felt. When pain is present it is usually referred to the inner side of the anterior surface of the knee by means of the geniculate branch of the obturator nerve, although there may be pain in the hip or groin as well.

The pain in coxa vara when present usually occurs in the groin about the middle of Poupart's ligament and in the adductor region due to spasm and

is generally indicative of an epiphyseal case and means that there is congestion round the epiphysis when it is or has been yielding.

Night cries never by any means occur in the latter condition and so they are suggestive of morbus coxae. The great symptom of morbus coxae is the flexion deformity which is as a rule associated with adduction and internal rotation or with abduction and external rotation. The latter deformity is not necessary, and I have seen cases exhibiting purely flexion. Abduction as a rule comes on early in the disease if it is present and it has been said to be caused by an effusion into the joint, but this is doubtful. It is quite an arbitrary and somewhat erroneous classification that flexion and abduction precede flexion and adduction. In the majority of cases I have seen adduction comes on early combined with the flexion and abduction does not occur. However I have seen one case of two years standing untreated, where there was ankylosis with the limb widely abducted.

Adduction usually appears when the flexion deformity has progressed so far as  $25^{\circ}$  to  $40^{\circ}$ . It gives the affected limb false shortening and makes the hip prominent. In cases of extensive destruction of the joint and upper end of the femur adduction and external rotation are sometimes seen together but as

a rule adduction is associated with internal rotation and abduction with external rotation.

The cause of these deformities is not wholly known - flexion comes on as an attempt on the part of Nature to immobilise the affected part and is reflexly muscular at first although later on in the course of the disease contractive changes occur in the ligaments. To show that this is so it is only necessary to measure the circumference of sound and affected thighs and calves in early cases of morbus coxae. There is found to be muscular atrophy on the diseased side with cases of only a week's history. It seems that the attitude the patient assumes has a direct bearing on the malposition. When lying in bed the patient naturally lies over on the sound side and by gravitation the limb becomes adducted and rotated inwards.

The most important symptom in hip disease is the involuntary muscular spasm. This reflex spasm is participated in by all the muscles acting on the joint involved and is probably due to direct irritation of the nerves supplying the joint.

This symptom above all others is the most important in the differential diagnosis between morbus coxae and coxa vara and other affections which simulate it. The symptom is the first to appear and it remains till the condition is cured.

All the muscles acting on the joint are affected equally and so on examining the limb one feels the

limitation of movement to be equal in all directions. The feeling of this spasm when examining a diseased joint is diagnostic and when once experienced will never be mistaken.

In coxa vara pure and simple this spasm is entirely absent and on this account alone the differential diagnosis should not be difficult. There probably is limitation of movement in certain directions in coxa vara. In the common type where the convexity of the neck is above and behind there is limitation of movement in abduction flexion and internal rotation, but the resistance is more stubborn and abrupt than in hip disease, as apart from the shortening of various tissues, there is also the locking of the neck or trochanter against the acetabulum rim. In the same way where the convexity is above and in front there is limitation in abduction extension and external rotation, but the same rule holds good.

A difficulty in diagnosis occasionally occurs in coxa vara of the epiphyseal type, where the epiphysis becomes congested and softened, sometimes called the acute stage. - this is due to injury or over strain and it may cause pain and rigidity, but these symptoms rapidly pass away with rest, and so make clear the cause of the trouble. The epiphysis may become infected as a rule by tubercle, more rarely by some coccal invasion and if so the rigidity remains and we can judge by the local signs the nature of the infection, the joint assuming the symptoms of a morbus coxae or a septic joint.



Congenital dislocation of the hip is another condition with which coxa vara may be confounded,.

The hip is dislocated either forwards or backwards, more commonly the latter, and it simulates coxa vara by the limitation of movement that occurs in abduction flexion and internal rotation as well as by the nature of the gait.

The most important similarity between the two conditions is the fact that in both, the great trochanter is elevated above Nelaton's line. The mistake in diagnosis is more apt to be made in the case of patients over ten years of age where the tissues round the head are not so lax as in the infant. The vast majority of cases show the displacement of the head to the posterior and it lies on the dorsum ilii.

The limp is peculiar differing from that of coxa vara. When the weight is put on the affected limb which is the shorter, it becomes still shorter owing to the elasticity of the capsule. In walking there is a kind of plunge of the body towards the affected side which does not occur in coxa vara. The pelvis is tilted downwards on the affected side to compensate for the shortness of the limb on that side.

In walking the thigh is somewhat flexed and there is great lordosis of the lumbar spines owing to the centre of gravity being posterior to that of a normal hip.

On the affected side the trochanter is noticed as

an abnormal lateral projection on a level with the anterior superior spine which is of course tilted downwards,.

In childhood motion in the false joint is more free than normal and the salient point is that if the affected thigh be flexed and adducted the head can be felt in the *dorsum ilii* and by rotating the femur the head can be felt moving under ones finger. As the child becomes older, mobility becomes decreased owing to the increase in size of the femur and the restriction in upward movement.

The range of abduction is decreased and in the adult the limb may become permanently flexed and adducted. Between the ages of 20 and 30 great pain often occurs due to the fixing of the head and in some cases I have seen exsection of the head and neck has been necessary to relieve the tension. By this means all the pain is relieved and the patient's condition improved. In infants the diagnosis between congenital dislocation and coxa vara may easily be made by the finding of the head on the *darsum ilii* in the former. There is also a marked give and take movement called telescoping perceived by alternately exerting traction and upward pressure due to the laxity of the capsule in congenital dislocation which is not present in coxa vara. The history is always available in the case of congenital dislocation, the parents noticing a limp from the time the child began to walk.

Forward dislocation of the hip is uncommon, here the head lies beneath the anterior superior spine. In this variety the symptoms are not so marked as in the case of the posterior dislocation. This type simulates coxa vara more closely than the other because the head of the bone cannot be palpated.

Shortening is not well marked and the limp is slight as the tissues round the anterior superior spine are firm and form a secure support on account of their resistance.

The whole body is inclined slightly backwards but lumbar lordosis is not increased and in some cases is even diminished. The radiograph here will clear up any difficulty in diagnosis and the history of the time of onset of the limp will also help in the elucidation.

Sometimes medical advice is not sought till adolescence in congenital dislocation and then only on account of the pain which sometimes occurs. The movements of the hip are restricted and painful and the condition must be diagnosed from a separation of epiphysis or early articular trouble.

The pain is caused by the stretching of the tissues and shows that the patient has been putting too much strain on the joint. Secondary osteitic changes even occur as a result and a roughening of the head with a fitting of the cartilage may be seen in the radiograph.

Bilateral coxa vara cannot be mistaken for bilateral congenital dislocation, as the two conditions vary so much. In both there is much lordosis but the gait and posture are quite different. The Scissor deformity of coxa vara and the wide separation of the thighs of the double congenital hip together with waddling gait of the latter are quite sufficient to differentiate the two conditions.

Coxa vara can be diagnosed from pathological dislocation by all the dissimilitudes mentioned while discussing the differential diagnosis from morbus coxae.

Although the great trochanter is elevated above Nelaton's line the muscular spasm and in all probability the presence of tubercular sinuses will set all doubt at rest.

The diagnosis from lumbar spondylitis should be made with ease by means of careful examination of the back. The lumbar spines will be found to be rigid in all directions on movements being attempted. Careful investigation should also exclude sacroiliac disease. The peculiar listing of the trunk towards the unaffected side with the long curve of the spine convex towards the sound side is unique. In this condition there is flexion deformity due to contraction of the ilio psoas, but all movements at the hip will be found unlimited and free except extension which is limited for the reason just mentioned. There is pain on lateral pressure on the pelvis and also on pressure of the synchondrosis posteriorly.

Fracture through the neck in children does occur and may be confounded with coxa vara. There may or may not be complete disability. If the fracture is complete the disability is immediate, if partial, it may come on in two or three weeks.

The symptoms will be hard to diagnose from a separation of epiphyses except by means of the X-ray. Fracture through the neck in adults always brings about immediate disability and the history of trauma is invariably definite.

The treatment of coxa vara naturally differs with the variety with which we have to deal. Speaking generally however, one can divide it into medicinal, preventive and operative.

In both types of coxa vara with the trouble just beginning it is necessary to supply the patient with some appliance which will prevent the condition becoming worse. If the case is a severe one and the movements of the joint are impeded owing to the deformity together with symptoms of shortleg, pain and disability, it is necessary to remedy the condition by operative means.

All cases of cervical coxa vara should be regarded as rachitic in origin and treated as such constitutionally and medicinally.

The early case of cervical coxa vara with little or no bending of the neck and symptoms of lameness just beginning, should at once be treated with a

support for the affected side.

The child should live in the open air with just enough gentle exercise to prevent digestive trouble, and should be given cod liver oil assiduously, if mixed with hypophosphite of lime in the form of an emulsion, so much the better. The diet should consist of light and easily digestible material and should be occasionally supplemented by raw meat, which can be scraped and given in sandwiches. Fresh air is the main essential, and this general treatment should continue with the use of the support for twelve to eighteen months or indeed such a time till the bone becomes hard.

Cases of epiphyseal coxa vara seen early, with the giving way of the epiphysis incomplete or just complete, and shortening of negligible quantity must be treated by total rest in bed to begin with. It is also advisable to supplement the rest by traction on the hip to overcome any tendency to shortening. A complete rest of 8 to 10 weeks is necessary, and the traction can be exerted by means of the Thomas abduction frame, or by means of the Thomas knee bed-splint to be described below.

The knee bed-splint can be transformed to a walking appliance when necessary and it is then called a calliper splint.

The bed splint consists of a ring of round iron to which is welded a long loop of the same

material going some inches below the foot. The ring in shape is an irregular ovoid flattened in part and shaped behind to fit the contour of the buttock. The inner bar of the loop is attached to the ring slightly more anteriorly than the outer bar, to avoid chafing the other thigh while walking. The ring slopes without inward and before backward in such a way that the inner point that rests upon the ischial tuberosity is the lowest part of the ring. The angle formed by the plane of the ring and the inner bar is about  $135^{\circ}$ . The thickness of the iron is from  $\frac{3}{16}$ " to  $\frac{3}{8}$ ", and varies with the weight of the patient. In making the ring, the end should be joined by welding and the side bars of the long loop are joined to the ring in a like manner.

The lower end of the loop should be dimpled to receive and retain the straps from the adhesive extension plasters. The ring is padded with boiler felting to the thickness of about  $\frac{1}{2}$ " on its outer portion and  $1\frac{1}{2}$ " to 2" at the inner posterior portion upon which the ischial tuberosity is to rest, and then covered with basil leather or tan sheepskin, care being taken to have the stitching away from the point of contact with the skin.

Two strips, from 3 to 4 inches wide are sewn from bar to bar, one at the knee and the other at the ankle and they form posterior supports to the limb when in the splint.

When the splint is put on by pushing the ring well up till it presses against the ischial tuberosity

extension is exerted by means of the usual extension plasters, to the ends of which tapes are fastened.

After pulling the limb, extension is kept up by winding the strings spirally round the bars till they meet below, when they are fastened together in the depression at the bottom of the splint referred to above.

The calliper splint is now made from the bed-splint, after the prescribed period of rest in bed is reached, and the method of transformation is as follows.- The bedsplint is applied and pushed well up into position on the straightened limb. A point is marked off on each bar an inch below the sole and another 1 to  $1\frac{1}{2}$  inches below this again. The side bars are cut off at the second point and a bend at right angles inwards is made at each first point. The heel of the boot is now bored from side to side and a brass tube let into it. The bent ends of the side bars are now passed into this tube. A leather pad is worn on the anterior surface of the thigh and is fastened to the side bars, also, so that the leg is fixed by the pad in front and the knee and ankle straps behind.

This form of ambulant splint is used in all cases when they are fit to walk, both in the epiphyseal and cervical types, and are always worn for some months in the bad cases when operative measures have been used.

Operative treatment is considered in those cases where conservative measures are unavailing



and loss of function and deformity have reached an extensive degree.

The methods of operative treatment are as follows.-

1. Forcible abduction.
2. Subtrochanteric osteotomy.
3. Resection of a wedge-shaped piece of bone from the upper surface of the neck.
4.                   osteotomy, or the removal of a wedge from the outer side of the femur at the level of the small trochanter.
5. Osteotomy of the neck.
6. Transtrochanteric osteotomy.
7. Exsection of the head and neck, leaving the great trochanter with the shaft.
8. Exsection of the head and neck with a portion of the great trochanter.

Forcible abduction is suitable in early cases of both cervical and epiphyseal coxa vara.

In the cervical type where the neck is beginning to bend, and the bone is softened and congested, this forcible abduction is all that is necessary. The method answers equally well in epiphyseal cases seen before secondary sclerosis has occurred.

The limb is forcibly abducted under an anaesthetic to about  $60^{\circ}$ , the shaft being used as the fulcrum and the lower part of the capsule keeping the head fixed in the acetabulum. The upper part of the neck comes into contact with the rim of the acetabulum, and pressure being exerted to a still further degree, the deformity is overcome.

In those cases where the bone has become sclerosed, and symptoms of shortening with limitation of abduction are present, an osteotomy of one of the types enumerated above must be performed. Hofmeister recommends an intertrochanteric osteotomy. Codovilla divides the femur in a curvilinear manner at the base of the trochanter major and Whitman describes the subtrochanteric osteotomy. All these methods are satisfactory, but personally I am only familiar with the transtrochanteric method as practised by Robert Jones. I have had the treatment of many cases in which this operation has been performed during the period of my association with him. It is of great use, not only in coxa vara, but also in all chronic arthritides of the hip associated with deformity and short leg. In all osteotomies it is advisable as a preliminary to overcome any impediments to abduction whether of muscular or ligamentous origin. The adductor group of muscles as a rule require subcutaneous tenotomy, and vigorous stretching of the capsule will be found necessary as the Y shaped ligament of Bigelow is generally contracted. The technique of transosteotomy, as performed by Robert Jones is, viz.-- A small incision is made a little above the upper border of the trochanter major, extending to the bone through the periosteum. A periosteum detacher is now substituted for the knife and the periosteum is stripped up. The special saw is now guided onto the bare bone and the periosteum elevator removed.

The incision is made obliquely through the great trochanter as in the accompanying diagram and the whole of the bone sawn through.



The saw is a modification of the Adams saw and has a button on the end which enables one to saw with more freedom and there is no danger of transfixion or of losing one's place in the saw cut. The trans-trochanteric route is found advisable, as it obviates any chance of ununited fracture owing to the extra callous exudation in this locality.

The operation is practically a subcutaneous one, one stitch being only required to close the skin incision. The bone sawn through and the dressing applied, the patient is now placed upon the Thomas abduction frame. This consists of a double Thomas hip splint and loops for extension as in the bed knee splint; one limb being abducted to about  $45^{\circ}$ . A leather saddle fits the interior of the frame and on this the patient lies. A periveal band is fixed on the sound side and the limb fixed in the abducted position, extension being obtained on both legs by means of the extension tapes twisted round the side irons as before described in the knee bedsplint. On measurements being taken, the shortening will be found to have entirely disappeared, the position of the head, neck and shaft now being thus.-



Other writers, especially of the American school, prefer to immobilise the leg in a plaster case extending from the axilla to the feet, but this method is not so convenient and traction cannot be exerted at will.

The patient is kept upon the frame for 8 or 9 weeks and during this time open air treatment can be pursued in rachitic cases.

After the prescribed period of rest is past, the frame is discarded and a walking calliper is substituted. The calliper must be worn for several months until the bone becomes hard and all chances of relapse are obviated.

To show the results, pathological and clinical, of this operation, I quote two cases, one of cervical, the other of epiphyseal coxa vara, with X-ray photographs of the affected hip before and after operation.

#### CASE 1.-

T.F. Aet 16. Bending of the neck of the femur.

The patient came in complaining of lameness on the right side. He stated that the right leg was getting shorter. Fed on the breast up to 11 months old - no early rickets - no rickets in the family.

He was quite all right in every way till Sept 1906 when he noticed the right leg getting shorter and he began to limp when walking. This continued getting gradually worse till his admission in March 1907.

On examination it was found that abduction of the right hip was limited to about 20° and that internal

rotation was also limited.

Measurements.-

Ant. Sup. spine to int. malleolus.

L.  $38\frac{1}{2}$  ins.      R.  $37\frac{1}{2}$  ins.

1 inch real shortening.

Umbilicus to int. malleolus.

L.  $41\frac{1}{2}$  ins.      R. 39

The trochanter is nearly 1 inch above Nelaton's line.

A transtrochanteric osteotomy was performed, and the X-ray taken after the operation shows the difference of the angle formed by the neck and shaft.

This patient is still in bed, under treatment, the evidence of late rickets being present in a very marked degree.

Transtrochanteric osteotomy is done in epiphyseal cases where the so-called "acute" stage is over, suitable in those cases where the neck is soft and congested, and secondary sclerosis of the bone has not yet appeared. The case I now quote when seen by Mr. Jones was too far advanced for forcible abduction so the osteotomy operation was decided upon.

CASE II.

E. G. aet 13. Separation of epiphysis left femur. Patient was fed on the breast up to 12 months - no history of rickets. In May 1905 while jumping down some steps the boy fell partly on his head and partly on his hip. He walked home, and in fact was quite

well for 12 months, when he began to have pain and to drag the leg along. The pain and lameness were worse after he had been walking and became tired, which came on after very little exercise.

On examination it was found that abduction at the hip was limited to about  $30^{\circ}$  and there was also limitation in internal rotation.

The trochanter was  $\frac{1}{2}$  inch above Nelaton's line and there was  $\frac{3}{4}$  inch real shortening and  $1\frac{1}{2}$  ins. of apparent shortening.

A transtrochanteric osteotomy was performed in June 1906 and the leg abducted in a Thomas abduction frame. The patient has now been walking in a calliper for about ten months - there is still about  $\frac{1}{2}$  inch of apparent shortening but he walks well, - there is no pain and abduction to about  $55^{\circ}$  is possible.

I append the skiagrams of the affected hip before and after operation.



Cunieforn osteotomy is recommended by Whitman for the treatment of cases in young children - but I have never seen the operation performed in cases of this kind.

WA wedge shaped piece of bone with its base exter-

nally is removed from the femur at the level of the trochanter. As in transtrochanteric osteotomy, the ligaments must be previously stretched and the adductors tenotomised.

A longitudinal incision is made on the external surface of the thigh from a point one inch below the apex of the great trochanter and the incision continued downwards for 3 inches.

The periosteum is scraped well away exposing the bone.

The base of the wedge should be about  $\frac{3}{4}$  inch broad and this should be directly opposite the trochanter minor. The upper section should be at right angles to the shaft - the lower one being more oblique. The cortical substance at the inner aspect should not be divided, as when the wedge is removed and the limb abducted, it serves as a hinge, and keeps the fragments in good position.

This operation on account of the fragments being thus held in apposition is preferable to the linear osteotomy at the level of the trochanter minor, practised in America. In the few cases I have seen of the linear osteotomy there is a tendency to the riding of the central fragment as it encroaches into Scorpas triangle.

I have never seen Mr. Jones perform a cunieforn osteotomy for coxa vara, but in one or two cases of

morbus coxae and arthritis deformans with bad deformity where he has done it, the results have been good. I append the X-ray of a case of arthritis deformans so treated.

A wedge of bone was removed from the outer border of the bone at the level of the trochanter minor and the leg abducted on a Thomas abduction frame.

These cases tend to show the result of the operation in coxa vara, as in both there was adduction, the primary deformity of coxa vara.

In two cases where exsection of the head for extreme coxa vara has been performed by Mr. Jones, he has removed only the head and neck, leaving the great trochanter intact.

Only one of these cases has come under my notice, but the condition of the patient is much improved, as she now walks well without her calliper splint. There is naturally some telescoping of the false joint, but all the pain has now gone and the patient is very satisfied with the results of the operation.

As I have mentioned before there is still some difference of opinion as to the real nature of the cervical coxa vara. Some authorities hold that the condition is a distinct one from rickets, whereas others are of opinion, that it is only part of a general rachitic condition, but that it may or may not be the only manifestation shown.



From the cases I have collected one is led to believe that cervical coxa vara may be the first manifestation of adolescent rickets and probably may be the only one. That it is due to rickets or a localised osteomalacia, there can be no doubt and from what I have seen of the condition, I cannot imagine that it can be produced by faulty attitude without the softening of the bone due to the above causes.

Assuming that faulty position in standing might cause the condition, especially the use of the so-called stand-at-ease posture, I examined a number of cases of static scoliosis where the patients assumed this position. In no case did I find any sign of coxa vara of the side on which the body weight had been borne.

In infantile rickets the coxa vara is as a rule secondary to commomer distortions of the lower extremities, either genu varum or genu valgum - more usually the latter.

With the idea of finding out the relationship of the deformities I have taken a series of radiographs of the hips of children presenting genu varum or valgum due to rickets. These cases have, in all instances, been brought to see Mr. Robert Jones regarding the crooked legs, and in no instance had any complaint been made of the hips.

The results tend to show that there is a beading of the neck of the femur in children suffering from well marked rickets, the angle between the neck and

shaft in these cases being less than that in healthy children. It is also seen that the longer a rickety child has been walking with the bones in a softened condition, the worse is the degree of coxa vara produced, and in the majority of cases the degree of this deformity is proportionate with the genu varum or genu valgum. In those cases where coxa vara is present abduction is limited - the degree ranging from  $25^{\circ}$  upwards.

It will be of great interest to note whether the symptoms of the condition in these children will manifest themselves as they grow older.

In each case some error of diet was apparent - the breast-fed babies without exception were not weaned until they were over twelve months old, one or two cases remaining on the breast for eighteen months.

The majority of the children were bottle fed, the fluid given being generally cows milk and water in equal parts with a little sugar. Cream was not added in a single case.

In the vast majority of cases of adolescent coxa vara that have come under my notice, the cause of the condition is undoubtedly a slipping of the epiphysis as in most of the radiographs some alteration of relationship between the articular head and neck is evident.

In a few instances, however, the cause is undoubtedly adolescent rickets as in the case of T. Foster, quoted previously. Some cases are due to

osteomalacia, others to osteo arthritis, whilst one or two evidently began in early childhood owing to rickets and were not seen by us till adolescence was reached.

1. Norman Rudbach, aet 18 months.

Coxa vara absent.

This child has never walked - he was fed on the bottle up to the age of 13 months.

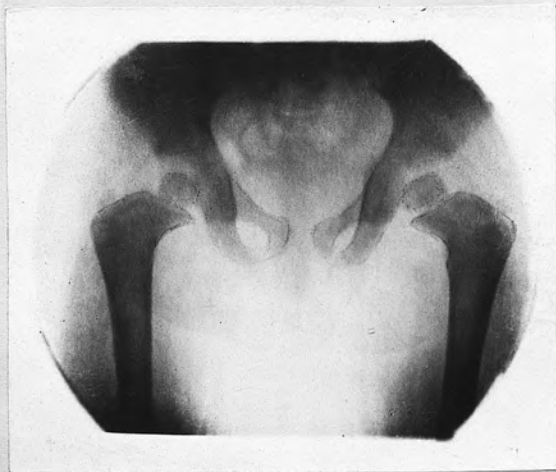
There is well marked genu varum with evidence of rickets at the wrists and ankles which are enlarged. The anterior fontanelle is not yet closed. The child has never made as yet any attempt to walk, and there is no sign of coxa vara in either hip.

2, Gladys Rudbach, aet 3½.

Sister of the above case.

Bending of the neck on both sides, especially the left.

Was also bottle fed up to the age of thirteen months. She has done little walking as she has always been delicate. Rickets is well marked - the rickety rosary is present and the enlargements at the wrists and ankles are great. There is a varoid deformity deformity of both tibiae as well as genu valgum of both legs. There is also an anterior convex deformity of the tibiae present but this is only slight. The child began to walk sixteen months ago. The radiograph shows a slight bending of the neck of both femora - the left being more marked than the right.



3. William Crosby aet 5.

Little or no coxa vara - was bottle fed entirely up to fourteen months. Rachitic element is very strong. There is well marked "bossing" of the frontal bone - the chest is typically rachitic with costal beading and eversion of the costal margin - all the epiphyses are enlarged. There is great deformity due to extreme genu valgum with pronounced anterior bowing of the tibiae. The child began to walk at the age of eighteen months, but has done little owing to the great deformity.

The femoral neck on each side is normal, but the right one is apparently beginning to become somewhat bowed.

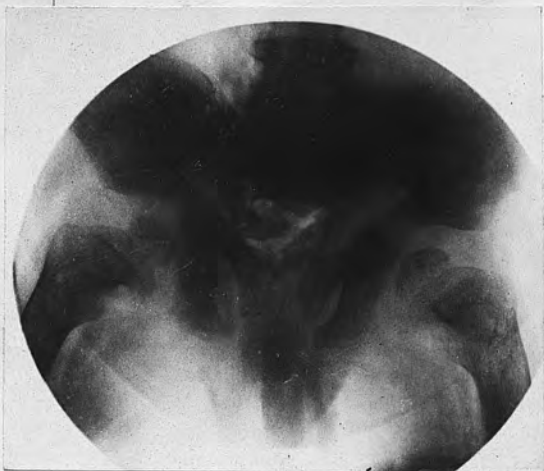
4. John Crosby, aet 5.

Little or no coxa vara. A twin brother of the above. Was bottle fed up to fourteen months - general rachitic condition of epiphyses with frontal bossing and costal beading. Genu valgum is extremely well marked though hardly so much deformity is apparent as in the brother.

The right femoral neck shows no change - the left however, has a less angle, though coxa vara cannot be said to be present.

In neither of these cases has much walking

been done, the mother having kept them off their feet as much as possible on account of the extreme genu valgum.



5. Henry Jacobs aet 3.

Well marked double coxa vara.

This case displayed well marked general rickets. There is swelling of the wrists and costal beading. The child was bottle fed entirely for over twelve months. There is great deformity due to extreme genu varum.

Coxa vara is well marked on both sides - indeed so much so that although the child began to walk at the age of eighteen months, there is reason to believe that this may be a case of congenital coxa vara.



6. Ernest Tom, aet 1½.

Slight right coxa vara - the rickety element is not so strong in this case as in the preceding one. The wrists are enlarged and there is costal beading present. The child was fed on the breast for thirteen months, at which time it began to find its feet, but it does not yet walk strongly. Genu varum is fairly well marked. The bones of the leg are by no means soft. Coxa vara is beginning on the right side and the left femoral angle is smaller than is usual in children of this age.

7. Charles Hughes, aet 19 months.

Slight double coxa vara.

This child was entirely breast fed up to the age of fourteen months. There is marked tendency to rickets, general epiphyseal enlargements being present. The head is large and the frontal bossing being plainly visible. The child began to walk five months ago at the age of fourteen months. The anterior fontanelle is just closed. There is a tendency to coxa vara on both sides, the right being more marked than the left, although the femoral angle of the latter is obviously decreased.

8. Bertram Mitchell (2½)

No sign of coxa vara.

This child was entirely breast fed for the first twelve months. There is well marked genu varum





with other manifestations of rickets, the wrists being enlarged and costal beading being present. The child has never been allowed to attempt to walk. The radiograph shows no sign of coxa vara present.



9. Alfred Dean aet 19 months.

A strongly marked rachitic subject, the anterior fontanelle is not yet entirely closed. The frontal bone shows well marked bossing. The chondro costal epiphyses are enlarged as are those at the wrist. The child was extreme genu varum without any anterior deformity. As will be seen in the radiograph there is lack of calcareous material in the bones of the pelvis and in both femora. Double coxa vara of an extreme type is present. The child has been walking for four months.



10 Lillie Meyer, aet 4

Double coxa vara - well marked on the left side. This case, like the last, exhibits costal beading and enlarged wrists with bossing of the os frontis. The child was fed on the breast up to the age of 18 months and came to hospital on account of marked genu varum. She began to walk when she was two years old. There is ant. convexity of tibiae. There is coxa vara present on both sides, more especially the left.



11. Margaret Wright, aet 3.,

Slight coxa vara of both sides, more especially of the left.

This child has well marked genu valgum, for the cure of which she was brought to hospital. Signs of rickets present - enlarged wrists and costal beading.

The child has never been much on its feet, although it began to walk at the age of 19 months.

12.



12. Edna Mowbray, aet 4.

Well marked double coxa vara.

This case displays extreme rickets - the chest is ill formed, chondrocostal beading is present as is also enlargements of both wrists and knees. The child was bottle fed on cows milk and water in equal parts up to the age of 12 months. Genu valgum is extreme, the bones being very soft and the lateral ligaments of the knees are lax.



13. Patrick Carbery aet 12 months

This child was also bottle fed but rachitic evidence is not so strong as in the preceding case. The child began to walk four months ago and as a consequence shows fairly well marked genu varum. Coxa vara is present in both hips and the radiograph can be compared with the one of a non-rachitic child of the corresponding age.



14. Ivy Dawe, aet 3.

Little or no coxa vara present.

This child has always been very delicate since birth, which was somewhat premature.

All the front milk teeth are decayed - there is

costal beading and enlargement at the wrists. The child was bottle fed entirely. There is bowing of the left femur, but the tibiae are straight as is also the right femur. The child began to walk six months ago, but has done very little on account of its general weakness.



15. Wm. Betney, aet 1½ years.

No sign of coxa vara.

This child has less marked evidence of rickets than any of the preceding ones. There is swelling at both wrists and the anterior fontanelle is not quite closed. There is well marked genu varum but little costal beading. The child was bottle fed up to 12 months. Coxa vara is entirely absent, explained by the fact that walking has never been attempted.



16. Dorothy Mamery, aet 3 years.

Coxa vara present on both sides.

Rickets is well marked in this case. The child is small and puny. The epiphyses at the wrists and ankles are enlarged and painful on palpation. The rickety rosary is present. The child had a well marked genu varum of each leg. The mother states that she weaned the patient at the age of nine months, but afterwards apparently it was allowed to eat anything, and moreover was kept almost altogether in the house, as another baby was born sixteen months afterwards.



17. Patrick Ireland, aet 4.

Slight coxa vara present.

This child is very rachitic and was brought to see Mr. Jones with very bad genu valgum mainly of the tibiae. He was fed on the bottle entirely for sixteen months. He began to walk at the age of  $2\frac{1}{2}$  years, but as he was so crooked and constitutionally weak, he has not been allowed to do any great amount of walking.



18. Peter Furlong, aet 2.

Right coxa vara present slightly.

This child suffers from rickety genu varum although other rachitic manifestations are not very well marked. The epiphyses are enlarged and tender to some degree. The patient was breast fed up to the age of one year. He has been walking for about two months.



19. Patrick Dalings, aet 5.

In this case, as in the preceding one, the rickety taint is slighter than most of the others. Genu valgum is well marked in both legs but the shape of the chest is not abnormal and the rickety rosary is not present. The child was breast fed up to ten months old. The bones appear to be getting harder. The child has been walking for three years. Slight double coxa vara is present.





20. Nora Gordon, aet 4.

Marked left coxa vara.

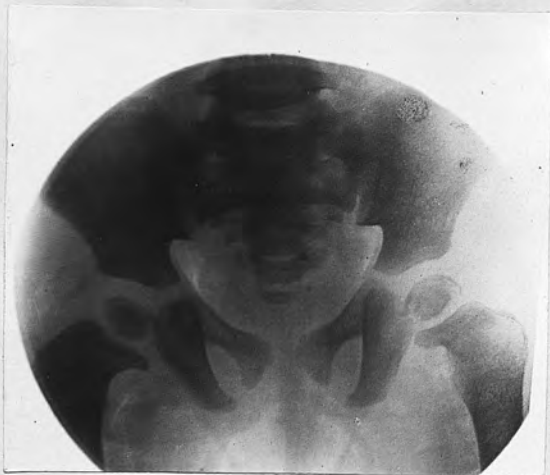
The rachitic element is strong in this child's case. There is extreme genu valgum present and Harrison's Sulcus is well marked in the chest,. The epiphyses at the wrists and ankles are greatly enlarged. The child was fed on the breast for about 16 months and she has been walking for  $2\frac{1}{2}$  years.



21. E. Atherton, aet  $3\frac{1}{2}$ .

The child has rickets slightly at the present- as far as one can see the attack is over, as the bones are hard although genu valgum is well marked. The attack has been bad - so much so that the mother has not allowed the child to do much walking, although she could do so at the age of eighteen months. The child was fed on the breast for twelve months.

There is slight coxa vara on the left side.



22. Walter Cookson, aet 3.

Well marked double coxa vara.

The evidence of progressive rachitis is strong. The bones are still soft and the well marked genu varum can be almost straightened with the hand. Harrison's sulcus is present in the chest and the epiphyses of ribs, radiu and tibiae are all enlarged.

The child was fed on the breast till eighteen months old and has walked since he was twelve months old, the mother states.



23. Ernest Walker, aet 4.

Double extreme coxa vara.

This child is recovering from well marked rickets. He has a bad genu varum of both tibiae and other rachitic symptoms are present most markedly. He has only been walking thirteen months, and the bones must have been excessively soft to have allowed of so much distortion in such a short time. The child was fed on the breast alone up to the age of two years.



24. Frank Turner, aet 3½.

Has been walking for two years. He has well marked genu valgum of both legs and the rachitic is still evidently present. The child was fed on the breast for about sixteen months.

Double coxa vara is present, especially on the left side .

25. Dora Dalziell, aet 3.

Has been walking for  $1\frac{1}{4}$  months. Was fed on the breast to 15 months. Has double genu valgum markedly.

Signs of rickets present strongly - all the epiphyses at wrists, knees and ankles being enlarged and the frontal eminences are "bossy". Double coxa vara present.

24



25



70.

Name	Age	How long walking	Degree of coxa vara present	Deformity for which patient was brought
1. Norman Rudbach	1 $\frac{1}{2}$	Not	No signs of coxa vara	B.
2. Gladys Rudbach	3 $\frac{4}{12}$	2 yrs.	Beginning coxa vara on both sides.	K. K. & B.
3. W. Crosby	5	1 $\frac{1}{2}$ "	No sign - has done practically no walking.	K. K.
4. J. Crosby	5	1 $\frac{1}{2}$ "	Slight on right side-ditto-	K.K.
5. Henry Jacobs	3	1 $\frac{1}{2}$ "	Well marked double coxa vara.	B.
6. Lillie Meyer	4	2 "	Double coxa vara,- well marked on left side.	B.
7. Ernest Tom	1 $\frac{1}{2}$	8 mos.	L. marked coxa vara, R.slight.	B.
8. C. Hughes	19 mos.	.6 mos.	slight coxa vara	B.
9. Alfred Dean	19 "	4 "	Both sides well marked	B.
10. B. Mitchell	2 $\frac{1}{4}$	Not	None	B.
11. Margaret Wright	3	1 yr.	Beginning double coxa vara, especially the Left	K. K.
12. Edna Mowbray	4	2 yrs.	Well marked double	K. K.
13. Pat Carbery	1 $\frac{3}{4}$	5 mos.	Double coxa vara	B.
14. Ivy Dawe	3	1 $\frac{1}{2}$ yrs.	Well marked double coxa vara.	B.
15. W. Betney	1 $\frac{1}{2}$	6 wks.	Coxa vara absent.	B.
16. D. Mamery	3	1 $\frac{1}{2}$ yrs.	Double coxa vara.	B.
17. P. Ireland	4	2 $\frac{1}{2}$ yrs.	(Done very little walking) Slight C.V.	K. K.
18. P. Furlong	2	2 mos.	R. coxa vara present.	B.
19. P. Dalings	5	3 yrs.	Double coxa vara - slight -	K. K.
20. N. Gordon	4	2 $\frac{1}{2}$ yrs.	L. Coxa vara marked.	K. K.
21. E. Atherton	3 $\frac{1}{2}$	2 yrs.	(Done very little walking) Slight L. Coxa vara.	K. K.
22. W. Cookson	3	2 yrs.	Well marked double coxa vara.	B.
23. E. Walker	4	13 mos.	Double extreme coxa vara	B.
24. F. Turner	3 $\frac{1}{4}$	2 yrs.	Double coxa vara - markedly on L. side.	K. K.
25. Dora Dalziell	3	14 mos.	" " "	K. K.

The following cases of derangement of or about the hip joint that have come under my notice, I quote from the point of view of their interest or from the difficulty in their diagnosis.

The first series of cases, is a group of three - all of which were diagnosed as epiphyseal separations, but the exact nature of the injury as demonstrated by the X-rays was different in every case to what one was led to believe by the clinical signs.

Case 1. Dorothy Campbell, age 16.

Came to see Mr. Jones with the following history. Two years ago she was at her work as an operative in a cotton mill when she fell on her hip against a hard projection. The injury was, as she thought, slight, and so she went on with her work, but had some pain on standing a few days afterwards, which became worse after she had walked for any distance. She continued working without any other symptoms except the occasional pain and fatigue, for over twelve months.

She now began to limp and this lameness became gradually worse during the ensuing six or eight months - the pain meanwhile became worse as the lameness increased and it was on this account she sought advice at the hospital.

On examination - the child is found to limp markedly, leaning towards the left side. The pelvis is tilted up slightly towards the left side and there is slight adduction. The trochanter is large, prominent and

somewhat tender on palpation, but firm.

Measurements.--

The trochanter is  $\frac{1}{2}$  inch above Nelaton's line.

R. R.  $30\frac{1}{2}$             L. R. 30

R. A.  $31\frac{1}{2}$             L. A. 31

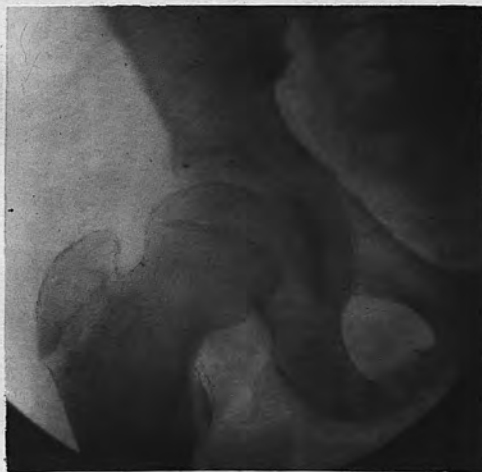
The limit of abduction on the R. side is  $60^{\circ}$  and on the left about  $40^{\circ}$ .

Epiphyseal coxa vara was diagnosed.

The skiogram shows the hip joint to be quite normal but the epiphysis for the great trochanter is separated & displaced upwards for about  $\frac{1}{2}$  inch. As the removal of the epiphysis will obviously weaken the femoral arch, the pain on long standing or after much walking is accounted for, - both the pain and lameness being due to straining of the hip as a whole.

The calliper was ordered to be worn on the left side, to take the strain off the affected hip and now after an interval of four months the pain was quite gone.

The tilting of the pelvis and consequent adduction produced the apparent shortening to which was attributable the error in diagnosis.



Case 11.      Philip Riley, age 15.

Complains of lameness with a large lump over the left hip.

Duration 7 months.

History.- When the patient was three years old he fell and hurt his left hip. He was taken to a hospital, where he was treated for some weeks as an out patient. The mother was not told what was the matter with the hip, but she is certain that no splints were applied - after two or three weeks attendance the boy was discharged.

He was perfectly well and the hip never caused him any trouble till about two years ago, when he noticed that his hip bone had become enlarged. He did not pay much attention to the lump as it caused him no inconvenience. Seven months ago, however, he began to limp slightly on the left side, and this limp has become gradually worse, so he came to the hospital for advice.

On examination the boy is found to limp very slightly on the left side. The limp is apparently due to a slight shortening of the limb rather than to any restriction of movement at the hip joint.

There is great enlargement with much thickening of the great trochanter which seems to be more anterior than is usual.

There is no dislocation of the head of the femur to be made out.

Measurements.-      R. R. 35½      L. R. 34½  
                         R. A. 37½      L. A. 36½





Philip Riley - Coxa Valga.

The trochanter is one inch above Nelaton's line.

Abduction is limited to 30°, but adduction, internal and external rotation are all free. There is no flexion deformity.

X-ray appearances.-

The skiogram shows a very peculiar state of affairs to be present. There has been a complete separation of the epiphysis between the head and the neck. The articular head has lodged onto the superior surface of the neck, the new articular head being formed partly by the edge of the old one and partly by the neck itself. There is a dislocation of the hip upwards but there is no obvious sign of a new acetabulum.

The condition was probably caused by the injury sustained in childhood, but it is difficult to say whether the dislocation accompanied the separation of epiphyses at that time or is congenital in origin. The former is the more likely hypothesis.

Owing to the peculiar nature of the injury, it was decided not to proceed with any operative treatment, as the impairment of function was of such a negligible quantity. A calliper was ordered to be worn to take the strain off the affected hip.

This has been very satisfactory, and the patient walks very well in it. He will continue its use for some months till all fear of further strain is removed.

Case III.      Elsie Schofield, age 13.

Complains of a limp, with pain in the right hip.  
Duration 4 months.

Six months ago the patient was working at her occupation in a cotton mill, when she was pushed down by a friend, and she fell on her right hip. She got up, apparently having sustained no injury, as she felt no pain at the time, or no ill effects at that time.

She went to her work as usual, and took her customary amount of exercise until about four months ago when she began to have pain in the hip and she also noticed that she was beginning to limp. These symptoms have become gradually worse up to the present time.

The pain, which the child describes as of an aching character, becomes worse when she has been walking. The pain also is worse than usual when she begins to walk after resting for an hour or so, if she is sitting down - this however, is not the case when she gets up in the morning. She walks without pain or stiffness after a night's rest.

Movements are not restricted but there is a slight flexion deformity of about  $9^{\circ}$ . Internal rotation is increased, as is also external rotation. Hyper-extension is possible and is not at all restricted.

Abduction is possible on the right side to about  $60^{\circ}$  whilst on the left side only  $50^{\circ}$  can be obtained without pain.

Measurements.-      L. R. 32      R. R.  $32\frac{1}{2}$   
                         L. A.  $34\frac{1}{2}$       R. A.  $34\frac{3}{4}$

There is no degree of abduction.

The great trochanter on the right side is nearly  $\frac{1}{2}$  inch below Nelaton's line.

X-ray appearances.-

In this case the separation has been incomplete. There is a gap at the innermost point of the epiphyseal junction between the head and neck which has spread inwards for about half the thickness of the bone.

This separation has widened, with the result that as the outer half remains intact, the external portion of the articular head is nearly in apposition to the superior border of the great trochanter.

By this partial separation, the angle that the head and neck make with the shaft is diminished by about  $30^{\circ}$ .

Coxa Valga was diagnosed, but the precise nature of the injury was only apparent after the examination of the skiogram.

Treatment.-

This patient was also ordered to wear a calliper to take the strain off the affected limb. The splint has now been worn for three months, and all pain has now disappeared.

ELSIE SCHOFIELD  $\rightarrow$



CASE IV. bears a striking resemblance to the previous case.

John Bayley, aet 16.

Complains of pain in the right groin and an old limp. The patient is a small boy for his age and an old patient of Mr. Jones'.

As a child he was an extreme case of rickets, having well marked bowing of each femur, and together with great 'inknee' of each tibia. For these conditions an osteotomy of each femur was performed in 1901 and an osteoclasis of each tibia in 1902.

Since that time the boy has improved, and for the last twelve months has been working in a shop where he has had much running about to do, with the carrying of more or less heavy weights.

For the last two or three months a pain, which he had occasionally noticed before, has been present in the middle of the right groin, more or less persistently. During the same period of time a limp has been present, which is now slightly worse than it was at first.

There has never been any history of injury to the hip as far as the patient remembers.

The pain in the groin is worse when much walking has been done and the patient always noticed it for a short time after getting up in the morning.

On examination.-

All the movements at the right hip are free. The great trochanter is slightly below Nelaton's line.

There is no flexion deformity.

Rotation outwards of the thigh is normal, but the movement of internal rotation is increased, there being almost half again as much movement as on the left side.

R. R. 28      L. R.  $27\frac{1}{2}$

R. A.  $29\frac{1}{2}$       L. A. 29.

Limit of abduction  $30^{\circ}$  on the Right side, and  $45^{\circ}$  on the left side.

A diagnosis of coxa valga was made.

X-ray appearances.-

There is a well marked separation of the epiphysis for the head in an upward direction tending to cause coxa valga.

As in the last case the head is raised and part of it tends to lie on the superior surface of the neck, so that externally the articular head is approximated to the great trochanter.

The X-ray of the condition bears out the clinical features of the case, accounting for the increase in the real length.

The curious part of this case is that there is no history of any fall or strain likely to begin the trouble. In some cases however, no definite history is available, the primary cause being some small twist or strain so small as to escape the notice of the patient.



It is curious to note how the head is in some cases elevated and in others depressed.

The diagnosis here was masked by the fact that the boy had been such a rachitic subject, and that there was no history of any injury likely to have begun the process of separation.

In this case there was no sign of coxa vara in the left hip, nor was there any evidence of cervical softening in the right one. The fact that the boy was so crooked when the active stage of rickets was present that he did no walking accounts in some degree for this fact.

#### Treatment.-

As the separation is so recent, it was decided to watch the case for some time without adopting any treatment - the patient meanwhile is under observation and further X-rays of the hip will be taken periodically.

The following cases of epiphyseal coxa vara presented less difficulty in diagnosis than the four previous ones.-

#### Case V.

Wm. Darebrother, age 14.

Complains of walking with a limp accompanied by pain in the right hip.

Duration 4 months.

#### History.-

In April last he was playing football, and missing his kick on an occasion he sprained his hip. He felt



nothing at the time as the pain disappeared in a day or two. In the next month (May) he noticed that without any obvious reason he began to limp on the right side when walking, and at the same time an aching pain appeared in his right hip.

The limp and the pain became more pronounced when he had been walking and became tired, and it was also stiff for a short time each morning on first getting up. On these occasions he used to move the leg up and down for a minute or so and it became better.

The lameness was a slight limp at first, but it has grown steadily worse until now, when it is well marked; the right limb being obviously tender.

On Examination.-

All movements of the right hip are restricted. The trochanter is very prominent and seems to be enlarged.

R. R.  $30\frac{1}{2}$       L. R. 31.

R. A. 32      L. A. 33.

There is slight adduction. No abduction is possible past the point, when the right lower extremity is at right angles to the pelvis.

The great trochanter is at Nelaton's line.

Inversion and eversion are also limited.

A diagnosis of epiphyseal separation was made.

X-ray appearances.

The X-ray negative shows the separation of the epiphysis between the head and neck to be complete

A



B



THIS XRAY TAKEN 3 MONTHS LATER SHOWS OSTEITIC CHANGES  
DUE TO TRAUMATIC EPIPHYSITIS.

but very little displacement has taken place. The head remains in situ but the shaft has been carried up for about  $\frac{1}{2}$  inch.

Taking into consideration that the injury was sustained four months before the X-ray was taken and that so little shortening has occurred, we are safe in assuming that the separation has been a gradual one and that it has only been wholly separated a short time.

#### Treatment.

As there was a certain degree of adduction accompanying the shortening, forcible abduction was performed. The limb was subjected to mild traction, and was then abducted to about  $30^{\circ}$  forcibly and afterwards put up in a plaster of paris spica.

Instructions were given that the child was to lie up and the limb on no account to be used in any way whatsoever.

#### Case VI.

Is another instance of separation of the epiphysis, but the radiographs show well the secondary osteitic changes that occur in the neck, especially at the upper portion of it.

H. Wood. Age 17.

Complains of inability to walk and pain in the left groin.

The boy began to limp slightly six weeks

ago, for no ascertainable reason. After this limp had continued for about three weeks, he fell one day onto his left hip and was unable to get up again. He was in bed for four days and he then tried again to walk, but his foot gave way and he was again confined to bed, - this time for a fortnight. The doctor who was called in diagnosed morbus coxae, and sent the patient on to Mr. Jones.

On Examination - his measurements were found to be .-

R. R.	37	L. R.	36
R. A.	42	L. A.	40½

The great trochanter on the left side is 1 inch above Nelaton's line. There is a flexion deformity of 45°. No abduction is possible. There is slight adduction as the patient lies.

At the time of examination an X-ray was taken which exhibits the following points.-



There is a well marked separation of the epiphysis between the head and neck of the left femur. The neck and shaft are carried directly upwards for about one inch so that the epiphyseal surface of the head is merely in contact with the under surface of the neck. There is much adduction present which accentuates the deformity.

The second radiograph was taken some two months later, when extension and abduction had been applied.



B. Coxa vara is still present but the condition is much improved, as will be readily seen when the relationship of the pelvis to the shaft of the femur is contrasted with radiograph A.

The condition now cannot be differentiated from cervical coxa vara, except for the fact that there is no increased radiability but rather decreased radiability of the upper border of the neck of the femur. This decrease shows that the bone has undergone sclerosis, being due to secondary osteitic changes

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that occur.

Treatment.-

This case was of interest owing to the fact that the boy limped for nearly three weeks before he had the fall which caused the complete disability. The separation probably had begun insidiously and was rendered complete at once by the severe strain thrown on to the hip. It is only in injuries of some severity that complete separation takes place at once, and only these cases cause immediate disability. The hip was abducted for some 8 or 9 weeks and then a calliper was worn for six months.

Arthur Ellis. - Age 17.

Was perfectly well up to the age of 15.

He never suffered from rickets and there is no rachitic tendency in the family.

In the winter of 1905-6 he was playing football and one day missed his kick. He did not fall but he felt a great pain in his hip - he worked next day and in two or three days was apparently quite well. Three weeks later he discovered that he was becoming lame and that the leg was wasted. After much walking when he became tired, the leg used to get numb and the hip was worse.

On Examination.- it was found that full flexion was not possible. Circumference of affected thigh compared to the sound one are  $14\frac{1}{2}$ "  $17\frac{1}{2}$ ".

G. T. 1" above Nelaton.

Flexion deformity, nil.

Abduction limited to  $30^{\circ}$  compared to  $45^{\circ}$  on the sound side.

Rotation inwards limited to  $\frac{3}{4}$ .

Rotation outwards free and increased by  $\frac{1}{4}$ .

R. R.  $34\frac{1}{2}$       L. R.  $35\frac{1}{2}$

R. A. 36      L. A. 37.

The case is a typical one of epiphyseal exa vara and in the print one can see how the neck is carried upwards although secondary osteitic changes have occurred, observing the infraction which originally existed. The X-ray was taken some months after the accident, when the patient was first seen.

ARTHUR ELLIS →



Wm. Nelson, age 18-

Has been doing heavy manual labor for two years. Was once kicked on the knee by a horse, but never had any injury to the hip. Complains of lameness and complete disability.



There is no flexion deformity - rotation inwards is diminished by  $\frac{3}{4}$  - rotation outwards is complete. The great trochanter is  $1\frac{3}{4}$ " above Nelaton. There is a diminution of 3" in the circumference of the affected thigh and there is inability to abduct it beyond the straight line.

Although there is in this case no definite history of injury, the epiphysis is seen to have slipped and the neck to be carried upwards.

The convexity at the upper end of the neck is due to secondary osteitic changes of a reparative nature.



I reproduce photographs of four other cases of epiphyseal coxa vara, whose history and symptoms are similar to the cases quoted.

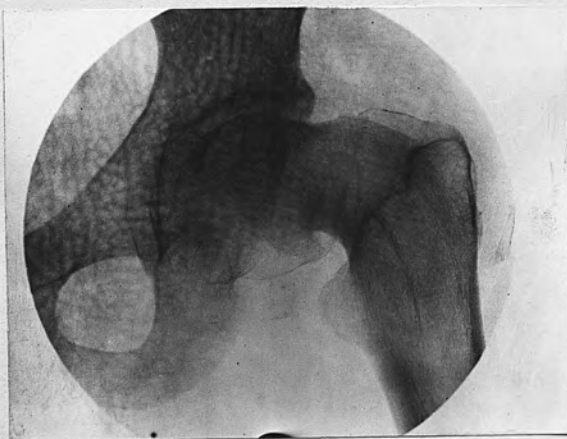
Thos Tudor. Age 17.

Here the infraction between the head and neck is seen to be filling up with new bone.



Ernest Platts, age 18.

There was no history of injury or rickets in this case. The bony lamellae are thin, suggestive of a rachitic diathesis, but the neck is seen to be much carried up, due to the epiphyseal slipping.



J. Purcell, age 17.

This case shows points of similarity with the previous one.



J. Meadows, age 18.

The neck in this instance has slipped downwards causing a coxa valga.



The following cases are rachitic in origin either infantile or adolescent.

Chas Stead age 3.

A rachitic subject was brought to hospital on account of lameness. This was found to be due to a congenital dislocation of the right side. The left hip displays well marked infantile coxa vara.



Percy Ellis - age 11.

Was admitted to hospital for the treatment of extreme double genu valgum.

The boy was quite healthy and straight up to two years ago when the knock knee first began to be noticed.

All the bones were softened and the epiphyses at the wrists, knees and ankles tremendously enlarged, so radiographs of all the affected bones were taken.

The pelvis shows marked pseudo osteomalacia and extreme double coxa vara. There is great lack of lime salts and the bony lamellae are thin and widely

separated. This is evidently a case of delayed rickets.



Evelyn Ward age 8.

Shows well marked double coxa vara, which originated from infantile rickets.



Price Peters Age 5.-

is similar to the previous case.



Gladys Rosentloan age 9 -

Shows the same condition.



May Sloan age 9 -

In this case no history of rickets was obtainable, but the limp was said to succeed a bad attack of scarlet fever.



Albert Bland, age 17.-

Began to limp soon after he first walked. He was fed on the bottle entirely and another member of the family had rickets.

There is complete disability of the left leg.

L. R.  $31\frac{1}{2}$       R. R.  $33\frac{1}{2}$

L. A.  $34\frac{1}{2}$       R. A.  $37\frac{1}{2}$

G. T.  $2\frac{1}{2}$ " above Nelaton.

Flexion deformity to nearly  $90^{\circ}$ .

Rotation inwards limited to  $\frac{1}{2}$ .

Rotation outwards free.

Abduction limited to  $\frac{1}{5}$ .

The condition has become steadily worse up to the present time.

The X-ray shows the most extreme cervical coxa vara evidently due to infantile rickets.

There is increased radiability, the neck has disappeared and the head is greatly distorted. Lime salts are almost absent and the lines of tension and pressure are quite lost. The great trochanter is seen to be in apposition to the ilium 2 inches above the superior acetabulum rim. The infracton seen is secondary to the rachitic condition. It is situated external to the epiphysis.

ALBERT BLAND →



The following case of arthritis I quote as the history simulates that of a slipping epiphysis.

George Upton age 5.-

Was quite well up to 5 weeks ago when he fell on the left hip. Since that time he has been becoming lame.

There is no real shortening, and about  $\frac{1}{4}$ " of apparent shortening with  $20^{\circ}$  of flexion deformity.

The joint is rigid in all directions, least in flexion, most in abduction and rotation.

The radiograph shows much necrotic change in both acetabulum and head, probably due to coccal invasion.





The following case I quote on account of its interest and the difficulty in diagnosis.

James Butler, age 36.

Twenty years ago he was kicked by a horse on the right hip. No great inconvenience was felt but about five years afterwards he noticed a lump growing at the front of the thigh at the same level as the hip bone, and this lump was increased gradually up to the present time. At no time was it any hindrance to him in any way and it never caused any pain. At the present time it feels to the patient about the size of a small orange.

Two days ago the patient, who is a gardener, fell from an apple tree onto his right hip. Though greatly shaken and in much pain he walked to his house about 200 yards.

He was sent to hospital and Mr. Jones diagnosed a detachment of an osteana which was verified by the X-ray photograph.

The mass which is situated on the antero external surface of the femur at the level of the trochanter minor is about the size of a tangerine orange and is pedunculated. On deep palpation, it was found to be moveable.

The growth was removed by open incision and

the fracture was found to have occurred at the point where the pedicle joined the femur.



The photograph shows the osteoma in the recent condition reduced to  $\frac{1}{2}$  size.



The following case displayed double coxa vara which was part of a general osteomalacia.

Annie Jones, age 21.-

Was quite healthy up to the age of seventeen. Acute rheumatism occurred at this age and twelve months later double genu valgum followed. She was able to walk up to a year ago,. The present condition shows extreme softening of all bones, which can be easily bent and this change extends to the bones of the cranium. The condition is improving with absolute rest on a double frame.



The following case is one of coxa vara due to rheumatoid arthritis forming the so called senile hip.

Wm. Rogers (65) A cellarman, comes to hospital complaining of lameness, pain and stiffness in the right hip.

This condition has been coming on for the last four years, the pain in the groin has been present for two years and is now worse than ever it was.

The pain gets worse when exercise has been taken and it begins from the great trochanter down the outer side of the thigh.

The hip is stiff when the patient gets up in the morning and gets better when he has walked a little on it.

On examination the right trochanter major is found to be prominent and slightly broader than the left one. Movements at the hip joint are very much impaired only about  $45^{\circ}$  of flexion and extension being possible.

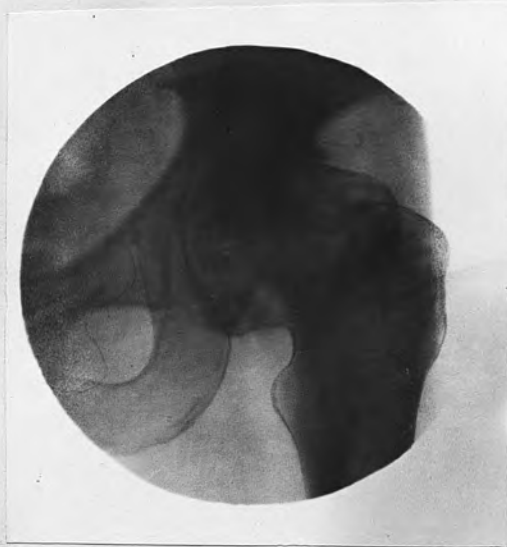
As he lies in bed the hip is flexed to  $15^{\circ}$  and adducted to a corresponding angle.

Rotation of the hip inwards is impossible except to a very slight degree, but external rotation is quite free and unlimited.

Abduction is quite impossible beyond a straight line in the long axis of the body.-

R R	$32\frac{1}{2}$ "	L R	$33\frac{1}{2}$ "
R A	34"	L A	$36\frac{1}{2}$ "
A S S	11"		
G T above N.	1"		
Angle of Adduction	$13^{\circ}$		

The patient's gait is most restrained and there is great lameness with tilting upward of the pelvis on the right side.



X ray.

The angle is considerably lessened - more so than is usually seen in a man of this age. The blurring of outline and general indistinctness of lamellae so characteristic of rheumatoid arthritis is well seen.

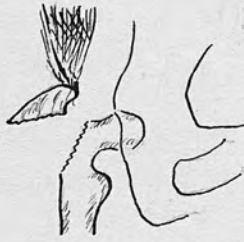
Treatment.-

Pseudarthrosis (Robert Jones) was decided upon. The operation lately devised by Mr. Jones for ~~the~~ procuring a moveable joint from one where there is synostosis is as follows.-

A vertical incision 4 to 6 inches in length is made on the external surface of the thigh with its centre at the most prominent point of the trochanter.

The trochanter is exposed to view in toto: a chisel is now taken and a large slice removed from the trochanter from below upwards and inwards. This piece is turned upwards, on a hinge, as it were, formed by its periosteal attachment at its upper part and the muscles attached to the top, viz.- the gluteus medius

and minimus.



The shaft of the femur at the lower portion of the trochanter is now freed in its entire circumference and divided by means of a Gigli saw. The insertions of the psoas and iliacus are below their level and are thus preserved.

The neck is now cut through with a chisel flush with the acetabular rim and the intervening portion of neck and trochanter removed.



All the bleeding having been stopped the slice of the great trochanter is now turned inwards on to the acetabulum and fixed into position with a screw.



The upper end of the femur now comes in contact with the periosteum of the great trochanter forming a false joint. Movement was passively performed in 3 weeks and the patient allowed to walk with a calliper in 6 weeks.

This operation is of great value as by its means much of the telescoping so prevalent in those cases where the head, neck and great trochanter were removed. Union cannot take place as the upper end of the femur is the only portion bereft of periosteum.

ANOTHER CASE OF SENILE HIP.



The following case of coxa vara caused by spontaneous fracture of the neck, due to secondary carcinoma of neck and trochanter I quote from the point of its great interest and variety.

Catherine Shannon, age 40.-

This patient is a married woman with 5 children and she was perfectly healthy up to 3 years ago, when

she had her right breast removed for carcinoma at the Royal Infirmary, Liverpool.

The mass at the time of the operation was about the size of a hens egg and although the hard lump had been noticed for 4 or 5 months previously, it had not been commented on as she was suckling a baby.

Three months after the operation, which was most complete, a slight recurrence occurred in the posterior triangle of the neck. This was removed immediately.

For about 20 months after this the patient was perfectly well and returned to her occupation as a school teacher.

In January 1907 she became pregnant and about this time she noticed a slight pain in the left groin. About Easter she began to walk lame and the pain in the groin became worse if the foot or leg were jarred in any way.

In June 1907 the left leg was apparently so short that she had to walk with a stick, but the trouble was still attributed to pregnancy.

No weight could now be borne on the bad leg and crutches were used and their use has been continued up to the present.

Six weeks before the baby was born, on an occasion the patient slipped slightly and in recovering herself she put weight on the bad leg. Great pain at once followed and the leg began to swell.

She was removed to hospital with thrombosis of the saphena vein and she remained here till after the



baby was born in October.

Since then the leg has gradually become worse and the hip has become more and more swollen.

In January she went to the Royal Infirmary, and the surgeon suspecting secondary trouble in the hip, sent her to Mr. Jones.

The hip is swollen and slightly painful on pressure. Movement in all directions is free but limited. External rotation is increased by  $1/5$  and rotation inwards decreased by  $1/2$ . Hyperextension of the hip is impossible. All passive movements can be executed without pain. The great trochanter is raised above Nelaton's line for 1 inch. There are  $1\frac{1}{2}$  inches of shortening. Abduction is not possible beyond an angle of  $30^{\circ}$  and there is pain present on exerting this amount of abduction. The scar in the breast looks well and there are no secondary deposits ascertainable elsewhere.

The patient walks with crutches and she has not been able to bear weight on the left leg since last June.

X-ray appearances. -

There is coxa vara present. There are apparently some changes present in the neck as the laminae appear thinned and this change extends to the head. The great trochanter however appears to be the seat of the most marked change. There is apparently a cystic condition of the bone, the greater portion of the great trochanter being evidently in this state.

Within the area that appears cystic the lamellae are much changed being thin and irregular, giving a blotchy appearance which is totally different from that produced in sarcoma.

There is a shadow obliquely across the much shortened neck evidently caused by a fracture.

A diagnosis of secondary carcinoma was made and as the joint was not involved it was decided to exsect the joint and not amputate the lower limb. This was done - the head and neck with great and small trochanters were removed.

I show the X-ray of the recent specimen to show how beautifully the laminae are portrayed in the neck and their alteration. B

The pathological report is as follows.-

Macroscopically.- There is marked abnormality in the disposition of the parts at the upper end of the femur. The neck of the bone is completely absent, the head at its anterior-inferior surface resting on the small trochanter, and looking in an upward direction. There is a complete fracture where the head joins the shaft.

On section. - The great trochanter and shaft seem normal in colour and consistency. The medullary cavity ends abruptly below the great trochanter. The head rests on the inner aspect of the shaft - from which it is separated at the site of the fracture above mentioned - and on the internal surface of the small trochanter. The head is pink in colour, of uniform solid consistency, and abnormally soft.

CATHERINE SHANNON ⇒

XRAY IN SITU



XRAY OF EXSECTED HEAD

TRANSVERSE →  
VIEW OF FEMUR

ANTERO-POSTERIOR VIEW  
→



B

Microscopically.- There is very little bone left in the section. It is mainly composed of a fibrous tissue stroma with intervening spaces occupied by epithelial cell-groups. The spaces of the meshwork are variable in size, and according to their size contain larger or smaller cell-groups. In some cases there is only one cell in a space. The strana shews some round-celled infiltration; the cells are epithelial in character and irregularly rounded in shape. They do not definitely indicate by their character the position of the primary growth.

Diagnosis. Secondary Carcinoma Head of femur.

This case is one of great rarity the last one quoted, where the head neck and trochanter were excised was by Rose in 1894. The shortening of the limb was due primarily to absorption of the neck and secondarily to the spontaneous fracture that occurred last September due to a slip. The patient is still in bed but will begin to walk in a calliper splint in about six weeks.

The prognosis is of necessity grave but the excision of the diseased parts gives some chance of recovery, amputation with complete removal of pelvic soft parts, the only other alternative, being contra-indicated by the condition of the patient.

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