SACRALISATION OF THE FIFTH LUMBAR VERTEBRA.

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WHEN the body of the fifth lumbar vertebra is partially or completely fused with the sacrum, or when overgrowth of one or both of its transverse processes takes place to such an extent as to cause them to articulate with the iliac bones, the condition has been called sacralisation.

It is an abnormality well known to anatomists, but it is only in recent years that attention has been directed to it by Continental and American surgeons as a cause of obscure lumbo-sacral and sciatic pain.

In 1910, Adams (1) published the case of a girl aged 16 who had progressive lumbo-sacral scoliosis associated with pain referred to the sacro-iliac region. Radiography showed the transverse process of the 5th lumbar vertebra to be abnormally developed, and to articulate with the iliac bone. To this he attributed the symptoms which were relieved by resection of the transverse process.

Richards, Goldthwait and Clarke in America, Rossi and Bertholotti in Italy, Kleinschmidt in Germany, André Rendu, Arcelin, Nové Jossierand and others in France have published many cases. Here I might say that it was in very excellent papers by the latter which appeared in the *Lyon Médicale*, July, 1920, and *La Presse Médicale*, July, 1920 (for which I have to thank Mr. A. K. Henry), that I obtained most of my information on this interesting subject, and from which I intend largely to quote.

To regard the condition as a curiosity to be brushed aside as being of no practical importance can scarcely be argued from the attention which it has received from those whose names I have mentioned. Within the past few months I have seen four cases to which I shall refer in detail later on. Recently I accidentally picked up from amongst my old plates the negatives of two other cases, one of which I radio-

graphed in April, 1917, for caries of his 3rd and 4th lumbar vertebræ. This plate also showed a sacralised 5th lumbar, although I did not then recognise it as such. Early in 1918 a gentleman was referred to me for radiography of his urinary tract. I found a small calculus impacted in the lower end of his right ureter which was subsequently voided. He also had unilateral sacralisation on the right side, but he had no symptoms referable to it. I casually came across this negative quite recently also, and I have no doubt but a careful search through my old plates would reveal many other examples of this abnormality.

Unless it is that these unusual cases have come together in a bunch as we all know they sometimes have a peculiar habit of doing, it seems that the condition needs only to be better known to be more generally recognised.

Anatomical Considerations.

The spinal column is subject to many anatomical variations, and these anomalies are commonly found in the cervico-dorsal, dorso-lumbar, and lumbo-sacral regions. In the lumbar region six vertebræ are sometimes found; the transverse processes of the 1st lumbar are sometimes short, and have accessory ribs. This occurs when the transverse process of this vertebra is "associated with an independent costal centre, which may blend with it, or persist as a lumbar rib." (Cunningham's Anatomy.)

As regards individual vertebræ variations in the 5th are perhaps the commonest. The spines are often bifid; the neural arch may not have fused and there is *spina bifida*. The transverse processes may be elongated or bulbous at their extremities, and articulate with the ileum, or they may be fused with the sacrum.

Here it might be well to recall that the vertebræ are developed from three primary centres of ossification—viz.: one for the body and one for each lateral mass which includes the lamina and its processes.

The laminae unite during the first year. There are five secondary centres: one for each upper and lower surface of the body, one for the tip of each transverse process, and one for the tip of the spinous process. The 5th lumbar

vertebra, however, sometimes has five primary centres of ossification—viz. : one for the body, one for each side from which is developed the superior articular process, pedicle, and transverse process, and one on each side which subsequently form the inferior articular process, lamina and transverse process.

It is not surprising, then, that variations are found in this bone, the development of which is so complex.

Weidersheim, in *The Structure of Man*, says that fusion of the 5th lumbar vertebra with the sacrum is due to a tendency of the pelvic girdle and sacrum to shift farther forwards. He says:—"Although the pre-sacral portion of the column consists normally of twenty-four vertebræ, embryology and comparative anatomy show that this cannot be regarded as a primitive condition, and that the pelvis formerly lay much further back than at present, that is, that the trunk was originally longer than now.

"Rosenberg has demonstrated that in the course of human development the first sacral vertebra becomes incorporated in the sacrum later than the second, and that later than the third, and so on. And further, since the primary relationship between the vertebræ, which become the two anterior coccygeal of the adult, and the developing sacrum is discoverable, it is evident that while new sacral articulations are formed anteriorly, detachment of the vertebræ which were formerly sacral takes place posteriorly, the latter being transformed into coccygeal vertebræ. *A forward shifting of the sacrum and pelvic girdle is thus ontogenetically proved.*

"These changes come to an end when the twenty-fifth vertebra, by virtue of its apposition with the hip-girdle, becomes the first sacral and the promontory attains its full differentiation between it and the last lumbar vertebra—i.e., between the twenty-fourth and the twenty-fifth vertebræ of the whole column.

"This later assimilation anteriorly of the sacral vertebræ is further evident in the fact that synostosis between the separate parts of the sacrum always takes place from behind forwards.

"The tendency of the human pelvic girdle to extend even farther forwards is revealed in cases in which the last or

fifth lumbar vertebra enters into the constitution of the sacrum. The number of pre-sacral vertebræ is in such a backbone reduced to twenty-three, and this is the normal condition in the orang and chimpanzee, and the general, though not the invariable, condition in the gorilla. This change is accompanied in man by depression of the promontory which becomes duplicated. The sacrum appears deeply sunk into the pelvis; although such sinking may also occur without any incorporation of the fifth lumbar vertebra in the sacrum. In both cases the iliac crests rise almost to a level with the upper edge of the penultimate lumbar vertebra." (*The Structure of Man*. 1895. Pp. 33 and 34.)

Sacralisation may be uni- or bilateral, and it may exist to varying degrees on one or other side.

Rossi's statistics show

12 Bilateral symmetrical.

8 Unilateral, of which 5 were in the left, and 3 on the right side.

2 Combined with the spina bifida.

Nineteen radiograms collected by Nové Jossierand and A. Rendu show

6 Bilateral symmetrical.

8 Bilateral asymmetrical.

5 Unilateral, of which 3 were on the right side and 2 on the left.

Six cases which I have seen show

3 Bilateral symmetrical.

1 Bilateral asymmetrical.

2 Unilateral, one on the right side and one on the left.

SYMPTOMS—Pain is the chief clinical manifestation, but it is not constant. Rossi admits that the deformity may remain latent indefinitely. It may be discovered accidentally in the course of examinations for trauma, rheumatism, or renal calculus. When it causes pain it is usually between the 20th and 30th year, although Adams, Nové Jossierand, and Rendu record 2 cases at the age of 16. Bertholotti holds that there is a relation between the onset of the first symptoms (pain) and the completion of the processes of ossification. The symptoms vary. Sometimes pain is continuous, and increased by exercise. Sometimes there may

be acute attacks of neuralgic pain at intervals of days or weeks, or the pain may come on so intensely and so suddenly that the patient is unable to move.

The site of the pain is also variable, but it is usually in the lumbar region, and towards the base of the sacrum. It is median when the abnormality is symmetrical, and to one or other side when it is unilateral. It is then located in the region of the sacro-iliac articulation, and usually on the same side as the abnormality, although it may exceptionally be on the opposite side. The pain may radiate along the sciatic nerve towards the ischium or coccyx, or into the groin. One case is mentioned in which there was a patch of hyperaesthesia so intense as to prevent the patient sitting comfortably for any great length of time.

Bertholotti and Rossi lay stress on the nervous lesions which accompany these neuralgias, such as flaccidity of the muscles, zones of hyperaesthesia, diminution of tendon reflexes, diminished response to electrical stimulation, and even reaction of degeneration in certain groups of muscles, particularly the flexors. After minute examination from this point of view, Nové Jossier and Rendu have been unable to confirm these observations, but they suggest as a possible explanation that these cases were more or less severe. They have, however, observed in one or two of their cases a functional derangement for which they have been unable to find a satisfactory explanation—namely, inability to flex the knee beyond a right angle without causing pain, for, they say, there is nothing in the joint capable of causing this limitation of movement. The pain referred to the groin is deep-seated, and is localised principally towards the lower end of the ureter, and is increased by pressure.

On examination one finds the site to which the pain is referred more or less extensive, and there is pain on deep pressure. Flexion and lateral inclination of the spine are painful.

In bilateral sacralisation there is flattening in the lumbar region with obliteration of the normal lordosis. This region seems to be shortened, elevated, and the transverse dimensions of the sacrum appear to be increased.

In unilateral sacralisation there is frequently a lumbar scoliosis and appreciable asymmetry of the sacro-iliac region. Sometimes even one side of the pelvis is more elevated than the other, and there is slight lameness.

DIAGNOSIS.—From what has been already said it is not very difficult to recognise the condition, and radiography will show the abnormal development of the transverse processes of the 5th lumbar.

It is, however, very difficult to establish the relationship which exists between the abnormality, and the symptoms complained of by the patient. The latter are common to many and varied affections of the region, *e.g.*, sacro-iliac disease, caries of the lumbar vertebræ, osteo-arthritis of the vertebræ, renal calculus, etc., any of which may exist with latent sacralisation. One of my cases had caries of the 3rd and 4th lumbar vertebræ, one had superficial erosion of the sacrum, and one had symptoms suggesting renal calculus, and one actually had a calculus impacted in the lower end of the ureter. In the matter of differential diagnosis I will quote verbatim what Nové Jossier and Rendu say.

“ In the present state of our knowledge to elucidate the problem one may be influenced by the following facts:—

“ (1) The similarity between the symptoms of sacralisation and the affections named is vague and remote, and it is still less on thorough examination because the definite diagnostic signs are wanting. Thus in many cases where local and referred pain point to sacro-iliac disease, pain is not caused by separating or compressing the iliac bones which characterises inflammation of the sacro-iliac syncondrosis.

“ Similarly in Pott's caries. Sacralisation produces rigidity and pain on movement, but this pain is not confined to the body of a single vertebra. There is no projection of the spinous processes and the rigidity is less than in lumbar caries, and the lateral movements and rotation are more limited than flexion and hyper-extension, contrary to what is observed in tuberculosis of the spine. The referred pains of sacralisation appear to be indefinitely localised, and the symptoms less accentuated than in nerve lesions.

“ Finally when the symptoms suggest an affection of the

kidney or appendix the clinical examination and radiography fail to show any physical signs relating to them.

“(2) The mode of onset and subsequent development of pains caused by sacralisation are sufficiently characteristic.

“A healthy young person begins to complain without any apparent cause. The pain persists or returns sometimes at prolonged intervals without any interference with the general health, and without any indication of new signs of a spinal or nervous lesion. These points are strong, presumptive evidence of sacralisation. It is well to note that sacralisation might become evident only after trauma or an attack of rheumatism. The diagnosis then becomes much more difficult. The association of the site of pain with that of sacralisation is an additional fact not without value. We have observed the pain always on the side of the malformation when it is unilateral or predominant on one side, and when the deformity is generally symmetrical, then it is bilateral. The lumbar pain is located most frequently on the affected side; nevertheless, it is well to remember, as Richards points out, that it may be on the opposite side.

“(4) Richards insists strongly on the necessity for searching carefully for the points of bony contact by making many radiographs at different angles. His advice ought to be followed, and there is no doubt that the existence of bony contact supports a diagnosis of sacralisation.

“At the same time it must be noted from cases so far published that bony contact is not an essential condition, and that one ought not to try to establish a constant ratio between the degree of bony deformity and the intensity of the symptoms.

“When all these factors agree the diagnosis of sacralisation ought to be placed on a firm foundation. On the other hand, it would be prudent to keep the patient under observation for a certain time before making a final diagnosis, and even then there may be some reservation. But it may be hoped that with greater experience of the condition there shall be more definite signs of recognising it.”

Of the six cases which I have mentioned, in two only were the symptoms definitely referable to the abnormality, and they could be explained on no other hypothesis. One was

a robust man, aged 47, who led an active life in the country, he took much exercise, and he was fond of riding and shooting. His symptoms developed gradually, and there was no history of injury. He had pain over the left sacro-iliac region on standing and also when sitting in certain positions. He had no pain when walking, and he had no pain when he was partly standing and partly sitting on a high seat.

His malady was variously diagnosed as rheumatism, lumbago, sciatica, and sacro-iliac disease, and in order to establish this latter diagnosis he was referred to me for *x-ray* examination. This showed an abnormally-developed transverse process of the fifth lumbar vertebra on the left side which was articulating with the iliac bone (*see* Plate 9).

The patient I have shown here to-night is under the care of Mr. Barniville at the Mater Misericordiæ Hospital, to whom I am indebted for the privilege of exhibiting her. She is a school-girl aged 13. Her parents are alive and in good health, and she has several healthy brothers and sisters. She has had no previous illness. About a year ago she had influenza, after which she had pain in the lower part of the back and in the legs on walking. She also noticed that she walked peculiarly. She is now fairly well nourished, but thin. She walks with the knee-joints slightly flexed, and the thighs slightly abducted. She refers pain mainly to the outer surface of the thighs, and she says it is slight in the lumbar region. Her fifth lumbar spine is prominent. There is no tenderness of the spine or sacro-iliac joints.

Flexion, lateral flexion, and rotation of the spine are limited. The lower lumbar spine is rigid. Her knee jerks are somewhat exaggerated. Complete extension of the knee joints can be produced passively, but it causes pain in the hamstrings to do so.

X-ray examination shews bilateral symmetrical sacralisation of the fifth lumbar vertebra, the spine of which is tilted upwards, and it lies close to the spine of the fourth lumbar vertebra. There are no signs of caries of any of the vertebræ (*see* Plate 11).

TREATMENT.—Two methods of treatment have been practised: radical and palliative.

The results of radical treatment (excision of the offending

transverse process) have been uncertain—no case of complete cure has been reported.

Palliative Treatment.—Rest, the application of continuous currents, *x*-rays, and other physical therapeutic methods have given relief in the experience of many.

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