SACRO-ILIAC SYNOSTOSIS AND PELVIC DEFORMITY

L. H. Wells, M.B., CH.B., D.SC. (RAND.), F.R.S. (EDIN).

Professor of Anatomy, University of Cape Town

Recently, while working through a collection of bones the records of whose origin had been lost, I came upon an adult female pelvis showing unilateral sacro-iliac synostosis associated with a typical oblique contraction ('Naegele' pelvis). The obliquely contracted pelvis has usually been regarded as very uncommon (Baird, 1950). However, Greenhill (1955) says: 'This type of pelvis is more common than is usually believed. Thoms in routine roentgen studies of obstetric patients found 3 cases in 2 years'. On this account it has seemed to me that a brief account and discussion of this specimen would be of value.

The pelvis is that of a mature but at most middle-aged woman; the character of the pubic symphyseal surface, judged by the criteria laid down by Todd (1921) for American White and Negro-white hybrid women, suggests an age above 30 but probably less than 50 years. The lumbo-sacral and left sacro-iliac joints show very slight accentuation of their margins, but no osteophytic outgrowths. The front of the bodies of the 1st and 2nd sacral vertebrae is, however, very much roughened over the whole area for attachment of the anterior longitudinal ligament. The acetabula are symmetrical and free from pathological changes.

Fig. 1 shows the typical 'Naegele' distortion of the outline of the pelvic brim. The sagittal plane of the sacrum, if prolonged forwards, passes to the right of the right pubic tubercle, so that the symphysis lies fully an inch to the left of this plane. The iliac crests are, however, approximately symmetrical. The principal dimensions of the pelvis are as follows: Intercristal diameter 245 mm., anterior inter-spinous diameter 215 mm., sagittal diameter of brim from promontory 92 mm., promontory-symphyseal conjugate 98 mm., transverse diameter of brim 119 mm., right oblique diameter 125 mm., left oblique diameter 108 mm.

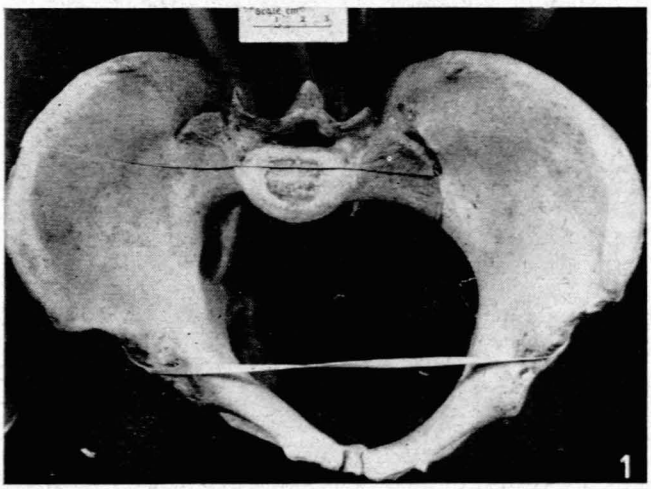

Fig. 1. The pelvis described in the text, viewed perpendicular to the plane of the pelvic inlet. The left iliac spine, which is in deep shadow, has been outlined in white.

The right sacro-iliac joint is solidly synostosed. On the iliac face its line is marked by a slight and irregular bony ridge; on the pelvic face it cannot be traced at all, a completely smooth surface flowing from the ilium on to the lateral mass of the sacrum. There is no trace of a pre-auricular sulcus on this side, whereas there is a slight and narrow one on the left. Posteriorly the ossification process seems to have involved the interosseous ligament to some extent. Although the line of the joint cannot be completely traced, it is clear that the lateral mass of the sacrum does not extend so far laterally on the right side as on the left. The great sciatic notch is slightly narrower on the synostosed than on the normal side; the latter admits 3 fingers with ease, the former with slight difficulty. On the normal side there is a conspicuous roughened area at the junction of the iliac and pubic parts of the pectineal line; on the fused side this is only faintly developed.

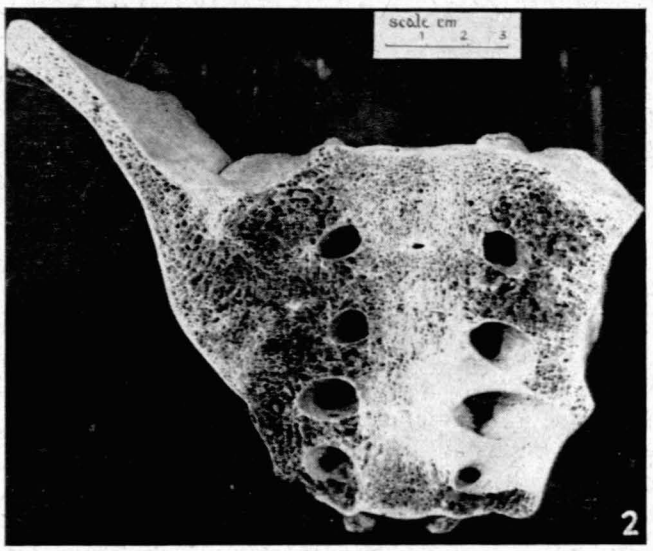

Fig. 2. Section through the sacrum and right ilium in the long axis of the sacro-iliac joint.

A saw-cut has been made through the specimen approximately in the long axis of the sacro-iliac joint. As Fig. 2 shows, there is no trace of a joint cavity in this section. The slight ridge which marks the position of the joint on the iliac face is formed by a thickening of the outer compact stratum; at the inferior limit of the joint there is no such thickening. The internal structure is a meshwork of cancellous bone. Superiorly and inferiorly the presumed position of the joint is marked by a zone of relatively fine mesh, but this thins out and disappears towards the centre, where the coarser meshwork extends without a break from the ilium into the sacrum.

The section through the auricular surface on the normal

side of the sacrum shows that the skin of compact bone underlying the articular cartilage is very thin. It is backed by a narrow zone of fine-meshed cancellous bone which merges into the coarser meshwork of the interior.

TWO PROBLEMS

The problems raised by this specimen are, first, the relationship between sacro-iliac fusion and pelvic asymmetry, and second, the cause of fusion in this instance.

Heyns (1955) points out that additions to the perimeter of the pelvic brim take place at the acetabular, the symphyseal, and the sacro-iliac joint epiphyseal cartilages. The epiphyseal plates for the auricular surfaces of the sacrum are responsible for the lateral growth of the sacral alae; it is not clear whether the amount of bone growth on the innominate surfaces is comparable. Despite minor complexities, it is clear that increase in the width of the posterior sacral segment depends very largely upon growth at the sacro-iliac joint, chiefly it would seem on the sacral side. Heyns further suggests that growth along the ventral border of the iliac auricular surface is associated with a migration dorsally of the sacro-iliac joint. Differential growth along this border may be responsible for the sex difference in inclination of the sacrum, and indirectly for that in width of the great sciatic notch.

Payton (1935) suggested that the 'Naegele' deformity might result from failure of the sacro-iliac joint on one side to migrate dorsally. This would manifest itself by an unusual distance between the joint and the crest of the ilium, as though the ilium had grown past the sacrum instead of carrying it along. In the present specimen, however, the two ilia are approximately symmetrical in relation to the dorsum of the sacrum. In spite of the slight difference in the sciatic notches, it seems very unlikely that the deformity in this case can be attributed primarily to failure of the sacro-iliac joint to migrate dorsally.

The most probable cause of the deformity in this case is therefore a failure of growth on one side of the sacrum. This explanation of the 'Naegele' and its relative the 'Robert' pelvis is very generally accepted, but on the reason for the sacral defect and its relation to sacro-iliac fusion there is no such agreement. One school of thought, represented by Baird (1950), considers that the 'Naegele' deformity usually results from disease of the sacro-iliac joint in infancy with ankylosis; the alternative view, expressed by Brailsford (1953), attributes it to failure of development of the ala of the sacrum on the one side and subsequent fusion of the ilium to the defective sacrum. Greenhill (1955) admits both possibilities, but maintains that congenital defects of the wings of the sacrum do not produce so gross a deformity as disease of the sacro-iliac joint.

It is understandable that disease of the sacro-iliac joint in childhood, with more or less complete destruction of the growth cartilage, should be followed by ankylosis, and that subsequent growth at the other cartilage zones would produce increasing deformity. Why a primary defect in the sacral ala should tend to sacro-iliac fusion is less obvious.

My former colleague in the University of Edinburgh, Dr. Ethne Little, had the opportunity some years ago of studying a young adult woman displaying a typical 'Robert' pelvis. In this case there was radiologically no evidence of sacro-iliac fusion, although the classic descriptions of the Robert pelvis insist on its presence. There seemed to be no reason for dissociating this case from other examples of the Robert pelvis. The conclusion to which it pointed appeared to be that the primary defect is in the growth of the sacrum. From this point of view it might be argued that the Robert pelvis is an extreme degree of the 'anthropoid' pelvic form. Whether these inferences can be extended to cover the Naegele pelvis is another matter.

Complete unilateral fusion without pelvic asymmetry has been described by Shore (1930) in a Zulu male aged 56 years. On section, the position of the joint was found to be marked by a band of compact bone several millimetres broad and remarkably even in width. The cancellous bone on either side of this band was very regular in its organization, with no evidence either of excess bone formation or of bone absorption.

Shore argues that 'uniformity in the extent of the union, uniformity in the compact bone which replaces the sacro-iliac joint, and uniformity in the texture of the cancellous bone which abuts on the union are jointly and severally inconceivable as the result of synostosis of arthritic origin'. He therefore regarded his specimen as one of 'developmental' or non-pathological synostosis. From the symmetry of the pelvis he concluded that fusion had taken place after growth was completed, inferring that fusion in early life would have resulted in asymmetry. Further, he tentatively suggested that the synostosis might be likened to the fusion of an epiphysis or of the vertebral components of the sacrum. This suggestion clearly cannot be pressed too far, since a synovial joint is concerned and not a simple cartilaginous layer.

Sacro-iliac fusion, however it comes about, involves an obliteration of the joint cavity. It is indeed conceivable that the process of chondrification might extend across the primitive joint plate so that no synovial cavity developed. Secondary fusion between the two articular cartilages is perhaps easier to envisage, even in the absence of distinct pathological changes. Whillis (1940) indeed claimed that adhesion between articular cartilages is frequent if not normal in late foetal life, but his evidence has not been substantiated by other investigators.

Schunke (1938) states that cavitation in the sacro-iliac joint begins during the 10th week of intra-uterine life, but does not reach its full extent until late in the 7th month, although passive motion commences after the 6th month. Fibrous strands connecting the articular cartilages are present in foetal and early post-natal life and may be found in the adult. Brooke (1924) describes fibrous adhesions between the articular surfaces in the adult, giving the joint the semblance of a fibro-cartilaginous amphiarthrosis, but he insists that this is a pathological condition associated with advancing age. Schunke finds that the synovial cavity is normally preserved throughout life, even when extra-auricular synostosis has occurred. This type of union, which is common in the 5th decade especially in males, is due almost entirely to ossification in the anterior sacro-iliac ligament above the pelvic brim (the proximal sacro-iliac ligament of Fick). The condition, of which I have seen a number of examples, is quite different from true sacro-iliac fusion.

The specimen described by Shore presents the impression

that the joint space has become completely filled by compact bone. In mine there is no such band of compact bone, merely a discontinuous zone of fine-meshed cancellous bone. This might simply mean that the fusion is of longer standing in my specimen, but there is no way of proving this.

Although there is no gross evidence of inflammatory reaction in my specimen, I do not think that a pathological background can be excluded. Indeed a pathological destruction of the joint and the adjacent growth cartilages during childhood, followed by bony repair, is in many respects the most intelligible explanation.

From the foregoing it will be evident that no final answer to many of the questions raised by this study can as yet be given. It is clearly necessary for cases showing either defective sacral development or juvenile sacro-iliac arthritis to be followed through life and if possible to autopsy. The difficulty is that in many cases the anomaly, if not discovered accidentally in the course of some other investigation, may betray itself only as a well-established deformity or may pass unrecognized throughout life.

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