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## A STUDY OF THE ANATOMY AND THE CLINICAL IMPORTANCE OF THE SACRO-ILIAC JOINT \*

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Some time ago the writer was much surprised, on reading the literature of the minute anatomy of the sacro-iliac joint or synchondrosis, to find such a marked disagreement among the prominent anatomists and gynecologists. To quote in brief from some of them: Morris holds that even the presence of synovial membrane is not constant, stating that it is more apt to be present in the female. Luschka believes that a small amount of synovial membrane is always present and that it increases in size at times of pregnancy. Cunningham states that the synovial cavity is imperfect and rudimentary, but believes that hyaline articular cartilage exists usually. Testut, the great French anatomist, mentions certain folds of synovial membrane which occur here and there, filling up gaps or margins of the fibrocartilage. Morris denies that there is any appreciable movement at this synchondrosis. Williams (in 1903) states that "the articulation between ilium and sacrum is described as a synchondrosis, but is really a joint, on account of the presence always of more or less synovial membrane." Kuttner asserts that it is a joint with motion and that the horizontal position increases the true conjugate diameter of the pelvis by 6 mm. and Walcher's position by 9 mm., as compared with the lithotomy position.

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\* From the anatomic laboratory of Cornell University Medical College.



On account of the above-mentioned disagreement of the best authorities as to the anatomy of this joint, with emphasis on the term "joint" rather than synchondrosis, I was induced to ascertain, if possible, by the dissection of a sufficient number of joints, its true anatomy. By the kindness of Professor Haynes an abundance of material was furnished me at the Cornell University Medical College.

The results of this work are briefly as follows: In the careful dissection of fifty specimens a perfect joint, composed of all its elements, such as synovial membrane and cavity, and strong well-formed capsule was found in each instance, and proved to be as constant in its size and relations as any other joint. Before opening the joints many were injected with an aqueous solution of methylene blue, which colored the synovial membrane so that it could be seen to distend and retract all along the anterior-inferior aspect of the joint when motion was elicited. This part of the capsule is very thin, which accounts for the fact that infection of this joint is very prone to discharge by this avenue into the pelvis and rarely through the very thick part of the capsule posteriorly; also, this part of the capsule often ruptures in symphysiotomy, and in case of puerperal sepsis opens the joint to infection. Sansten states that it ruptures in 44 per cent. of cadavers below 6 c.c. of pubic separation. The lumbosacral cord passes in close proximity to the joint at its lower third, and undoubtedly is frequently involved in affections of this joint, thus explaining the presence of persistent pain in the distribution of this nerve, i. e., sciatica.

The articulation is easily opened by incising the anterior part of the capsule and forcing the pelvic bones apart in front, the symphysis pubis having already been separated. The sacrum and the ilium swing on the posterior and interosseous ligaments, as a door on its hinges. Hence the frequent interference with locomotion and permanent injury of this joint following symphysiotomy.

In my dissections the interosseous ligament always separated from the ilium and never from the sacrum. The round ligament sometimes ruptured and sometimes its bony attachment. The anterior or auricular portion of each articular surface was covered with a thin plate of cartilage, which was thicker on the sacrum than on the ilium. It averaged, in the fifty specimens, in its



greatest length, 7 cm. ( $2 \frac{3}{5}$  inches), and in width 3 cm. ( $1 \frac{1}{8}$  inches). The largest joint area of hyaline cartilage was 8 cm. ( $3 \frac{1}{16}$  inches) in length and 3 cm. ( $1 \frac{1}{8}$  inches) in width. The smallest was 6 cm. ( $2 \frac{1}{4}$  inches) in length and averaged in width  $2 \frac{1}{2}$  cm. ( $1 \frac{5}{16}$  inches).

The posterior irregular part is the attachment of the interosseous and round ligaments, around the latter of which most of the motion occurs as about an axis. One joint was affected with osteoarthritis and the anterior part of the joint was obliterated with bony deposit, which also extended into the posterior ligament.

Let us now consider briefly the mechanics of this articulation. The sacrum is an inverted key to an arch suspended principally by the posterior sacroiliac ligament. The base of the sacrum, in the upright position, projects forward beyond the articular surfaces of the ilium and has a tendency to tip down. This is prevented by the sacrospinous ligaments, which tie the lower part of the sacrum to the ischium. Here is a great articulation placed at the cross-roads, so to speak, between the trunk and the thighs and mechanically imperfectly constructed to sustain sprains and injuries.

Distinct motion was elicited and measured carefully in every specimen except one and motion was absent here, as stated above. These researches were carried on in conjunction with Dr. Henry L. Taylor and will be reserved for a future publication. Sixteen of the cadavers were placed in Walcher's position<sup>1</sup> and the true conjugate diameter of the pelvis averaged an increase of 8 mm. ( $\frac{1}{3}$  inch). Walcher obtained 9 mm. on the living subject.

My interest in the pathology of this joint was first stimulated by seeing a case of relaxation of this joint with Dr. Goldthwait of Boston in 1903. This was before the publication of the monograph on this subject by Dr. Goldthwait and Dr. Osgood, who were the first to demonstrate the existence of such a condition. The relaxation in the case referred to was caused by lying for a very long time in the position of dorsal decubitus following a pelvic operation.

Under favorable circumstances, however, this joint will stand much abuse, as in the case of a symphysi-

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1. Patient on back with her legs hanging over the edge of the table.



otomy. Edgar reported five cases in which he obtained from 2 to 2½ inches of separation at the symphysis followed by firm union and without symptoms. Nevertheless, this articulation is liable to all the affections of other joints and in the event of infection the prognosis is often serious, because, first, it is very likely to be a metastatic infection from some other part of the body, and, second, as described above, on account of the danger of spontaneous drainage forward into the pelvis.

#### ILLUSTRATIVE CASES

**CASE 1.—History.**—Miss N. M., was seen by me Feb. 25, 1906. She worked in a web factory; her previous history was negative. Last October she fell over a large stone in the country and strained her back, and was in bed two weeks. This was followed by inability to stoop, lie on back, or stand on right foot, without severe pain in extreme lower part of the back, which always remained in the same place and became more severe at her menstrual periods. The patient's only comfortable posture was lying on the left side.

**Physical Examination.**—Total lateral spinal curvature to the left. Spine normally flexible. Hip and other joints normal. Very distinct tenderness over lower part of right sacroiliac joint. Goldthwait's symptom present, i. e., pain in region of sacroiliac articulation, when the thigh was flexed with extended leg to a right angle or less. Pain produced by standing on right foot; most severe, however, when patient attempted to turn over, while in a reclining position.

**Treatment.**—Pelvis was encircled by very tight two-inch bands of surgeons' adhesive plaster just below the anterior-superior spines of the ilia. Patient reported in one week entire relief. The strapping was reapplied, at periods of a week, four times. A long corset with a four-inch elastic webbing belt at bottom to grasp the pelvis was then made, which has been worn with entire relief ever since.

**CASE 2.—History.**—Miss A., O., aged 15, was referred to me by Dr. A. A. Crane, Waterbury, Conn., Feb. 20, 1906. She attended school and practiced on the piano a good deal. Previous history was negative. The patient has had pain continuously in lower part of back ever since falling on the ice three years before. There was an increase of pain at the time of each menstrual period, although menstrual fluid had not appeared. Pain was produced by walking, sitting, especially on the affected side, or laying on the back. The patient never lays on the back, always on the left side.

**Physical Examination.**—Fairly well developed and nourished girl. Examination negative except for marked total spinal curvature to the left. No rotation. Tenderness over upper part of right sacroiliac joint. Spine normally flexible



except in its extreme lower part. Goldthwait's symptom markedly present. Pain elicited by patient standing on right foot and lying on the back.

*Treatment.*—This was same as first case. The relief was marked, although for three years the patient had been under constant treatment without the slightest amelioration of the symptoms. Three months later the patient reported that relief had continued and that she had gained ten pounds in weight.

I am indebted to Dr. H. H. A. Beach and Dr. R. B. Osgood for the privilege of reporting the following case:

*CASE 3.—History.*—F. C. R., a man, aged 23, entered the Massachusetts General Hospital, Dr. Beach's service, Sept. 28, 1905; occupation, mechanic. Past history was negative; no rheumatism. Three months before, while carrying one end of a heavy canoe the patient slipped into a hole and felt something slip in the lower part of his back. This was followed immediately by pain when sitting or turning in bed. The patient and his friends noticed that his right hip was becoming more prominent than the left. The pain increased also.

*Physical Examination.*—Very frail physique. Thorax and abdomen negative. Body tilted to left when patient stood, set or reclined. Flexing extended leg on pelvis caused pain when a right angle was reached. Forward and backward motions showed that the spine is held rigidly on the pelvis. Lateral motions of the spine were normal, from the mid-dorsal region upward. An *x-ray* picture showed a dislocation of the right sacroiliac joint.

*Treatment.*—Ether was given October 6 and Dr. Osgood reduced "the right ilium to its normal position, so that its crest came on the same level as that of the left ilium and so that the sacrum seemed in its normal relations." A long plaster of Paris jacket extending well over the hips was then applied, with the lumbar spine in extreme lordosis. I saw this patient Oct. 8, 1905, and at that time he was walking about without pain or deformity.

*CASE 4.—Patient.*—M. G., a married woman, aged 35, was seen at the Post Graduate Hospital in June, 1906. Past history was negative. One year ago patient had a very difficult labor, forceps having been necessary. The convalescence was normal except for a great deal of trouble with the lower part of the back, on account of which she remained in bed six months. Patient stated that the first thing she noticed was pain and "a grating sensation" in that region, and indicated the left sacroiliac joint as its location. The pain, however, persisted unabated and was much exaggerated at her menstrual periods. Stooping, standing on left foot and lying on back, caused pain in this region.



*Physical Examination.*—Patient well nourished. Total spinal curvature to right, patient sitting more comfortably on the right side. Tenderness to deep pressure over lower part of the left sacroiliac joint. Goldthwait's symptom present.

*Treatment.*—Pelvis was strapped and relief was immediate. The strapping was continued for six weeks and then a long corset with a webbing belt was fitted. The relief had continued when the patient was last seen.

CASE 5.—Dr. M. H. was attending the lectures at the Postgraduate Medical School in July, 1907, when I demonstrated a case similar to the above cases. The relief from the strapping was so marked that the patient threatened to leave a cane, on which he was so dependent only a few minutes before. Dr. M. H. was so impressed with the similarity of his own symptoms that, after the lecture, he came to me and stated that he felt sure that he was suffering from the same condition. He said that he had sought relief without avail, from many sources, including his colleagues and several members of the faculties of the Post Graduate Medical School and the Rush Medical School in Chicago, of which latter school he was a graduate. He had been thrown from the back of a horse two and a half years before, from which time symptoms dated. The result from the above-mentioned treatment in his case was as striking as in the case he had just seen.

A sixth case represents, with the postoperative case already cited, a class in which a relaxation occurs from a long-continued strain on the ligaments, as contrasted with a sudden trauma.

CASE 6.—The patient was a man aged 45; his symptoms dated from the time he had held, for a considerable time, in a stooping position, a heavy plate-glass window, while a fellow workman fastened it in place. This patient had a convalescence similar to the others but slightly prolonged, which, by the way, is very liable to be the case in this type of trauma, according to my experience.

CASE 7.—*History.*—M. G., a man, aged 21, was seen May 12, 1907. For the past year the right knee had been very painful and had been in a plaster of Paris splint most of the time. The patient had used crutches most of the time. His general health had declined and he had lost considerable weight. Four months before he was seen he began to have pain in the lower part of the back, especially when walking, stooping or turning over in bed. The past few weeks the pain had become much more severe. The decline in the general condition had been more rapid. The appetite had become very poor and the patient thought that he had a fever each afternoon.

*Physical Examination.*—The patient was very poorly nourished and pale; temperature 101 F. at 3 p. m. There was con-



siderable swelling about the right knee. It was flexed about 15 degrees and very sensitive to slight passive motion. Condyles of femur were apparently enlarged; tibia somewhat subluxated. There was a total lateral curvature of the spine to the left. The lumbar region was held very rigidly. There was considerable swelling and deep fluctuation over the right side of the sacrum. A rectal examination disclosed a tumefaction and questionable fluctuation on the right side of the pelvis in the region of the anterior-inferior part of the sacroiliac joint. A diagnosis of tuberculosis of the knee and the right sacroiliac joint, with secondary infection and rupture of the latter into the pelvis was made.

*Treatment.*—An incision over and down to the joint was made posteriorly. The portion of the ilium overhanging and obscuring the joint was chiseled away and apparently good drainage secured. The patient rallied somewhat after the operation and disappeared from observation. His death was reported two months later.

#### CONCLUSIONS

1. The sacroiliac articulation has all the elements of a joint and therefore has a similar pathology.

2. It has a motion and plays an important rôle in labor.

3. Its variation, according to individual, age or sex, is very slight.

4. Its anatomy is such that drainage into the pelvis is very apt to occur, and, therefore, in the event of infection, early posterior drainage is often indicated.

5. Its affections are, undoubtedly, the cause of many obscure and unexplained backaches and persistent sciaticas.

6. The important ligaments of this joint are so placed that the sacrum and the ilium swing open, in the event of a symphysiotomy, as described above, and little permanent damage results, even if the pubic separation has been great enough to rupture the unimportant anterior-inferior part of the capsule.

7. The relaxation of this articulation should be guarded against by support of the lumbar spine with pillows, etc., in cases of protracted postoperative convalescence. Undoubtedly, many here can recall instances of Nature's warning, in the form of a convalescent's backache, which the nurse so readily relieved by merely placing a pillow under the lumbar spine.

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