



1998

A Review of the Sacroiliac Joint

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A REVIEW OF THE SACROILIAC JOINT

by

Michael Schielke
Bachelor of Science in Physical Therapy
University of North Dakota, 1997

An Independent Study

Submitted to the Graduate Faculty of the

Department of Physical Therapy

School of Medicine

University of North Dakota

in partial fulfillment of the requirements

for the degree of

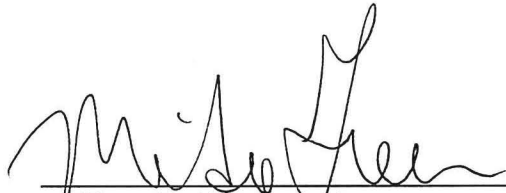
Master of Physical Therapy

Grand Forks, North Dakota

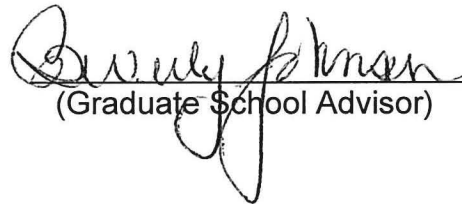
May
1998



This Independent Study, submitted by Michael Schielke in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.



(Faculty Preceptor)



(Graduate School Advisor)



(Chairperson, Physical Therapy)

PERMISSION

Title A Review of the Sacroiliac Joint

Department Physical Therapy

Degree Master of Physical Therapy

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ACKNOWLEDGMENTS

I would like to thank my wife, Elizabeth, for her continual support and encouragement.

Special thanks to:

Meridee Green for her input and patience.

Jon Arntson for his editing advise.

Travis Robinson for his artistic talents.

Alyson White for typing and editing expertise!

ABSTRACT

The purpose of this review is to explore the literature regarding sacroiliac joint motion in an attempt to ascertain the extent of movement possible, to describe relevant sacroiliac joint anatomy and joint function, and to review assessment and treatment techniques used with sacroiliac joint dysfunction. Sacroiliac joint motion and function have been the subject of much controversy among clinicians who treat low back pain. Because of its location, orientation, and morphology, the sacroiliac joint is a difficult joint to visualize clearly with radiographic procedures, which increases the problems in diagnosis of sacroiliac joint pathology. Although the arthrokinematics of the sacroiliac joint remain controversial, clinicians now generally agree that a small but significant amount of motion does occur at the sacroiliac joints. Many different descriptions of sacroiliac joint motion exist. Consequently, many different clinical tests are used to evaluate the joint. Palpation tests for sacroiliac joint dysfunction have shown poor intertester reliability, while provocation tests exhibit good intertester. Treatment techniques used by clinicians include modalities such as ice, massage, and electrical stimulation to reduce pain. Muscle energy techniques and mobilizations are used to correct sacroiliac joint positional faults. It is important to bear in mind that the effectiveness of these treatments is not well documented.

CHAPTER I

INTRODUCTION

Low back pain is a problem that has plagued and puzzled mankind for thousands of years. Despite the application of recent advances in research and technology, history taking, and thorough physical examinations, a high percentage of patients with low back pain have no identifiable pathology. Obviously, the identification of some widespread pathology, probably biomechanical, is being ignored or is escaping through the vast network of commonly used tests, signs, and procedures. These tests, signs, and procedures are either not appropriate to the pathology involved or not being properly interpreted.

Sacroiliac (SI) joint dysfunction is commonly ignored. Motion in the joint is minimal and is commonly dismissed as physiologically insignificant, and the function of the joint has not been properly described. Because of its location, orientation, and morphology, the SI joint is a difficult joint to visualize clearly with radiographic procedures, which increases the problems in diagnosis of SI joint pathology. However, a considerable body of literature exists regarding the SI joints, and research has suggested that the SI joint is a commonly overlooked cause of low back pain.

Some clinicians have treated SI joint dysfunction for years with little or no understanding of the function of the joint. Some have ignored the joint, denying both function and dysfunction, and a few have made an honest, but frequently unappreciated, effort toward thorough assessment. Assessing SI joint dysfunction is important, and many physical therapists evaluate this joint when examining patients with lumbosacral pain. Although the arthokinematics of the SI joint remain controversial, clinicians now generally agree that a small but significant amount of motion does occur at the SI joints. Many different descriptions of SI joint motion exist. Consequently, many different clinical tests are used to evaluate the joint and treatments can vary among clinicians based on the findings of these tests.

The purpose of this review is to explore the literature regarding sacroiliac joint motion in an attempt to ascertain the extent of movement possible, to describe relevant sacroiliac joint anatomy and joint function, and to review assessment and treatment techniques used with sacroiliac joint dysfunction. Appropriate knowledge of the SI joint, along with proper assessment and treatment techniques, will allow physical therapists to help those patients suffering from low back pain which originates from SI joint dysfunction.

CHAPTER II

SACROILIAC JOINT ANATOMY

A basic understanding of pelvic anatomy is essential prior to discussing the sacroiliac joint in detail. According to *Gray's Anatomy*,¹ the pelvis is the base of the trunk which bears the weight of the upper trunk and vertebral column, which in turn is supported by the lower extremities. The pelvis consists of three bones and three joints.

The three bones include the two innominate bones, which rest on the lower extremities, and the sacrum. The sacrum is wedge shaped and tapers from superior to inferior and is also broader anteriorly than posteriorly; it fits firmly between the two ilia bones. Adult females tend to have a shorter and wider sacrum with a flatter, deeper ventral concavity as compared to males. Females also tend to have a shorter, broader pelvis with ilia flared more laterally, while the male pelvis tends to be less flared with the ilia more vertical and a narrow sacral base.² Movement of the fetus through the birth canal is facilitated by the shape of the female pelvis.^{1,2}

The three pelvic joints include the two sacroiliac joints and the symphysis pubis. The two SI joints involve the articulations between the two sides of the sacrum, and the adjacent iliac bones on each side. Gray indicates that “the sacro-iliac articulation is synovial.”¹ Other researchers conclude that

fibrocartilage lines the iliac side of the joint, while the sacral surface of the SI joints is lined with hyaline cartilage (with the sacral cartilage being three times thicker than the iliac cartilage in early adult life).^{3,4} Due to this fact, the SI joints are sometimes described as being part synovial and part fibrous.⁵ The joint surfaces of the sacrum and ilium are L-shaped, with the superior segment being shorter and more vertical as compared to the longer inferior segment being aligned horizontally.^{6,7} These surfaces have irregular elevations and depressions which limit the motion of the joint. The SI joints often become partially ossified by the fifth decade of life, especially in males.⁸

The arterial supply to the SI joints are derived from articular branches of the superior gluteal, lateral sacral, iliolumbar arteries. The SI joints are innervated from the articular branches of the superior gluteal nerves, the sacral plexes, and the dorsal rami of S₁ and S₂.⁸

There are no intrinsic muscles of the SI joint which could directly move the sacrum between the ilia.⁸ All adjacent muscles (i.e., the quadratus lumborum, erector spinae, gluteus maximus, gluteus minimus, piriformis, and iliacus muscles, etc.) have fibrous expansions that blend with the anterior and posterior SI joint ligaments and contribute to the strength of the stability. However, the overall stability of the SI joint comes from six strong ligaments that surround the joint (Fig. 1). The three main ligaments, which are intrinsic to the SI joint, include the anterior SI ligament, the short posterior SI ligament (often called the interosseous ligament), and the long posterior ligament. The three main

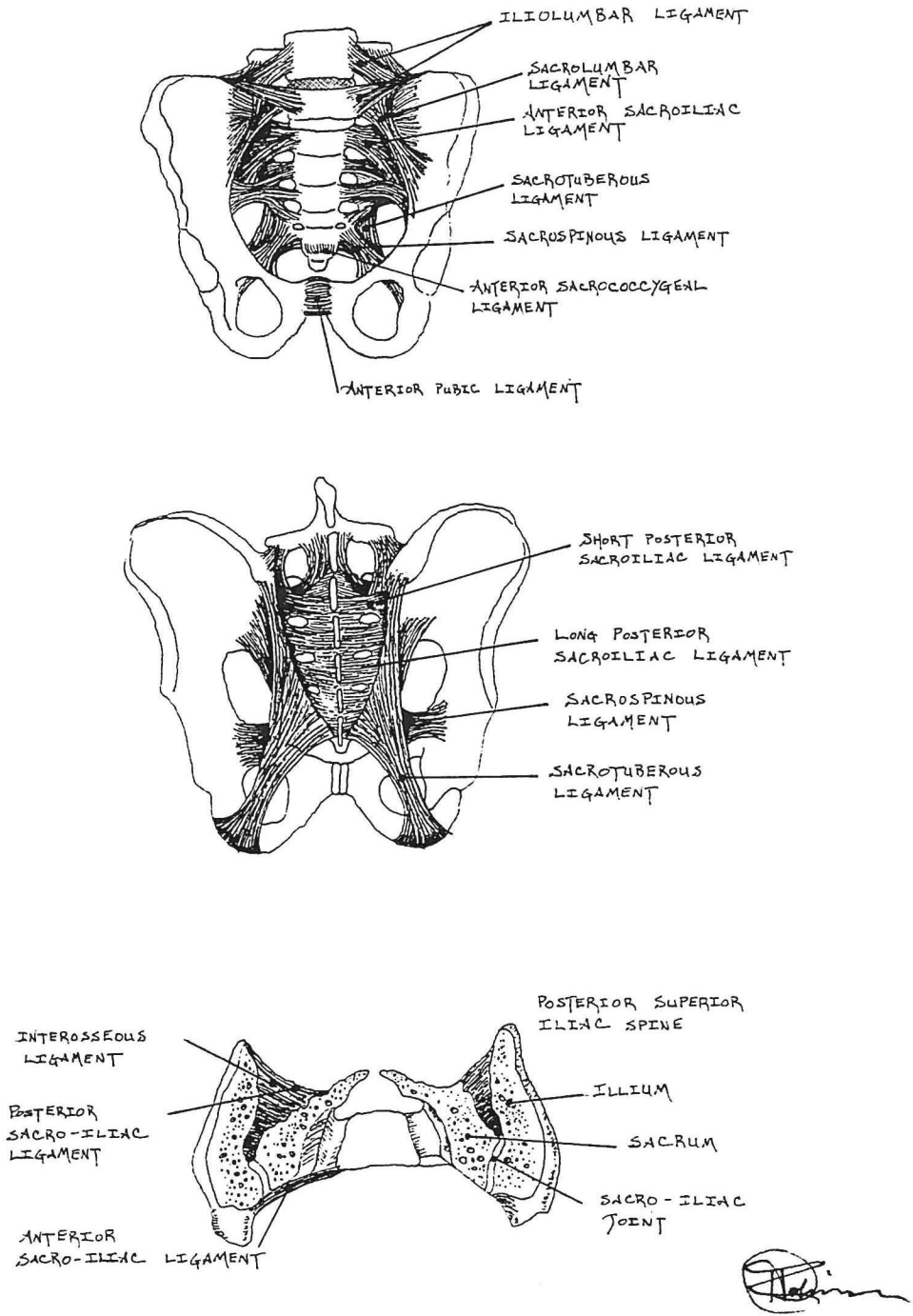


Fig. 1—Ligaments surrounding the sacroiliac joint.

ligaments that are extrinsic to the SI joint include the sacrospinous ligaments, the sacrotuberous ligaments, and the iliolumbar ligaments.⁹

The anterior SI ligaments, which resist anterior movement of the sacral promontory, are a thickening of the anterior and inferior parts of the fibrous capsule. At the level of the arcuate line and the level of the posterior inferior iliac spine (PSIS), these ligaments are particularly well developed, but they are thin elsewhere.¹ The short posterior SI ligaments are massive, strong ligaments which connect the iliac and sacral tuberosities and form the major bone between these two bones; they fill the roughened and irregular space above and behind the joint.¹ The short posterior SI ligaments, along with the sacrospinous and sacrotuberous ligaments, help to prevent sacral flexion.

The sacrospinous ligament attaches to the ischial spines and run superior, medial, and posterior to the anterior sacrum and coccyx, while the sacrotuberous ligament attaches to the posterior superior iliac spine (PSIS), lower sacrum, and upper coccyx and runs in an oblique lateral direction to their attachment to the ischial tuberosity.¹ The long posterior SI ligament lies over the short posterior SI (interosseous) ligament and functions to resist downslipping of the sacrum.⁹ The long posterior SI attaches to the third transverse tubercle of the dorsal sacrum and the PSIS and merges with the sacrotuberous ligament laterally.¹ Finally, the iliolumbar ligaments resist posterior innominate rotation (ilia rotating about a fixed sacrum) and also provide stability for L₅ which prevents it from gliding forward on the sacrum.⁹ These ligaments run from the iliac crest to the transverse processes of L₄ and L₅.¹

Compared with the human synovial joints, the SI joint is unique and fascinating. It is probable that a slight shifting of one articular surface in relation to the other may minimally disturb the alignment of the interlocking surfaces and cause SI joint dysfunction. A question then arises as to the amount of movement available at the SI joint. This question will be addressed in the following chapter.

CHAPTER III

SACROILIAC JOINT MOTION

There has been considerable controversy and speculation about the role and type of movements that occur at the SI joint. If the SI joint is to be considered as one cause of low back pain, one must make an assumption that the SI joint is capable of motion. Since the sacro-iliac articulation is a true synovial joint as indicated by Gray,¹ a reasonable assumption can be made that motion does occur at the SI joint. A growing number of studies conducted on SI joint motion support the assumption that the SI joint is capable of motion. Experiments using several different techniques, including gross examination, roentgenography, tomography, and stress radiology, have been conducted on living subjects and cadavers to demonstrate sacroiliac movement.

Reported Motion

1930—During an in vitro experiment to determine the range of motion in the SI joint, Sashin¹⁰ removed the posterior half of the pelvis (including the lower lumbar vertebrae, the sacrum, coccyx, both SI joints, and part of the posterior aspects of the iliac bones). The anterior aspects of both joints, up to the anterior SI ligaments, were exposed. Then the outer ends of the specimens were held firmly in place and manual pressure was applied to the lower end of the sacrum. In a number of cases, the sacrum was fixed and pressure was applied to the cut

ends of the iliac bones. A gliding up and down, with a slight anterior-posterior movement, was obtained. The degree of mobility was carefully determined by measuring the amount of excursion of two fixed points, one over the ilium and the other over the sacrum near the articulation, and these were placed on a line perpendicular to the articular surfaces. The average motion obtained was four degrees; the maximum motion, eight degrees; and the minimum, two degrees. The maximum mobility of the joints was obtained in a woman who shortly before death had a full-term delivery. It is important to bear in mind that the cases were all examined within 24 to 48 hours after death and that the maximum age of the group was 29 years.

1936—Pitkin and Pheasant¹¹ studied 144 male university students using both roentgenography and inclinometry; they described two kinds of movements. One movement occurred about a transverse axis passing through the body of S₂ and was described as a flexion-extension movement. The amplitude of the movement averaged four degrees. The second movement was an antagonistic movement of the ilium around a transverse axis passing through the center of the symphysis pubis. An average movement of 11° (range 3°-9°) was noted. Besides these conclusions, Pitkin and Pheasant also indicated that:

1. In the standing position, all motions of the trunk, with the exception of flexion and extension, normally are associated with unpaired, antagonistic movements of the ilia.

2. Rotation and lateral bending of the sacrum normally do not occur alone, but as correlated motions that are coincidental to antagonistic movements of the ilia.

1955—Weisl² studied living subjects (65 men, 68 non-pregnant women, and 26 pregnant women) ranging from age 17 to 40. He obtained four lateral radiographs on each subject, recording four types of trunk mobility: resting, extension, flexion, and a combination of hip and trunk flexion. The subjects were examined radiographically in one of three positions: supine, prone, or standing. His results indicated that the greatest motion of the sacrum occurred from the recumbent to the standing position (5.6 ± 1.4 mm). Weisl also began the task of locating the sacral axis of rotation which he placed approximately 5 to 10 cm vertically below the sacral promontory.

1962—Clayson et al,¹³ using roentgenograms, took measurements of SI joint motion with the subjects (26 normal college age women) in the positions of maximal flexion, maximal extension, and in relaxed standing position to relate the extremes to the normal standing posture. The angle formed between a line connecting the anterior superior iliac spine (ASIS) and the superior surface of the sacrum was considered to reflect SI joint motion. From the sample of 26 subjects, the maximum value of rotatory motion was 20° , but only four values exceeded 11° . The mean motion reported by this investigator was $8^\circ \pm 4.9^\circ$.

1963—To aid in accurate measurement, Colachis et al¹⁴ embedded Kirschner pins into the iliac spines of 12 medical students and movements were carried out in sitting, standing, trunk flexion, and maximum flexion/extension

scissors movements of the thighs. Not unexpectedly, the pins impinged movements. Despite this fact, they concluded that there certainly is movement, but it varies greatly with the individual. A maximum of five degrees of translatory motion was recorded.

1974—Frigerio et al¹⁵ used stereoradiography and mathematical formulas to measure SI joint motion. Using two x-ray beams and plates located orthogonal to one another, they were able to capture pelvic linkage positions. Relative motion in three dimensions was then determined using the mathematical methods. A pair of exposures were taken on a male cadaver, one with both legs together and one with an extremity flexed 15° and abducted 30°. The same procedure was tested on a living subject. The in vivo measurements corroborated with the cadaver measures, but were larger. The investigators reported motion of the iliac crests relative to the sacrum of up to 26 mm in their one subject. Possibly because they have reported the highest value for motion in literature, this study is frequently cited. Since these researchers studied only one bony pelvis, one cadaver, and one live subject, their results should be viewed with caution.

1978—Egund et al¹⁶ embedded small steel (tantalum) balls (0.8 mm diameter) into the sacrum and paired ilia under local anesthesia using fluoroscopy to overcome the problem of tissue impingement associated with previous studies. He then studied the four subjects using roentgen stereophotogrammetry. Films were taken with the subjects in different positions: supine, prone, prone with manual pressure in the vertical direction against the

sacral apex, erect standing, standing on right leg, standing on left leg, and standing with maximum lordosis. Rotational movements recorded during the six movements were approximately two degrees and occurred around a transverse axis. Translatory motions average two mm, but varied considerably depending on the location of the axis of rotation.

1980—Reynolds¹⁷ used a stereoradiography technique to study SI joint movement on an unembalmed adult male cadaver. To accurately locate skeletal links in three dimensional space, tungsten-carbide balls were embedded as targets on or near skeletal landmarks for the sacrum, innominate bones, and femurs. The thigh was placed in maximal flexion, abduction, and abductoflexion with measurements taken at each position. The data were analyzed using a screw axis analysis (a screw axis is a line in space about which a rigid body rotates and translates). With flexion, rotatory movement was measured at 2.3°, and with abductoflexion, rotatory motion was measured at 1.2°. Reynolds suggested that the pelvis acts as part of the vertebral column as well as part of the lower limbs and should be modeled as the site at which loads and motions are transferred rather than the site at which they begin or end.

1980—Wilder et al¹⁸ used topographical and theoretical modeling to study the axes of motion and movement of the SI joint; data were obtained from 11 hemispheres. They concluded that motion could not occur exclusively around axes proposed by Weisl (axes of motion will be discussed later in this review). They also stated that individual specimens show various positions of the rotational axes, possibly due to soft tissue and joint contour differences. They

indicated that any rotation of the SI joint must be accompanied by translation and that an important function of the sacroiliac articulations was to absorb energy. These investigators considered that a translatory motion could occur about their proposed axes if some separation of the surfaces was present. The required separation theorized by Wilder et al¹⁸ was a mean of 7.25 mm (SD = 3.7) in the median plane and 3.4 mm (SD = 1.7) in the frontal plane.

1981—Grieve¹⁹ attempted to measure a motion used in clinical practice to assess the SI joint. She measured displacements during a knee raising movement. Markers were placed on the PSIS, the sacrum, L₄ and L₅, and the femur. Twenty-one subjects were filmed completing a left and right leg movement. Relative mobility for the supporting and moving joints was indicated using a frequency distribution according to the number of units of area under the movement graphs. Reported values of translatory movement ranged from 1 mm to 6 mm. It should be noted that soft tissue displacement could have caused measurement errors in this method.

1983—Lavignolle et al²⁰ conducted an in vivo study using five athletic adults (3 men and 2 women) as subjects. In a supine position with the trunk immobilized, the subjects actively flexed the right hip to 60° and extended the left hip to 15° (to simulate walking and running). Stereophotogrammetry and mathematical formulas were used to collect and analyze the data. The exact position of the axes were variable, but they were near the pubic symphysis and did not correspond to conventional anatomical planes. The mean rotatory movement noted by the investigators was 12° (the ilium displaced posteriorly

and medially and the ischium forward and laterally). They also noted that a translatory motion of six mm occurred.

1987—Miller et al²¹ measured the load-displacement behavior of single and paired SI joints in fresh adult cadavers. Test loads were applied to the center of the sacrum along two perpendicular axes while both ilia were in a fixed position, and later, with only one ilia fixed. Test forces were applied to the sacrum in the following order: anterior, posterior, flexion, extension, superior, inferior, clockwise axial torsion, lateral bending, and medial bending. Movements of the center of the sacrum were measured using an optical level system and dial gauges. Small movements (0.5 mm translation, 1.9° rotation) occurred when both ilia were fixed. The researchers concluded that fixing both ilia did not represent in vivo conditions. Translations increased three times the previous measurement when only one ilia was fixed and rotational movements ranged from two to seven times greater when one ilia was fixed compared to two being fixed.

1988—Scholten et al²² studied loads and motions of the pelvis using a biomechanical model. Their model was designed to describe the influences pelvis geometry and soft tissue properties would have on SI mobility and internal loads. Model motions indicated rotatory movements of one to two degrees and three mm of translatory motion were possible. Geometric changes as well as tissue stiffness did lead to notable changes in motion, but the motions remained small.

1989—Sturesson et al²³ inserted tantalum balls percutaneously over the ilium and sacrum and used roentgen stereophotogrammetry to measure SI motion in 25 patients. They described SI motion (ilia motion relative to a fixed sacrum) during supine to standing, supine to sit, and standing to prone with hyperextension (unilateral extension of one hip). Motions were measured about three axes, with notable motion occurring around a frontal axis. No consistent differences were found between symptomatic and asymptomatic joints. A mean translatory movement of 0.7 mm was noted, and a mean rotatory movement of $2.5^{\circ} \pm 0.5^{\circ}$ was reported.

Reported values for SI joint rotatory motion (measured in degrees) and translatory motion (measured in millimeters), whether obtained from living subjects, cadavers, or models, were reasonably consistent in size of the average or maximal values obtained. Rotatory motion generally averaged less than four degrees. Reported value for translatory motions (glides) in the anterior-posterior plane ranged between 0.5 mm and 7 mm, with a mode of about 3 mm.²⁴

It should be clearly accepted that some motion does occur in the sacroiliac joints which would warrant the need for manual physical therapy procedures designed to relieve symptoms and restore function. Investigators of SI joint mobility generally have focused on two main questions. What is the extent of movement? and What is (are) the axis(es) of motion?

Axes of Motion

Osteopathic theory requires that at least three transverse and two diagonal axes must be present to sustain sacroiliac and iliosacral motions and

sacral torsions. All of these axes are probably operative during some phase of motion, depending on the load through the articulations, the age, and stage of degeneration of the joint. A widely accepted model of SI joint axes of motion, which can be found in most educational texts, is described by Mitchell et al²⁵ as follows (Fig. 2):

1. *Superior transverse axis* (runs through the second sacral segment).
This is often referred to as the respiratory axis. This axis is actually a fulcrum formed by the attachments of the posterior SI ligaments and the thoracodorsal fascia. As one inhales, the sacral extension occurs; as one exhales, the sacral flexion occurs.
2. *Middle transverse axis* (located at the second sacral body). This is the principal axis of normal sacroiliac flexion and extension.
3. *Inferior transverse axis* (runs transversely through the inferior pole of the sacral articulations). This is the principal axis of normal iliosacral motion (anterior and posterior rotation of the innominates).
4. *Right and left oblique axes* (run from the superior end of the articular surface of the sacrum obliquely to the inferior lateral angle). Iliosacral motion occurring about the inferior transverse axis is associated with rotation at the pubis and through the sacrum at the contralateral oblique axis.

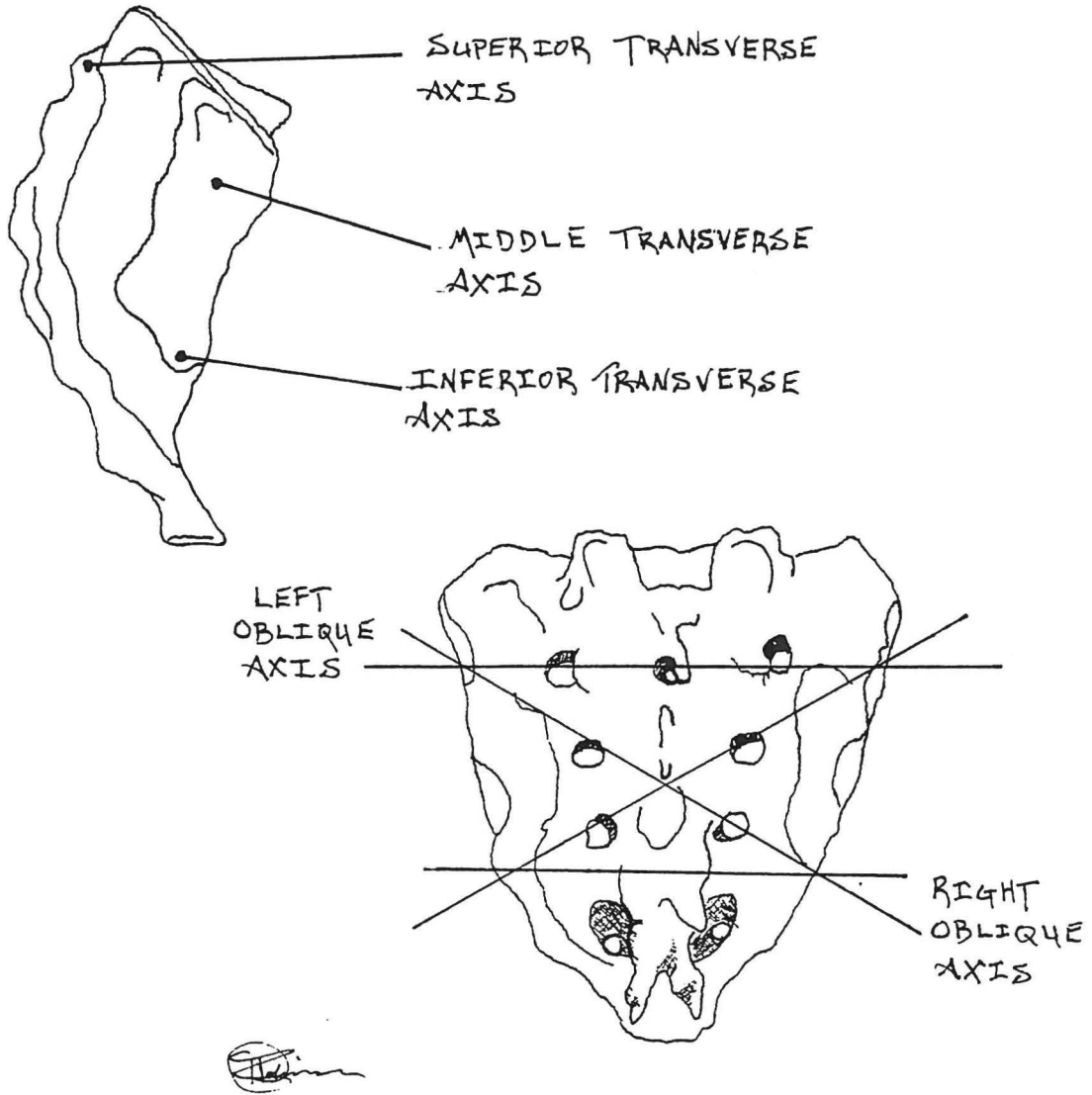


Fig. 2—Sacroiliac joint axes of motion.

Mitchell et al²⁵ also distinguished iliosacral and sacroiliac motion.

Iliosacral movements involve movement of the ilia on a fixed sacrum with these available motions:

1. Anterior rotation - anterior superior iliac spine (ASIS) rotates posteriorly
2. Posterior rotation - ASIS rotates anteriorly
3. Upslip - iliac crest is cephalad
4. Downslip - iliac crest is caudal
5. Inflare - medial displacement of the innominate bone
6. Outflare - lateral displacement of the innominate bone.

Sacroiliac movements refer to the sacrum moving on the fixed ilium; these movements include:

1. Nutation - sacral flexion
2. Counternutation - sacral extension
3. Sacral torsions - forward and backward torsions about an oblique axis.

Many other investigators, including Weisl,¹² Wilder et al,¹⁸ and Lavignolle et al²⁰ have also attempted to identify the axes of motion about the SI joint.

There appears to be no agreement in the literature for a single model of SI joint motion or a single fixed axis of motion. Since SI joint motion is a simultaneous combination of translation, rotation, upward or downward movements, and flexion or extension movements, motion and axes may vary instantaneously among individuals.²⁴

CHAPTER IV

SACROILIAC JOINT FUNCTION

The research presented to this point supports the notion that sacroiliac motion exists and is natural in certain functional activities. Researchers seem to agree that the movements are small and consist primarily of sagittal plane rotation and a translation. This chapter will focus on how the sacrum and ilia move with functional activities.

Activities commonly associated with onset of low back pain are lifting, bending, lowering, and twisting. The body position usually associated with most of these activities is trunk flexion. Harmless tasks, such as working over a counter, making a bed, shaving, and washing dishes, shift the weight of the trunk over the anterior pelvis. This anterior weight shift or standing in a lordotic posture causes an anterior rotation force on the pelvis. Lumbopelvic rhythm is the term used to describe the relationship between the lumbar spine and pelvis during forward trunk bending.²⁶ During the first phase of trunk flexion, the pelvis is locked by the hip extensors and the lumbar lordosis flattens. After the first 60° of flexion, the pelvis rotates anteriorly around the hip joints. Most authors indicate that the sacrum follows the lumbar spine during flexion. A return to the erect posture requires posterior tilting of the pelvis at the hips followed by extension of the lumbar spine.^{25,26}

Three-dimensional pelvic motion during ambulation has been described by Murray.²⁷ Using the right leg as the reference limb from terminal stance through swing phase, the pelvic girdle rotates to the left. During single limb support, the pelvis will drop on the right side. These pelvic movements in the transverse and frontal planes help minimize the movement of the body's center of mass which conserves energy during ambulation.

Another important role of the SI joint is to absorb shock during ambulation. Ambulation can be considered as a controlled fall with a forward lean of the trunk to initiate and continue forward movement (inertial moment), while the legs alternately move forward to maintain balance. A braking force (deceleration moment) is created on initial heel strike. Between the inertial moment of the upper trunk and the deceleration moment of the innominate is a margin of shear. The SI joints absorb the shearing forces.⁵ Iliac and sacral rotations may be influenced by lower extremity muscles and the forces in these areas should also be taken into consideration.²⁵ The force created on initial contact is partially absorbed at the foot on heel strike (dorsiflexors decelerate and lower the anterior foot to the ground) and partially absorbed at the knee (quadriceps femoris allows knee flexion before terminal extension). Anterior and downward motion of the pelvis occurs due to this knee flexion. Simultaneous plantarflexion causes an anterior and upward rise of the pelvis.⁵

In short, during ambulation, the ilium rotates posteriorly during swing phase and converts to anterior rotation after the loading response, while the sacrum rotates forward during the loading response and begins to reverse itself

during terminal stance. The thorax rotates 180° out of phase relative to the pelvis during the swing phase, while the lumbar spine rotates with the pelvis.²⁷ This counter rotation of the upper trunk rotates the sacrum slightly posteriorly which also serves to lessen the deceleration moment on the SI joint. The intensity of the force can be easily demonstrated by having a person ambulate without using counter rotation; that is, bringing the right shoulder forward with initial contact of the right leg and the left shoulder forward with initial contact of the left leg.⁵ Intuition would suggest that these intrapelvic motions are necessary during ambulation to help dampen the axial, torsional, and sheer stresses that occur.

In the normal standing posture, the line of gravity falls posterior to the center of the acetabula, and thus most of the weight of the trunk is transmitted through the posterior pelvis. This transfer causes a posterior rotation force, and the pelvis rotates downward posteriorly around the acetabula creating an automatic pelvic tilt without any support of the anterior pelvis from the abdominal muscles.²⁸ The sacrum, firmly entrapped between the innominates and suspended from the ilia, carries the weight of the spine. The SI joints are essentially non-weight-bearing joints. An increase in weight loading would increase the tension on the posterior ligaments and cause the sacrum to ride even more deeply between the innominates until the limit of motion is reached.⁵

Kapandji² discussed sacroiliac motion during labor and delivery. It is well known that the sacroiliac joints become more mobile during the gestational period due to the release of a polypeptide hormone known as relaxin. Relaxin

decreases the strength and rigidity of collagen which increases pelvic mobility.^{2,7} Hip flexion in a back-lying position tilts the ilia posteriorly in relation to the sacrum. This pelvic motion causes nutation at the SI joints which increases the diameter of the pelvic outlet. During the process of birth, the increase in the diameter of the pelvic outlet facilitates delivery of the fetal head. Counternutation is brought about by hip extension in the supine position and enlarges the pelvic brim. Therefore, a hip-extended position is favored early in the birthing process to facilitate the descent of the fetal head into the pelvis, whereas the hip-flexed position is used during delivery.²

Sacral motion during respiration has also been discussed in osteopathic literature. Mitchell et al²⁵ indicate that during inspiration the sacrum and ilium counternutate. During expiration, the opposite movements take place. Sacral motion during the respiratory cycle is primarily a rotation about a transverse axis.

Anatomically, the pelvic girdle is complex. It has been noted that its normal structure is variable throughout periods of normal development, between men and women, among women during menstruation and pregnancy, and among individuals in general. Since structure may dictate function, clinicians must remember the highly variable structure of the pelvis during examination for low back and pelvic dysfunction. Functionally, the pelvis must decrease and absorb forces and moments from the trunk and from the lower extremities and ground. Because the pelvis is a closed kinematic chain, intuition would tell us that intrapelvic motion must occur in order to absorb these forces. Clinicians must also be aware that the SI joint may function during open-chain (movements

of the trunk) and closed-chain (walking) activities, and that it may respond differently under those two circumstances.

CHAPTER V

SACROILIAC JOINT ASSESSMENT

Normally, a comprehensive assessment of the SI joints is not made until examination of the lumbar spine and hip has been completed. It is important to remember that pain felt in this area may be referred from either the lower lumbar spine or the hip joint. If the lumbar spine and hip are examined and the problem still appears to be present and remains undiagnosed, a pelvic examination should be initiated. The goal of assessment is to determine what force(s) reproduce(s) the patient's symptoms.²⁹

History

Certain traumatic incidents may indicate involvement of the pelvic joints, such as a fall on the buttock, a unexpected heel strike, a golf swing, or abnormal stresses occurring during sporting activities. Another consideration is SI joint pain which sometime follows giving birth or pain which begins with oral contraceptive use.⁹

Most patients present with a typical history of acute or chronic low back pain. A typical history of a patient with SI joint pain usually includes:⁹

1. Pain which increases with prolonged postures or with sitting or standing on involved side.

2. Pain which is aggravated by stair climbing, walking, and rolling over in bed.
3. Local tenderness at the SI joint with unilateral pain possibly referring down the leg (usually posterolateral and not below the knee). Referral of pain into the hip, groin, or abdomen is also possible.
4. Morning stiffness which eases shortly after weight-bearing activities.
5. Absence of lumbar articular signs and symptoms.

The patient should also be asked specific questions regarding occupation, pastime, neurological deficits, and past medical history which involves the SI joints (such as ankylosing spondylitis, Reiter's disease, rheumatoid arthritis, and Pagant's disease).²⁹

Observation

The patient's gait pattern should be observed for any abnormalities since pelvic pathology often affects ambulation. A decreased stride length and a vertical limp may be caused by SI joint pain. A painful SI joint may also cause reflex inhibition of the gluteus medius, leading to a Trendelenburg gait.²⁹

Posture should also be observed, noting any asymmetry which may be caused by pelvic girdle dysfunction. In particular, observe whether the patient stands with equal weight on both feet or has a lateral pelvic tilt which indicates a possible real leg length discrepancy. Patients will usually avoid weight-bearing (sitting and standing) on the involved side with a SI joint dysfunction. Medial rotation of the lower limb may be noticed with an anterior dysfunction of the innominate. A piriformis muscle spasm can cause the limb to externally rotate

on the affected side. Observation commonly reveals flatter muscle bulk of the gluteals on the painful side.^{9,29}

Palpation

Palpation is often used by clinicians as a means to inspect the bony structures and alignment of the pelvis. The following palpation techniques are described by Hertling and Kessler:⁹

1. In the standing position, compare the levels of the posterior superior iliac spines (PSIS), the iliac crests, and the anterior superior iliac spines (ASIS). The most common rotation of the innominate bones is the posterior rotation with the PSIS lower on the involved side. If the ASIS and PSIS are both higher on one side compared to the other, an upslip of the ilium on the sacrum may be present.
2. Repeat palpation of the ASIS, PSIS, and iliac crests in erect sitting to determine if a lateral pelvic tilt noted with standing disappears.
3. With the patient sitting and the spine fully flexed, check the position of the sacrum. Compare the relationship of the sacral base on each side. If one sacral base is more anterior than the other, sacral dysfunction may be present.
4. Place the patient in a supine and crook position. Have the patient lift the buttock and drop it to the mat. Then have the patient bring the knees to the chest and slowly lower the legs with the knees extended. Determine if one ASIS is closer to the midline (inflare) or further from the midline (outflare). Look for rotational dysfunctions (ASIS more

inferior or superior on one side). Determine whether both pubic bones are level at the symphysis pubis. (In a posterior dysfunction, the pubic bone would be higher and should correlate with the ASIS being higher on the same side.) Also, assess leg length equality with the patient in this position.

5. With the patient lying prone, assess the level of the ischial tuberosities. If one tuberosity is higher, an upslip of the ilium on the sacrum may be present.

Active Movements

During the active movements of the pelvis, the examiner observes for unequal movements, hypermobility or hypomobility, tissue contractures, tenderness, or inflammation. Active spine movements stress the SI joints as well as the lumbar and lumbosacral joints. With forward flexion, the innominate bones rotate anteriorly and the two PSISs should move upward equally and approximate each other.²⁹

A few of the active movements tests commonly used to assess SI joint dysfunction include:

1. Standing Flexion Test²⁵ - The patient stands with feet 12 inches apart. The therapist stands behind the patient and places his thumbs directly under each PSIS. The patient bends forward as far as possible while keeping the knees extended. The extent of cranial movement of each PSIS is observed. A positive test is indicated if one PSIS moves

further than the other. The side with the greater movement is the side of the articular restriction.

2. Piedallu's Sign²⁹ - With the patient sitting on a hard flat surface, one PSIS, more frequently on the painful side, is lower than the opposite side. On forward flexion, the position is reversed, the previously lower PSIS now becomes the higher of the two. The restricted joint is moving solidly as one following the spine, while the sacrum on the painless side is free to move through its small range with the lumbar spine.
3. Standing Gillet Test²⁹ - The therapist stands behind the patient and places one thumb directly under one PSIS and the other thumb at the S₂ tubercle (on the sacrum at the level of the PSIS). The patient stands on one leg and flexes the other hip and knee toward the chest. The therapist palpates the PSIS on the side being flexed. The test is repeated on the other side. As motion is completed at the hip joint, the palpated PSIS should dip downward. A positive test is one in which this dip does not occur and indicates a restricted joint.

Passive Movements

Passive pelvic joint movements stress the SI ligament and joints. The therapist tries to reproduce the patient's symptoms when performing passive movement tests. Some of the most commonly used stress tests include:

1. Pelvic Rock Test⁹ - With the patient in supine, the therapist places his palms on the ASIS and gently glides the innominates in an

anteroposterior direction. With this test, the therapist can get a sense of the mobility of the joint and the end feel. A hard end feel on one side indicates a probable restriction of movement on that side.

2. Supine Iliac Gapping Test⁹ - The patient lies supine while the therapist places the heels of his hands on the ASIS of the ilia and presses downward and laterally. The therapist's arms are crossed to increase the lateral force applied to stress the SI ligaments. The test is considered positive if the patient complains of pain in the gluteal or posterior leg regions, indicating an anterior SI ligament sprain.
3. Approximation Test²⁹ - The patient lies on his side. The therapist stands above the patient with her elbows locked in extension and palms interlocked over the upper margin of the iliac crest. The therapist exerts downward pressure on the iliac crest, which causes a forward pressure on the sacrum. The test is positive if SI pain, gluteal pain, or posterior leg pain is noted. A positive test indicates a posterior SI ligament strain or an SI joint lesion.
4. Sacral Apex Pressure Test²⁹ - The patient lies prone on a firm surface to stabilize the pelvis. The therapist applies downward pressure on the sacrum with the heel of the hand over patient's sacral apex. This produces a shearing movement of the sacrum on the ilium. A rotational shift of the SI joints is produced with this test. A SI joint problem may be indicated if pain is present over the SI joint. Grieve¹⁹

suggests that this is one of the most valuable tests because it is the most localized and specific to the SI joint.

5. Sacroteruberous Ligament Stress Test²⁹ - This test is also called knee-to-shoulder test. With the patient in the supine position, the contralateral hip and knee are fully flexed and then adducted. The innominate bone is flexed and medially rotated until tension of the sacrotuberous ligament is felt. Then a slow, steady longitudinal force is applied with both hands through the femur in an oblique lateral direction (toward the table) to stress the posterior SI ligament further. The force should be maintained for 20 seconds. The femur can also be used as a lever to rock the SI joint with flexion and adduction of the hip, moving the knee toward the opposite shoulder. This test results in significant gapping of the posterior SI joint, and if pain is present, it is usually indicative of a functionally shortened or stressed posterior SI ligament.

Magee²⁹ describes many other tests which can be used to assess the pelvis and SI joints. The straight leg raising test and the prone knee bending test can be used to test for neurological involvement. The supine-to-sit test can be used to determine whether a leg length discrepancy is caused by a rotation of the pelvis. Magee indicates that a real leg length test using a bony landmark for measurements should always be performed if a SI joint lesion is suspected.

Sacroiliac joint dysfunction is usually diagnosed using the clinical examination. Radiographic information is rarely useful in diagnosing SI joint

dysfunction, but it can be useful to exclude other conditions such as ankylosing spondylitis.⁹

Reliability Issues

Potter and Rothstein³⁰ examined the intertester reliability of 13 of the most commonly used tests for SI joint dysfunction (which include the tests described previously). The results showed poor intertester reliability for all tests except the iliac gapping and compression tests which achieved about 90% and 70% agreement, respectively. None of the other tests (standing and seated iliac crest palpation, standing and sitting PSIS palpation, standing and sitting ASIS palpation, Gillet Test, standing flexion test, sitting flexion test, long sitting test, and prone knee flexion test) exhibited more than 50% agreement. It is interesting to note that the iliac gapping and compression tests were the only two tests which relied on the patient's response to the therapist's action. Sacroiliac joint position and mobility cannot be ascertained with these two tests, as is attempted with the bony landmark palpation tests. Clinical experience was also examined between individual therapists and therapist pairs; data revealed that agreement did not relate to the years of experience. Agreement among the pairs ranged from 30% to 65%, with the majority of pairs being below 50% agreement. Experience, or lack of it, did not appear to affect reliability.

Simmonds³¹ recent study also demonstrates high errors in palpation of bony landmarks. Simmonds studied 20 physical therapists and reported a systematic error of 7 to 14 mm for intrarater and 12 to 24.5 mm for interrater consecutive tests in which invisible ink was used. Four bony points were

studied; the more deeply located landmarks (L_4 spinous and transverse processes) were associated with higher errors. For the PSIS, an intrarater mean of 8 mm (SD = 5.1) and interrater mean of 20.4 mm (SD = 13.2) were reported.

Variability of test results between therapists is clinically important because treatment plans for a patient could differ depending on which therapist performed the assessment. Treatment techniques and goals used by two therapists could be totally opposite from one another based on contrasting assessment findings. Continuity of care could be jeopardized if a different therapist had to treat a patient, a situation that often occurs in many clinics. Effective treatment plans are unlikely unless evaluation techniques are reliable.

CHAPTER VI

SACROILIAC JOINT TREATMENT

Treatment of the SI joint follows the same guidelines as for other areas of the body. Resting in bed may be helpful during the acute phase (one to two days) and modalities such as ice, massage, and electrical stimulation may be helpful to deal with the pain. Massage is not only soothing but can be an excellent means of deep palpation for the therapist to become more familiar with and to better assess the affected tissues in the area. Transcutaneous electrical nerve stimulation (TENS) can be useful during the acute or chronic phase of low back pain, but should be used along with a corrective exercise program. Since maintaining SI joint function is necessary, TENS should not be used alone to mask the pain caused by a SI joint dysfunction. Pelvic traction may be useful if a neurological deficit is present. By pulling the innominates caudally on the sacrum, traction may help correct a SI joint dysfunction.⁹

Movement downward of the acetabula in relationship to the SI joint not only results in biomechanical changes but causes the legs to appear longer than they actually are. Don Tigny⁵ indicates that heel lifts are commonly used under the foot of the short side to minimize ground forces and equalize the height of uneven pelvic crests. He has found, though, that he could equalize the height of

the crests and resolve the apparent leg length difference almost instantly using mobilization in over 95% of cases with an apparent leg length discrepancy.

According to Greenman,³² a sacroiliac cinch belt can provide dynamic tension around the pelvis and assist in stability during the treatment process. They can be of benefit to patients with an innominate shear dysfunction if worn for six weeks during weight bearing activities and for extended lengths during strenuous exercise and long motor vehicle trips. A cinch belt can also be used with chronic recurrent low back pain associated with an anteriorly nutated sacrum, a posteriorly rotated innominate, and a superior displacement of a pubic tubercle. The support should be used until the SI joint dysfunction is corrected to help prevent recurrence. If the support is put on without correcting the dysfunction, it may increase pain by increasing pressure on the pelvic joints in that position.

Passive mobilizations can be used as a treatment method; they can help stimulate the tissues to adapt to the proper lines of stress, to reduce pain, and to provide proprioceptive input. Many educational texts, including those written by Greenman,^{er} describe passive mobilization techniques. They all basically describe the same techniques. A few of the mobilizations performed by Kaltenborn³³ to correct SI joint dysfunctions are as follows:

I. Ventral Ilium Mobilization

Starting Position: The patient lies prone with a pillow under the abdomen, leaving the ASIS unsupported. The therapist faces the left side of the patient.

Hand Placement and Fixation: The therapist applies a stabilization force ventrally with the ulnar side of his right hand over the left caudal aspect of the patient's sacrum. The mobilizing hand of the therapist is placed on the right iliac crest.

Procedure: The therapist's hand moves the patient's right ilium downward and laterally into the plinth.

II. Dorsal Rotation of the Ilium:

Starting Position: The patient is left sidelying with the left hip extended. The right hip and knee are flexed. The therapist faces the patient.

Hand Placement: The ulnar side of the therapist's right hand is placed on the right iliac crest. The heel of the left hand is placed on the ischial tuberosity.

Procedure: The therapist uses both hands simultaneously to rotate the ilium dorsally.

III. Caudal Sacrum Mobilization:

Starting Position: The patient lies prone with the therapist facing the left side of the patient.

Hand Placement: The therapist stabilizes the ilium in a caudal direction with the web space of the left hand placed on the patient's right iliac crest. The ulnar side of the other hand is placed on the right side of the apex of the sacrum, avoiding pressure on the coccyx.

Procedure: The therapist's right hand moves the sacrum cranially.

The role of mobilization is limited to passive mobility, but the most important part of treatment deals with active mobility and patient self-treatment or mobilization outside the clinical setting on an ongoing basis as needed by the patient. Treatment will not relieve symptoms unless soft tissue dysfunctions are addressed. Active mobilization and corrective exercises play a crucial role in the treatment of SI joint dysfunction. Passive mobilization is useless if it is not followed by specific active mobilization. At the appropriate time, active movements should be started to normalize stresses and balance muscle length and strength.⁹

A muscle energy technique (MET) is a treatment procedure that uses a voluntary contraction of the patient's muscles against a controlled counterforce provided with exact positioning and direction of pull. Muscle energy techniques are considered to be active techniques unlike passive techniques in which the therapist does the work. These active techniques can be used to lengthen shortened muscles, strength weakened muscles, and to mobilize restricted joints. Saunders³⁴ describes the following METs to mobilize a restricted SI joint:

- I. Anterior Innominate MET: A pelvic examination will reveal a low ASIS and a high PSIS on the involved side. Muscular correction of this dysfunction uses muscles that can rotate the innominate in a posterior direction. The prime mover is the gluteus maximus. The technique is as follows:
 1. The patient is supine with the uninvolved leg hanging free from the edge of the treatment table supported at the level of the ischium.

2. The hip and knee are flexed on the involved side until the freely hanging leg begins to come up.
 3. The therapist then stabilizes the flexed knee with his shoulder.
 4. The patient is then instructed to push his knee against the therapist's shoulder using an isometric contraction for seven to ten seconds while breathing in a relaxed manner.
 5. When the contraction is ended, the therapist takes up the slack by further flexing the hip and knee toward the chest until resistance is felt. This procedure is repeated three to four times until all slack is taken up.
 6. The patient is now reexamined for change usually using the standing flexion test or the long sitting test. The treatment can be repeated if necessary.
- II. Posterior Innominate MET: A high ASIS and a low PSIS would be noted on the involved side with this SI joint dysfunction. Correction of this dysfunction uses muscles that can rotate the innominate in an anterior direction; the rectus femoris is the prime mover in this case. This MET technique is performed as follows:
1. The patient lies supine with the involved leg hanging free over the edge of the treatment table. The involved hip is extended with the knee flexed.

2. The uninvolved hip and knee are flexed toward the patient's chest until the freely hanging leg begins to come up. The therapist stabilizes the uninvolved leg in this position using his shoulder.
 3. The therapist places the other hand proximal to the knee of the freely hanging knee and pushes down to take up the slack.
 4. The patient is then instructed to push the freely hanging leg up against the therapist's hand with a submaximal force, holding the isometric contraction for seven to ten seconds. The patient should breath in a relaxed manner.
 5. The therapist then takes up the slack by pushing down on the freely hanging leg and bringing the flexed hip and knee of the uninvolved leg into further flexion. The next contraction begins with this new position and can be repeated three to four times.
 6. The patient is then reexamined to note any changes and treatment is repeated if necessary.
- III. Forward Sacral Torsion MET: A forward sacral torsion is indicated with a deeper PSIS on the opposite side. Correction of this dysfunction utilizes muscles that cause the sacrum to move backward on an oblique axis. The piriformis is the key muscle used in this technique which is performed as follows:
1. The patient lies on the side in which the PSIS depth is normal (left side since the left oblique axis is involved).
 2. The therapist stands facing the patient.

3. The patient is positioned close to the edge of the table. The downside arm rests behind the trunk with that hand grasping the edge of the table behind him. The top arm hangs over the edge of the table closest to the therapist and the patient's trunk is rotated forward with the chest approximating the table.
4. The therapist's cephalad hand palpates the lumbosacral area while the caudad hand flexes the patient's hips and knees to approximately 90° or until the therapist can feel motion at the lumbosacral area.
5. Next, the therapist moves the hand from the lumbosacral area and places it on the patient's shoulder near the edge of the treatment table. The patient is then instructed to take a deep breath and exhale while reaching toward the floor. The therapist helps by pressing down on the shoulder to take up the slack. This step should be repeated two to three times.
6. The therapist returns the hand to the lumbosacral area. The other hand (supporting the legs) lowers the ankles toward the floor until resistance is felt.
7. The therapist now gives resistance as the patient lifts both ankles toward the ceiling. The contraction is held for seven to ten seconds.
8. After the contraction is relaxed, the therapist brings the patient's hips and knees into further flexion while lowering the ankles towards the floor until resistance is met.

9. Steps 7 and 8 are repeated two to three times, then the patient is rechecked for changes in sacral positioning. The treatment is repeated if necessary.

IV. Backward Sacral Torsion MET: A deeper PSIS will also be noted on the opposite side with this dysfunction (like an anterior sacral torsion). However, the sacrum will be in a posterior position opposite of the involved joint, unlike the anterior sacral torsions. Muscular correction of this dysfunction uses muscles that cause the sacrum to move forward in an oblique axis. The gluteus medius and gluteus maximus are used in the case. The technique goes as follows:

1. The patient lies on the involved side (sacrum is posterior on opposite side).
2. The patient lies close to the edge of the treatment table with the therapist facing the patient.
3. The patient's trunk is rotated back so that it approximates the table. The patient's top leg is flexed at the hip and knee, while the lower leg remains straight.
4. The therapist now pushes the lower leg into extension, while palpating for motion at the lumbosacral junction with the other hand.
5. The therapist now moves the lower hand up to stabilize the pelvis, while the top hand is moved up to the patient's top shoulder. The therapist rotates the patient's trunk backward until it further approximate the table, until resistance is felt.

6. Next, the patient straightens the top knee and allows the top leg to hang freely over the edge of the table.
7. The therapist then moves his lower hand proximal to the top knee and resists movement as the patient tries to lift the top leg toward the ceiling. This contraction is held for seven to ten seconds.
8. The therapist then takes up the slack by further rotating the trunk to the table, while pushing down on the hanging leg.
9. Steps 7 and 8 are repeated two to three times and the patient is reexamined for sacral position changes.

V. MET Technique for Combined Treatment for Superior and Inferior Pubic

Subluxations: This technique uses the hip abductors to gap the joint and the hip adductors to reset the joint into normal position. The MET is performed as follows:

1. The patient lies supine in the hooklying position with the knees together. The therapist stands at the end of the treatment table facing the patient.
2. The therapist instructs patient to abduct his knees. The therapist resists bilateral abduction with his hands held on the outside of the knees. The isometric contraction is held for seven to ten seconds.
3. The patient is then instructed to bring the knees apart so legs are abducted 30° to 45° . Now the therapist resists the patient's contraction into adduction with a forearm placed between the two legs for resistance.

4. The contraction is held for a few seconds then relaxed. The adduction contraction can be repeated once or twice more before reexamining the patient.

An audible “pop” may be heard during this treatment. This “pop” indicates pubic symphysis separation and allows them to reset themselves. According to Saunders,³⁴ it is important to treat pubic lesions before treating additional sacral or innominate lesions. This technique should be used prior to incorporating the METs for treatment of sacral and innominate dysfunctions.

- VI. MET for Superior Innominate Shear (upslip): Characteristics of an upslip include a high iliac crest, superior ASIS and PSIS, a superior pubic tubercle, and a superior ischial tuberosity, all on the involved side. This MET is a direct action thrust technique applied in closed-packed position:
1. The patient lies prone with the therapist at the foot of the treatment table on the side of the dysfunction.
 2. The therapists grasps the patient’s involved distal lower leg above the ankles and raises the entire leg into 30° of hip and lumbar extension. The leg is then abducted to 30° and internally rotated.
 3. The patient then grasps the head of the table with both hands. The therapist takes up the slack by pulling the leg inferior along its long axis.
 4. The therapist then applies a quick caudal jerk on the leg.
 5. The patient is reassessed and the technique is repeated if necessary.

By using the closed-packed position of the hip, the distraction affects the innominate instead of the hip. Hip joint mobilization is done in supine in the loose-packed position.

VII. MET for Iliac Inflare: With this dysfunction, the ASIS on the involved side will approximate the midline, while the PSIS will be further from the midline on the involved side. The hip adductors are used to correct this dysfunction. The technique is performed as follows:

1. The patient is positioned in supine.
2. The therapist stands on the involved side and uses his cephalad hand to reach under the patient and palpate the PSIS.
3. The therapist's other hand grasps the patient's knee on the involved side and flexes the hip until motion is felt at the sacrum. The involved hip is then abducted to the end of the range (this position is maintained).
4. The therapist's palpating hand moves to the opposite ASIS to stabilize the pelvis, while the other hand is shifted from the involved knee to grasp the medial aspect of the involved side ankle. The therapist produces hip external rotation by moving the foot medially to its limit while still keeping the leg flexed and abducted in the position achieved in step 3.
5. While still holding the ankle, the therapist positions his elbow (of the same arm) against the patient's medial knee. The patient then tries to

adduct the affected leg against the resistance applied by the therapist at the knee.

6. The isometric contraction is held for five to seven seconds, then relaxed. During relaxation, the therapist takes up the slack by bringing the patient's leg into further abduction and external rotation.
7. Steps 5 and 6 are repeated three to four times. Then the patient is reexamined and treatment is reapplied if necessary.

VIII. MET for Iliac Outflare: Outflare of the innominate is indicated if the ASIS is moved away from the midline on the affected side and the PSIS is moved toward the midline on the same side. This technique uses muscular effort of the hip abductors along with direct traction applied by the therapist. The technique is as follows:

1. The patient lies supine with the therapist facing the patient on the involved side.
2. The therapist places his cephalad hand under the patient's PSIS and exerts lateral traction on the PSIS.
3. The therapist grasps the knee with the other hand and brings the involved hip and knee into 90° of flexion.
4. The therapist then places his shoulder against the lateral knee and brings the leg into full adduction.
5. The therapist now brings the hip into internal rotation by moving the foot laterally to the end of the range.

6. While maintaining this position of the leg with the lower hand and shoulder and while still applying lateral traction on the PSIS with the other hand, the patient pushes his hip into abduction against the therapist's resistance.
7. The isometric contraction is held for five to seven seconds. Once the contraction is relaxed, the therapist takes up the slack by bringing the leg into further adduction and internal rotation.
8. Steps 6 and 7 are repeated two to three more times. Then the patient is reexamined and treatment is repeated if necessary.

The muscle energy techniques above have been included because, according to Greenman³² and Saunders,³⁴ they are easy to perform and can be quite effective in reducing a sacroiliac joint lesion. It is important to bear in mind, though, that these authors do not cite any studies indicating the effectiveness of METs, nor was any literature found indicating their effectiveness. It is assumed that these authors, as well as others, base the effectiveness of METs on subjective information provided by patients. A more complete osteopathic evaluation and treatment scheme can be found in *An Evaluation and Treatment Manual of Osteopathic Muscle Energy Procedures*.³⁵

Pelvic girdle dysfunctions are complex and not easily understood. The pelvis, hips, and lumbar spine are all functionally and anatomically related; therefore, each should be assessed thoroughly and treatment should be based on the assessment findings. Treatment must focus on balancing muscle length and strength as well as balancing ground and trunk forces.³² Ergonomic

counseling is also very important and treatment of the SI joint will not be fully successful until faulty sitting postures and habitual work stresses are eliminated.⁹ Research regarding the SI joint and the surrounding muscular movements is still in its infancy. Although investigations have shown that motion exists at the SI joint (see Chapter III), the findings indicate the movement is limited and variable.³²

CHAPTER VII

CONCLUSION

The SI joint is a complex and fascinating synovial joint. The normal structure of the SI joint is quite variable throughout periods of normal development, between men and women, among women during menstruation and pregnancy, and among individuals in general. Since joint structure impacts function, clinicians must remember the highly variable structure of the pelvis during examination for low back and pelvic dysfunction.

The use of sophisticated methods of investigations, such as photogrammetry, computerized biomechanical modeling, and stereoroentgenographic photogrammetry, add to our knowledge of this joint but a universal model of sacroiliac function has not been presented or verified. There is also no support for consistent patterns of movement in conventional planes and a single axes of motion. The range of motion that exists in the SI joint appears too small, consisting of a few degrees or millimeters. It is possible, though, that these small movements could disturb the alignment of the joint surface and may justify the need for physical therapy intervention.

Unless reliability and validity of assessments and effectiveness of treatments can be demonstrated, clinicians should be cautious with their claims for measurement of and positive treatment effects on the SI joint. Clinicians

need to look and listen for adequate supporting data and beware of advantages and disadvantages of methods of study when reading and interpreting literature. Those clinicians who promote specific approaches should provide a basis for their method including clinical case studies, or better yet, randomized clinical trials. Finally, experimental results must be communicated effectively among clinicians.

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