MANUAL THERAPY EVALUATION OF THE PELVIC JOINTS USING PALPATORY AND ARTICULAR SPRING TESTS

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INTRODUCTION

The sacroiliac joint(s) (SIJ) seems to suffer more than any other part of the body, from inadequate definition when describing joint dysfunction. Frequently sacroiliac joint dysfunction (SIJD) is named on the basis of gross motion tests which use multiple joints and several trunk and lower extremity muscle groups. The traditional evaluation of the SIJ utilizes palpation of only a few pelvic bony landmarks and only a few joint spring tests. With traditional approaches the joint spring tests are used primarily to determine if pain is present. Due to the inherent strength of the SIJ's it might be difficult to provoke pain with articular spring tests. With regards to the SIJ, there appears to be an adequate amount of gross motion and muscle tests, but an inadequate amount of ligamentous and accessory motion tests. When evaluating the SIJ the distinction needs to be made between muscle problems, ligamentous sprains, hypomobilities, hypermobilities, and bony malpositions. We believe that the sacroiliac joint should be evaluated like any other synovial joint of the body. This should include palpation of additional bony landmarks, and especially include several multi-directional articular spring tests. These articular spring tests are primarily utilized to isolate and grade motion in the joint much like the ligamentous stress tests and joint play tests performed at the knee joint.

The purpose of this paper is to review traditional evaluation methods for SIJD, point out potential limitations with their use, and propose new methods of evaluation that include additional landmarks for palpation and several articular spring tests.

FUNCTION, JOINT CLASSIFICATION AND MOBILITY

The main function of the joint is to transfer body weight from the trunk and upper body to the lower extremities in stance and in sitting, (1, 2, 3) and function as a triplanar shock absorber, especially at heel strike (4,5). Therefore, the hypomobile joint will not dissipate shock and other structures will be stressed (5). The hypermobile joint may create excessive ligamentous stress. Slight mobility is important for shock attenuation. Stability is important as the joint is a

weightbearing structure and the pelvic bones serve as the origin and insertion of several major trunk and lower extremity muscle groups. Evaluation of joint function should include tests that address the slight mobility and the stability of the SIJ. The SIJ is essentially a synovial joint and therefore functions as a synovial joint. It has five of six synovial characteristics (6): 1) It has a joint cavity with synovial fluid. 2) It has a joint capsule with an outer fibrous and an inner synovial membrane. 3) Cartilage covers both of the joint surfaces. 4) It has ligamentous connections. 5) The joint has definite motion. The single non-synovial characteristic is the fact that it has different types of articular cartilage on each surface. The sacrum has hyaline cartilage and the ilium has fibrocartilage. That movement in the joint albeit small is normal, is an established fact (6-25). In a single plane up to 2mm is normal, however, motion is triplanar and the patient population may possess a much greater amount of mobility due to trauma, repetitive tasks, heredity, inflammation (25), or hormonal laxity (3).

DYSFUNCTION

Sacroiliac joint dysfunction will be defined as a movement abnormality of one pelvic bone in relation to another. Sacroiliac joint dysfunction will manifest as an increase or as decrease in mobility as noted with joint spring tests and may coincide with palpable changes in ligamentous tension and bony position. It may appear to singularly or collectively involve motion dysfunction of the sacrum, the symphysis pubis, the ilium, or both ilia. It is not uncommon for the lumbar spinal joints also to be involved. However, due to the functional interdependence of the pelvic bones, it is a rare event when only one pelvic bone mobility dysfunction is involved without causing mobility dysfunction of the other pelvic bones.

If the dysfunctional joint is hypomobile then there can be a general decrease, or a complete loss of mobility in one or several directions, or there can be a loss in all directions. In this example, one or several of the pelvic bones can move near to or at the end of the physiological range of motion and become stuck. The hypomobile joint will not dissipate shock efficiently and the consequence can be increased stress and perhaps tissue breakdown in other structures such as the hip joints and lumbar spine. If the dysfunctional joint is hypermobile, there can be an increase in mobility in one or several directions, or there can be an increase in all directions. The hypermobile joint is also incapable of adequate shock attenuation and the ligaments and capsule are likely to be overstressed. In prolonged weight bearing the hypermobile joint will probably sustain creep.

Our experience has been that in an outpatient orthopedic population the usual presentation of hypomobility/hypermobility is that it occurs in one direction in each of the three body planes, while the opposite hypermobility/hypomobility occurs in the opposite direction in each of the three body planes. This is referred to as a positional hypomobility/hypermobility as the mobility dysfunction is readily improved in all directions with gentle mobilization and stretching to decrease the hypomobility. It is interesting that the hypermobility often responds dramatically when the hypomobility is addressed. When global hypermobility present the approach much include strengthening, especially of the pelvic floor, support, and activity modification.

We will use the example of Anterior Ilium movement dysfunction to illustrate the problem of hypomobility and hypermobility. Anterior Ilium is defined as an excursion of the Ilium on the sacrum. In supine the Anterior Iliac Spine (ASIS) will be anterior, inferior and medial in comparison to the opposite side. In prone the Posterior Iliac Spine (PSIS) will be superior, lateral and anterior. In supine the joint will be hypomobile in posterior rotation in the sagittal plane and in posterior rotation in the transverse plane when tested at the anterior ilium in supine. Inferior mobility will be increased when tested at the superior portion of the anterior ilium in supine. In prone the joint will be hypermobile in a superior direction when tested at the ischial tuberosity, and it will be hypermobile in anterior rotation in the transverse and sagittal planes, when tested at the posterior ilium. Inferior mobility will be decreased when tested at the superior portion of the posterior ilium in prone.

SIJ mobility dysfunction often coexists with the opposite type of dysfunction on the opposite side. For example: A right sided Anterior Ilium coexists with a relative left Posterior Ilium (Posterior Ilium is the exact opposite of Anterior Ilium). The dysfunction is named for the side with the greatest degree of movement dysfunction and is often the side with the greatest amount of low back pain, buttock pain, or pain in the sacroiliac region.

Pain from the movement dysfunction may be secondary to muscle spasm, inflammation, ligamentous and capsular tension or compression. A similar etiology may occur in the joints above and below the pelvis due to faulty motion coupling of the lumbar spine and pelvis, and due to faulty motion coupling of the lower limb and pelvis. Referred pain can vary due to capsular and ligamentous innervation spanning from the second lumbar to the second sacral segments (26, 27). Pain however, does not necessarily coexist with pelvic mechanical dysfunction. This may be due to the fact that the pelvic joints are designed to tolerate a high degree of multi-directional stresses and that Type IV articular nociceptors require a very high threshold in order to become active (28). Pelvic joint dysfunction is therefore evaluated in all clients with biomechanical dysfunction of the spine or lower extremities, whether or not they have specific complaints of pain in the region of the pelvic joints.

Due to the functional interdependence of the musculoskeletal system, the fact that the pelvis is the hub of the body, and the large number of muscles that originate on the pelvis; SIJ dysfunction may contribute to proximal or distal biomechanical dysfunction (29, 30). As many muscle groups originate on the pelvis and insert on the lower extremity or trunk, it is reasonable to perceive pelvic joint dysfunction as "lumbar-pelvic-hip complex dysfunction". When pelvic joint dysfunction is present a secondary muscle inhibition may be present, due to reflex inhibition from the Type III mechanoreceptors which respond to ligamentous tension or compression (28).

RADIOGRAPHS

One of the problems with the diagnosis of SIJD is the lack of objective, repeatable data. Objective tests such as radiographs are unfortunately of limited value. Their role in demonstrating SIJD needs comment. While radiographs appear to be objective, they are unable to visualize all three planes of the joint simultaneously (25). They do not correlate well with dissection, nor with CAT scans (24, 31). Radiographs often give the appearance of bony

spurs or ankylosis which may not actually be present (24, 32), and the normal intraarticular bony ridges and depressions may be misinterpreted as osteophytes (32). Radiographs seem to have a limited ability to demonstrate mechanical dysfunction. A view that includes the symphysis pubis may only show increased joint width and vertical changes, without accurately demonstrating rotary dysfunction. It is important for the clinician to be aware of the limited role of radiographs. They have a limited ability to demonstrate the presence or lack of joint movement dysfunction.

POSITIONAL TESTS

Physical Therapists and other health care practitioners use several tests to determine whether ilium movement dysfunction is present. One common positional test is the assessment of iliac bony landmarks. When describing the ilium movement dysfunction named Anterior Ilium the current standard is to describe movement of the ASIS in one (33), two (34), or three planes (35). When Anterior Ilium dysfunction is present, the ASIS is described by one author as moving inferiorly in a single plane (33), by another author as moving anteriorly and inferiorly in two planes (5), and by this author as being anterior, inferior and medial in three planes, as noted in supine (35). The PSIS is described as being superior (33) or as being anterior and superior (36). This author has noted the PSIS to be superior, anterior, and lateral (35) when Anterior Ilium dysfunction is present. We are in agreement with Lee (34) who performs the positional evaluation of the ASIS's in supine and we believe that the triplanar description is most appropriate as SIJ movement is tri-planar. To ignore one or two planes in evaluation, in description of the dysfunction, and in treatment, most likely would be inadequate in achieving lasting treatment results.

Another positional test is the determination of iliac crest height with the client standing. Two authors are in general agreement on all landmark findings with Anterior Ilium Dysfunction except for Iliac crest height. One author palpates the iliac crest being positioned in front of the client, the other palpates from behind (2, 37). Could these two approaches to determination of iliac crest height yield different results? Also, could the presence of lower extremity structural inequalities such as a short leg, unilateral pronation or supination, or muscle imbalance, yield a false positive result for iliac crest asymmetry attributed to SIJD?

Several studies have shown a low interrater reliability with iliac crest palpation performed with the client standing (38, 39). Instead of palpating the iliac crests in standing we suggest palpating the anterior and posterior shelves in prone and supine. The anterior iliac shelf is defined as the two inch portion of the ilium immediately above the ASIS. The anterior shelves are palpated in supine with the examiners digits in full extension. The posterior shelf is the portion of the ilium that is midway between midline of the spine and the most lateral part of the ilium. The posterior shelves are palpated in prone with extended digits first pressing into soft tissue just below the last rib and then bringing them inferiorly onto the ilia. We believe that removing the effect of gravity by placing the client in prone and supine makes palpation easier and more accurate. We also believe that this method is ideal as it gives information from both the anterior and posterior ilium and is more informative with regards to complex patterns of dysfunction.

We believe that when biomechanical problems exist above and below the pelvis, the standing positional tests may render false information whereas the prone and supine positional tests may be more accurate. Some examples of potential biomechanical problems are: true (40) or functional leg length inequality, unilateral pronation (41) or supination, habit, posture, spasm (42), body sway or muscle imbalance. Cummings and Crowell noted that a false-positive interpretation of innominate rotation could occur when a true leg length inequality is present and visual assessment is used in standing (43). In order to minimize the influence of the trunk and lower extremities and their response to gravity we suggest doing positional tests in prone and supine. A review of the literature indicated a high inter and intra-rater agreement with positional tests performed in prone and supine (44).

Clinicians typically palpate the PSIS's in standing (2, 3, 33, 34, 36) to determine vertical relationships between the two ilia. The PSIS's are much closer to the true joint than are the ASIS's, the anterior iliac shelves, the posterior iliac shelves and the ischial tuberosities. Therefore, changes in the position of the PSIS's are much more subtle than changes in the position of the ASIS, the anterior iliac shelves, the posterior iliac shelves and the ischial tuberosities. We have found vertical and horizontal asymmetries of the PSIS's to be quite subtle, while anterior and posterior asymmetries of the PSIS's are readily apparent with prone palpation. Instead of using only the PSIS's to determine vertical changes, we propose that utilizing the posterior iliac shelves, the anterior iliac shelves and the ischial tuberosities can improve accuracy in determination of vertical relationships. For example: When Anterior Ilium is present the ASIS is noted to be more anterior, the ASIS and the anterior iliac shelf are lower. The posterior iliac shelf and ischial tuberosity are higher, and the PSIS is more anterior in comparison to the contralateral side.

The sacrum is another landmark that is palpated for position. With traditional methods the sacral sulci, bilateral palpation of the sacral base, and the sacral inferior lateral angles are the only sacral landmarks palpated (33, 34). The inferior lateral angles of the sacrum are palpated to determine their anterior/posterior and superior/inferior relationships. We note that among different practitioners the definition of sacral sulcus is variable. We define the sulcus as the depression that is palpated digitally between the PSIS and the sacrum. A shallower or deeper sulcus on one side compared to the other is not necessarily diagnostic of sacral malposition, but it may reflect a change in sacral position alone, or it may reflect a change of the ilium position alone (33). It may also reflect a change of sacral position coupled with a positional change of the ilium or both ilia. Palpation of the sulcus is therefore of limited value and the information can be obtained by palpation of other landmarks.

The inferior lateral angles of the sacrum are landmarks that can be uneven on a developmental basis. As stated above, palpation of the sacral sulcus may yield limited information. The use of only three landmarks: the sacral sulci, the sacral base, and the inferior lateral angles can be limiting, especially when subtle dysfunction is present. We feel more confident when additional sacral landmarks are palpated. In addition to palpation of the sulci, and the inferior lateral angles, the sacrum is palpated four times bilaterally at one and three centimeters from midline for a total of sixteen additional landmarks. This is performed with the client prone lying. Ifonly a few of these sacral landmarks are asymmetrical, the possibility of developmental asymmetry is given consideration. If many of the landmarks are asymmetrical, we have a greater

confidence in implicating a positional asymmetry, and proceed to perform articular spring tests to assess joint mobility.

Changing the clients from supine to prone has raised some concern about introducing an artificial change in bony landmark position (45). A split traction table that opens in the middle can be used to minimize positional artifact in changing clients from prone to supine. The client's anterior landmarks are palpated in supine and the therapist then lies on the shelf below to palpate the posterior landmarks, without changing the position of the client.

LUMBAR GENERAL MOBILITY AND TRADITIONAL SPRING TESTS

Traditional evaluation of the SIJ includes general mobility and articular spring tests of the lumbar spine. Some clinicians observe the response of the lumbar lordosis in neutral, flexion and hyperextension (33, 34). During these lumbar spine movements the motion response of the sacrum is noted by palpating the sacral inferior lateral angles. The lumbar spine is also evaluated via anteriorly directed spring tests (30,31). These tests are used to correlate with a specific type of sacral dysfunction. We question the ability of these tests to interpret sacral articular mobility dysfunction. Active lumbar motion and lumbar spring tests may give the impression of faulty sacral motion for the following reasons: 1) Lumbosacral facet asymmetry, which is very common (46), may change the motion of the sacrum. 2) A torsional fixation of the ilium on the sacrum could change lumbar and sacral mechanics due to the ligamentous and muscular attachments. 3) Unilateral lumbosacral spasm may be enhanced with active lumbar motion. We are convinced that these tests could present a false-positive for SIJD in the presence of a fused SIJ. This is due to the fact that the pelvis can move as a unit on the lumbar spine in any of the three body planes, and the lumbar spine can move on the pelvis in any of the three body planes. From a functional perspective these lumbar tests do seem very useful however, in interpreting how the lumbar spine and the pelvis move together, rather than giving specific information about isolated SIJ motion.

Rather than describe asymmetrical motion of lumbopelvic landmarks as "joint" dysfunction it might be more appropriate to use a general description such as "faulty lumbopelvic rhythm". We propose that this is a problem of semantics and that articular spring tests yield information about joint dysfunction, whereas gross movement tests yield more information about muscle function. The knee joint may provide a useful analogy. In observing limited or asymmetrical gross motion of the knee joint, it is impossible to state that there is joint pathology, such as hypomobility or hypermobility. Limited gross motion or asymmetry of active motion can certainly have an intraarticular or extra-articular etiology. Specific tests are available to stress the ligamentous structures, the menisci, the joint capsule and to assess joint play. Like the knee joint, asymmetrical or limited gross active motion of the lumbar spine and pelvic bony landmarks implies that there is a problem somewhere, but does not tell us if the problem is intraarticular or extra-articular. Specific joint stress tests are available for testing the SIJs and have some similarity to those available for stressing the intraarticular structures of the knee joint and for testing joint play. These are discussed in more detail in the under Joint Spring Tests.

GENERAL PELVIC MOBILITY TESTS

While all of the positional tests give information regarding positional asymmetry, they do not always imply SIJ movement dysfunction. The pelvis can move as a unit on the spine, and the pelvis can move as a unit on the lower extremities, without motion occurring within the pelvic joints. Traditional methods of SIJ evaluations rely heavily on positional tests and general pelvic mobility tests. General pelvic mobility tests give information about how the pelvis moves in space. The pelvis can move unevenly as a unit, even in clients who have fused pelvic joints. That this can happen can be validated with palpation of pelvic landmarks in clients who have radiologic (CAT scan) evidence for complete SIJ fusion, such as occurs in advanced ankylosing spondylitis. Therefore, tests which evaluate changes in position of pelvic landmarks do not always tell us about actual motion within the pelvic joints. Our profession needs to apply caution in the interpretation of pelvic landmark asymmetry with static palpation and gross trunk and lower extremity motion. It is no longer tenable that landmark changes with the aforementioned tests represents actual SIJ motion.

General pelvic mobility tests have been described in the literature as important tests for determining if sacroiliac "joint" dysfunction is present. If we compare orthopaedic physical therapy evaluation of the pelvic joints with evaluation of any extremity joints, a striking difference will be noted. When testing the SIJ via general mobility tests, asymmetrical movement of bony landmarks is ascribed to sacroiliac "joint" dysfunction (34). When performing gross movement evaluation of the extremity joints, asymmetry of bony landmark excursion is not given the label of extremity "joint" dysfunction. Rather, this gross active motion test of the extremity joints leads to other tests, to evaluate passive range of motion, including tests to evaluate and grade joint play, be it normal, hypermobile, or hypomobile. Three general pelvic mobility tests are described below, and will be contrasted with specific joint spring tests.

A general mobility test named The Standing Flexion Test, is performed by palpating the shelves beneath the PSIS's while the client actively flexes his trunk (33, 34). If one PSIS rises more than the other PSIS, the same sided ilium or lower extremity is theoretically limiting the mobility of the SIJ. If the ilium has moved in relation to the sacrum, the resultant joint mobility dysfunction might appropriately be referred to as a "true joint dysfunction". If a trunk or lower extremity muscle group is limiting the excursion of the PSIS, the dysfunction should not be named as "Sacroiliac joint dysfunction".

The Sitting Flexion Test is very similar to the Standing Flexion Test except that trunk flexion is performed in sitting (33, 34). To perform the Sitting Flexion Test the client sits while the clinician palpates the slope just below the PSIS's (33). While the client flexes, the clinician notes if one PSIS rises more than the other, and if so, the sacrum or spine is theoretically limiting mobility at the ipsilateral SIJ. Of concern is the possibility of over interpretation of these tests. The Standing and Sitting Flexion Tests are two tests among a small cluster of tests that need more research to validate their application. It seems that at times clinicians conclude dysfunction of the ilium or sacrum too readily with these tests, especially if a few other of the small cluster of SIJ tests are positive. It is important to remember the original intention of the tests. The tests are supposed to indicate dysfunction of the ilium or lower extremity

and demonstrate dysfunction of the sacrum or the spine.

While the Standing Flexion and Sitting Flexion tests are correlated with other tests before implicating the SIJ as being dysfunctional, we cannot help but question the validity of these procedures. To our knowledge no research has proven that the Standing Flexion, Seated Flexion and other similar tests actually isolate and measure SIJ motion. These tests use large trunk and lower extremity muscle groups that span multiple joints. We believe that these tests have been repeated so much in the literature and in continuing education courses that our profession has come to accept them without question as measuring something (actual joint motion) that has never actually been proven. As we have stated earlier in this paper, the pelvis can move in space in three planes as a unit, without motion occurring in the pelvic joints. The pelvis can move in space asymmetrically during gait, even in clients who have fused pelvic joints due to advanced ankylosing spondylitis. While there is poor (38) to fair (47) inter and intra-rater reliability with these tests, the validity (ability to actually isolate and measure SIJ motion) has yet to be established.

Another general mobility test is the Long Sit Test (33, 34, 48). To perform the Long Sit Test the relative leg lengths are assessed in supine by placing the client in symmetrical supine lying and palpating the medial malleoli. The client then comes up into long sitting. If a change in the apparent leg length is noted then the ilium or lower extremity is theoretically limiting motion at the SIJ. One study shows a fairly good correlation of this test with palpation of PSIS height in standing and with a positive Standing Flexion Test (48). However, these tests have never been validated as having the ability to isolate SIJ motion. One study shows a low intertester reliability with the Long Sit Test (38).

JOINT SPRING TESTS

If one of the main functions of the SIJ is to absorb shock (4, 5), then an important test would be one that measures the ability of the joint to absorb shock. A normal joint would ideally be nearly symmetrical in it's ability to absorb shock and transfer body weight on each side of the pelvis. A hypomobile joint would be dysfunctional in that it would be a poor attenuator of shock and could over stress the joints above and below the pelvis. A hypermobile joint would also be a poor attenuator of shock, and the ligaments and joint capsule would be overstressed. We believe that specific joint spring tests may be effective in measuring the joints ability to dissipate shock and transfer body weight and in determining if hypomobility or hypermobility is present. We utilize up to fifteen different basic articular spring tests to measure multidirectional mobility and stability in the SIJ joints and symphysis pubis (35). Additional joint spring tests are available if a modified test procedure is desired or if additional information is needed in complicated presentations.

When performing joint spring tests we note the quality and quantity of movement and rate it as hypomobile, normal or hypermobile. The movement may be further clarified by using a six point scale (Table 1). Pain response is also noted if present with spring testing, though absence of pain does not imply normal joint function. As many dysfunctional joints are not painful with spring tests, pain response is given secondary importance over mobility and stability. Joint

spring tests have been described by other authors (38, 49) with the primary emphasis on pain response. In describing six joint spring tests (described as provocative tests) Woerman (49) mentions pain as the primary measurement but mentions that observation of movement abnormality to be important with two of the six spring tests. The value of these six tests was minimized by the statement: "Sacral provocation tests should be done only when applicable, that is, when the above series of tests has not provided a clear picture of the dysfunction. These tests should not be performed if the previous tests have demonstrated a hypermobility." We are in disagreement as we do not believe that the positional and gross motion tests described, necessarily reveal actual joint hypermobility.

GRADE	DESCRIPTION
0	Ankylosis, Or No Mobility Percieved
1	Considerable Motion Limitation
2	Slight Motion Limitation
3	Normal Motion (specific for the individual)
4	Slight Motion Increase
5	Considerable Increase
6	Unstable

Table 1. MOTION GRADING Modified from Paris (50)

The spring tests are performed on one side and then the other unless specified otherwise. Spring tests are always utilized, even in the presence of symmetrical pelvic landmarks. Firm pressure is applied to the part being tested with as much contact as possible in order to minimize discomfort. The slack is taken out of the joint by applying steady or gradually increasing pressure, until the initial movement of the bony structure stops. The spring test is then applied as a gentle force within the physiological range. By taking up the slack the spring test should test actual joint mobility or lack thereof, and should not be a measure surrounding soft tissue extensibility. The additional palpation and articular spring tests give information that is useful in planning rehabilitation for SIJD. The palpation and spring tests are also useful in evaluating response to treatment.

Spring tests can be measured with force transducers such as the MICROFET* muscle testing device. The MICROFET is one of several force transducers available. It is a hand held instrument that measures the amount of force the clinician applies.

After taking up the slack in the joint the clinician can then apply the spring test using the MICROFET or other similar device to measure how much force is required when actual joint motion is perceived. One side of the pelvis is compared with the other. The clinician can measure the force before and after treatment. In a small sample the average force used in taking up the slack for the symphysis pubis was 5# and the maximal force for springing it was 10#. The other spring tests applied at the ilia, the sacrum, and the ischia averaged 20# to take up the slack and 40# maximum for applying the spring test. The force needed may vary from person to person. The above averages serve as a guideline with which to develop the skill of applying the spring tests. The figures were taken from a skilled clinician with over five years experience in using pelvic springs tests with minimal force that minimizes patient discomfort. The appropriate amount of force is the least amount of force that does not increase pain, but yields useful information. When precision of technique is mastered the required force is minimal. The empirical sense of 5-10#, and 20-40# can be developed by practicing with a bathroom scale. The MICROFET or similar testing devices are ideal for practicing spring tests on a normal population. By practicing the spring tests on a normal population the clinician can develop confidence and skill before applying the tests on a patient population. As treatment logically follows the information gathered from the spring tests, it is of paramount importance that the spring tests be learned properly.

With practice the tests can be performed in a very short period of time. The tests which are listed below are practical as they evaluate the pelvic for commonly observed patterns of dysfunction. The spring tests listed below also should cover the range of possibilities in testing for non-textbook patterns of dysfunction. Other tests exist which supposedly evaluate the sacroiliac yet go through the hip joint and therefore can make interpretation obscure. The tests below can certainly be modified to adapt to one's particular needs, body type, tolerance of test procedure, etc.

These tests are named for the direction of force imparted on the client's landmark(s) underneath the tester's hand(s). The tests are not necessarily named for the specific movement that occurs in the joint. This is done for the sake of minimizing confusion and making the spring tests easier to learn. The SIJ is a triplanar joint and force applied at one landmark may cause motion of the landmark to occur in one direction whereas motion in the joint itself may occur in the same direction, or motion may occur in the opposite direction. For example: A posterolaterally directed force at the ASIS causes the ASIS to move posterolaterally whereas the PSIS and iliac joint surface will move medially and posteriorly. In another example a posteriorly directed force in the sagittal plane on the ASIS causes a posterior force in the SIJ. This inconsistency of motion response to spring tests is simply due to the shape of this unique triplanar structure, and exemplifies the need for the above method of naming the spring tests.

*MICROFET is distributed by EMPI Inc. 1275 Grey Fox Road, St Paul, Minnesota 55112 (612) 636-6600, 1-800-328-2536

While motion in the joint rarely occurs in single planes, this method of spring testing seems to allow precision and thoroughness as it attempts to evaluate motion in all potential planes along their respective axes. The thoroughness of this method should allow the clinician to evaluate unusual or "non-textbook" presentations.

BASIC SPRING TESTS

Supine

1. Posterior Rotation of The Ilium. Stabilize both anterior ilia and induce posterior rotary force on one side then the other (sagittal plane, around a transverse axis). Both hands will receive information.

2. Iliac Gaping Test. With hands crossed on the anterior ilia apply a posterolateral force on both ilia (transverse plane, around a vertical axis).

3. Posterior Spring Test To Pubic Tubercles, performed one at a time (sagittal plane).

4. Inferior Stress To The Ilium. Push inferiorly on iliac shelves, one at a time (sagittal plane).

Prone

5. Anterior Rotation Of The Ilium. Apply anterior rotary force on the superior ilium, just above and lateral to the PSIS's (sagittal plane).

6. Sacral Rotation. With ulnar border or heel of hand on L/R side of the sacrum at levels S1, S2, S3, apply an anterior force on one side and then on the other. Pressure on the left side induces right rotation, pressure on the right induces left rotation (transverse plane, around a vertical axis).

7. Sacral Sidebending. At the inferior portion of the inferior lateral angles of the sacrum, apply a superior force on one side and then the other (frontal plane sidebending about an A-P axis).

8. Inferior Sacral Glide Test. The title should be self explanatory. Movement occurs in the frontal plane.

9. Sacral Forward Bending. Apply anterior force on the superior sacrum just above the level of the PSIS's at S1 (sagittal plane, around a transverse axis).

10. Sacral Backward Bending. Apply anterior force to sacral apex at 1" above the sacrococcygeal junction (sagittal plane, around a transverse axis).

11. Anterolateral Ilium Stress Test. Stress the ilium with anterolateral force at a 45 degree angle, applied directly on the PSIS (transverse plane).

12. Superior Stress To Ischial Tuberosity. Apply superior and slightly lateral force to the ischial tuberosity (frontal plane).

13. Inferior Ilium Stress. Apply inferior stress to posterior iliac shelves (frontal plane).

14. Lateral Ischial Stress Test. Apply lateral stress to the ischial tuberosities (one at a time) with stabilization just above the ipsilateral trochanter (frontal plane).

15. Anterior Stress To Ischial Tuberosities. The name should be self explanatory. This may measure tension in the sacrotuberous and sacrospinous ligaments and it tests motion of the inferior symphysis pubis about a transverse axis in the superior symphysis pubis (sagittal plane around a transverse axis in the superior symphysis pubis).

ADDITIONAL SPRING TESTS

Supine

16. Inferior Stress to Pube Bones. With thumbs on each pubic crest apply an inferior stress, one at a time (frontal plane).

17. Superior Stress to Pubic Bones. With ulnar border of the hand on the inferior pube apply superior force on one side and then the other (frontal plane).

18. Sagittal Pube Rotation. This spring test is performed when due to the amount of soft tissue, one cannot access the ischial tuberosities for an anterior spring test. This test is the exact opposite of the Anterior Ischial Tuberosity Spring Test. With thumbpads on the inferior pubic bones apply a posterior stress (sagittal plane around a transverse axis in the superior joint).

Prone

19. Superior Sacral Shear. Press firmly with open palm in an anterior direction to achieve adequate purchase on the sacrum. Apply vertical force (frontal plane).

20. Lateral Sacral Shear. Press firmly to maximize palmar contact on the sacrum. Shear the sacrum left and then right (frontal plane).

21. Sacral Sidebending. Apply a pure lateral force on the inferior sacrum to the left and then the right (frontal plane).

22. Medial Ischial spring. Apply medial stress at the lateral portions of the ischial tuberosities (one at a time). Stabilize just above the ipsilateral trochanter (frontal plane).

Sidelying

23. Type II Inflare Stress Test. Client has top leg in neutral position. The bottom hip and knee are flexed for comfort. A pillow is placed between the knees. Apply a medial stress to the anterior ilium. Note that this stress test emphasizes the medial component of the anterior ilium. This test is much more effective than tests #2, #10 in evaluating a subtle flare pattern with a much stronger medial/lateral component and a minimal anterior component (transverse plane).

24. Type II Outflare Stress Test. Client positioned as above. Apply a medial stress to the posterior ilium. This test is much more effective than tests #2 and #10 in evaluating a subtle flare patterns with a much stronger medial/lateral component and a subtle posterior component (transverse plane). This is the opposite of spring test #24.

25. Superior Joint Compression. Apply a compressive force on the superior and posterior portion of the ilium. Hand placement must be above the level of the PSIS's.

26. Superior Joint Distraction. Distract the ilium by lifting it from the anterior and posterior shelves. This is the opposite of test #25.

LIGAMENTOUS TENSION TESTS

The sacrotuberous, sacrospinous and inguinal ligaments are accessible for palpation. The inguinal ligament is often tender to palpation and displays increased tension with some types of pelvic joint dysfunction. The increase in tension is most likely due to reflex guarding of the abdominal musculature. It is useful to palpate the inguinal ligament before and after treatment as tension and tenderness often abates when the pelvic dysfunction is resolved.

The sacrotuberous ligament is readily accessible by probing with the thumbs between the medial aspect of the ischial tuberosity and the inferolateral angle of the sacrum. It can be strummed or depressed digitally. The tension can be increased or decreased depending on the type of pelvic joint dysfunction. Hypertonic or hypotonic sacrotuberous ligaments often respond readily to pelvic joint treatment.

The sacrospinous ligament is nearly covered by the sacrotuberous. It is most readily palpated just medial to the posterior inferior ischial spine. Tension is measured with anteriorly directed digital pressure. Sacrospinous ligamentous tenderness and hypotonus often accompanies an ipsilateral symphysis pubis dysfunction (shift of one pube bone relative to the other).

SACROILIAC EVALUATION

A sacroiliac evaluation always includes a lumbar spine and hip evaluation. As physical therapists we believe that the role of diagnosis lies with the medial practitioner and the evaluation of function and dysfunction lies in the realm of physical therapy. Several important diagnostic considerations such as blood tests, radiographs, bone scan, etc., are not included in this evaluation as they belong in the realm of the medical practitioner. We value a working relation with medical practitioners and especially value their important role in ruling out serious pathology. We believe that pelvic joint dysfunction is often overlooked in the medical model as a source of low back and buttock pain. This may be due to the limitations of radiography and the need for research on evaluation and treatment of pelvic joint dysfunction. Pelvic joint dysfunction may exist as a single entity but most often accompanies low back and buttock pain, and occasional hip pain. A comprehensive evaluation is an ideal to strive for. A basic manual therapy evaluation of the pelvic joints is described below. A lumbar spine evaluation and a hip joint evaluation is always performed along with a pelvic joint evaluation but is not described below. Although time consuming, we believe that this evaluation method is more thorough than traditional methods and that it yields more information. In using this system of evaluation we have encountered ten new patterns of pelvic joint mobility dysfunction which have not been mentioned in the literature (51).

HISTORY: The history taking should include questions about current and past episodes of low back and pelvic joint pain. Inquire about the nature of the pain and factors that increase or decrease pain. Tests, consultations and treatments for current problem should be noted. It is important to inquire about the client's general medical history, including previous injuries, major illnesses, hospitalizations, surgeries and regular medications. Patient's often discount the importance of history taking, thinking their medical history has no possible bearing on current complaints. While most of the client's seen in a physical therapy clinic have a musculoskeletal cause for their complaints, on occasion one may encounter a client with a serious underlying pathology.

STANDING:

We believe that many findings encountered in sitting and standing are often compensatory. Joint function based on joint spring tests require prone and supine positioning. We place more validity in pelvic joint dysfunction encountered with the prone and supine evaluation and reevaluate in standing after treatment. Postural and gross movement patterns are most apparent in standing and may improve after treating the pelvic joints. The root cause of compensatory postural patterns is often readily apparent in prone and supine. The strain pattern is often very different in standing and sitting when compared to prone and supine.

posture

gait and mechanics of the entire lower extremity

weight bearing on two scales

iliac shelves anteriorly

ASIS's: superior/inferior

ASIS's: medial/lateral

ASIS's: anterior/posterior

gross spinal rom

posterior iliac shelves

spinal posture: gross and segmental

sacrum (palpate bilaterally along entire length)

Standing Flexion Test: Palpate both PSIS's while client flexes the spine. The PSIS's rise symmetrically in normals, otherwise the side that rises more, is theoretically in dysfunction. This test is purported to determine whether the ilium or the leg may be exerting dysfunctional influence on the SIJ.

SITTING:

As stated previously the sitting evaluation may encounter compensatory patterns that won't exist in prone and supine. These sitting patterns will often change or will resolve when the primary problem is resolved. We uses sitting primarily for evaluating lumbar segmental position and active spinal motion in a flexed position.

posture: gross and segmental

segmental position and active motion: Test neutral sitting to hyperflexion and extension, sidebending and rotation.

anterior iliac shelves

ASIS's: anterior/posterior

ASIS's: medial/lateral

ASIS's: superior/inferior

PSIS's: anterior/posterior

sacrum (palpate entire length)

posterior iliac shelves

quick screen of entire trunk

Sitting Flexion Test: Theoretically this tests how well the sacrum moves between the ilia and determines which is the side of dysfunction. It can be influenced by any part of the spine and perhaps even by iliac position, though this is not a common belief. To perform the test palpate inferiorly to PSIS's and have patient flex maximally in sitting. The side of dysfunction should rise higher.

SUPINE:

strength/sensory

apparent leg length: at inferior shelves of medial malleoli

apparent leg length: at inferior shelves of lateral malleoli

apparent leg length: at calcaneus with feet in symmetrical dorsiflexion

SLR: if painful where?

Hip rom: rotation, flexion, Thomas test, and modified test for Tensor Fascia Lata length

anterior iliac shelves

ASIS's: anterior/posterior

ASIS's: medial/lateral

ASIS's: superior/inferior

inguinal ligaments: evaluate tone

pubic tubercles: anterior/posterior

pubic crests: superior/inferior

inferior pubic bones: evaluate anterior/posterior position

spring tests (see separate section)

soft tissue of abdomen and lower extremity

Long Sit Test: This test evaluates leg length in both supine and long sit, associated with SIJ dysfunction. Specifically, it evaluates for the presence of Anterior or Posteriior Ilium dysfunction. Theoretically the leg length appears to change in predictable fashion, though this is not always observed. This test seems too be very general and non-specific. Usually the

long/short leg in supine will change to become short/long in long sitting. Theoretically the leg length responds to the vertical component of the ilium in supine, but responds to the anterior/posterior component of the ilium in long sitting. Muscular influences on this test need to be considered.

Spring tests (see separate section)

SIDELYING:

segmental flexion, extension and posterior glide L4, L5

spring tests (see separate section)

PRONE:

lumbar gross and segmental posture and movement response from neutral prone to hyperextension

lumbar spring tests: posterior to anterior at midline and at each transverse process

posterior iliac shelves: Place extended digits at iliac shelves that are midway between midline of the spine and the most lateral soft tissue of the trunk. First press anteriorly into soft tissue below the lowest rib and bring your extended digits inferiorly onto the pelvic shelves.

PSIS's anterior/posterior

sacroiliac sulcus (optional)

sacrum: Palpate entire length 1cm away from midline, then 2-3cm from midline. Press firmly to palpate through soft tissues.

inferior lateral angles: superior/inferior

sacrospinous ligament tone

coccyx: position and mobility (posterior to anterior, side bending)

ischial tuberosities: superior/inferior

ischial tuberosities: anterior/posterior

ischial tuberosities: medial/lateral

sacrotuberous ligaments: evaluate tone

soft tissue assessment of spine, pelvis, and lower extremity

spring tests: (see separate section)

CONCLUSION

We believe that confidence and accuracy can be enhanced by using the proposed methods of evaluation. Traditional evaluation methods use fewer landmarks for palpation and utilize gross motion tests. Positional and gross motion tests mayhave a limited ability to evaluate for true sacroiliac joint dysfunction but probably are effective in determining gross motion coupling of the lumbo-pelvic-hip complex. We believe that the clinical successes achieved with traditional methods justify their continued use and we have incorporated them in our evaluation scheme. We strongly believe that traditional evaluation methods are important in that they test gross motion coupling of the spine with the pelvis and the hips. We believe that the use of fifteen different articular spring tests and additional palpatory tests yields very different information. The proposed spring tests should give more information about joint play. These specific joint spring tests appear more capable in evaluating actual joint hypomobility and hypermobility. In using this method of evaluation ten new patterns of pelvic joint dysfunction have been encountered and new methods of treatment have been developed in response thereof.

There is a significant need for research on traditional evaluation methods of evaluation and treatment and on the methods presented here. While research is in progress, we must be aware of both what is already known and what new questions need to be answered regarding this complicated and frequently ignored articulation. In spite of a limited, albeit increasing amount of research on the SIJ, we must not ignore the joint. Instead, we must diligently strive for better methods of evaluation and treatment and contribute to the body of research.

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