The predictive value of the sacral base pressure test in detecting specific types of sacroiliac dysfunction

Travis D. Mitchell MTechChiroSA^{a,*}, Kristina E. Urli MDipChiroSA^b,
Jacques Breitenbach MTechChiroSA^b, Chris Yelverton MTechChiroSA^{b,c}

^aPrivate Practice, Dubai, United Arab Emirates

^bPrivate Practice, Johannesburg, South Africa

^cHead of Chiropractic Department, University of Johannesburg, Johannesburg, South Africa

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Abstract

Objective: This study aimed to evaluate the validity of the sacral base pressure test in diagnosing sacroiliac joint dysfunction. It also determined the predictive powers of the test in determining which type of sacroiliac joint dysfunction was present.

Methods: This was a double-blind experimental study with 62 participants. The results from the sacral base pressure test were compared against a cluster of previously validated tests of sacroiliac joint dysfunction to determine its validity and predictive powers. The external rotation of the feet, occurring during the sacral base pressure test, was measured using a digital inclinometer.

Results: There was no statistically significant difference in the results of the sacral base pressure test between the types of sacroiliac joint dysfunction. In terms of the results of validity, the sacral base pressure test was useful in identifying positive values of sacroiliac joint dysfunction. It was fairly helpful in correctly diagnosing patients with negative test results; however, it had only a “slight” agreement with the diagnosis for κ interpretation.

Conclusions: In this study, the sacral base pressure test was not a valid test for determining the presence of sacroiliac joint dysfunction or the type of dysfunction present. Further research comparing the agreement of the sacral base pressure test or other sacroiliac joint dysfunction tests with a criterion standard of diagnosis is necessary.

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Introduction

Diagnosis of sacroiliac joint dysfunction is difficult because of the lack of a satisfactory criterion standard (“gold standard”).¹ Nevertheless, many different sa-

* Corresponding author. PO Box 2666, Dubai, United Arab Emirates. Tel.: +971 4 335 1200; fax: +971 4 335 2555.

E-mail address: travis@dubaihtc.com (T. D. Mitchell).

croiliac joint tests have been described, and none have been validated against any independent criterion standard.² The sacral base pressure test (SBPT) has been shown in a previous study to have good validity as an indicator of sacroiliac dysfunction.³

In 1905, Goldthwaite and Osgood considered the sacroiliac joint to be the main cause of lower back pain. However, in 1934, Mixter and Barr changed the focus to the herniated disk and surrounding structures as the cause of lower back pain.⁴ Since then, the sacroiliac joint has had a mixed participation in the cause of lower back pain⁴ and has been exposed to considerable controversy⁵ regarding its structure, function, and pathologic features.⁶⁻⁹

Sacroiliac joint anatomy

The 2 sacroiliac joints have a highly individualized and unique structure.¹⁰ They are true atypical diarthrodial (synovial) joints¹¹ with large variations found between individuals, between left- and right-sided joints in the same specimen,¹² and between men and women.¹³ The joint is atypical because it has a synovial portion consisting of the articular surfaces and a syndesmotic portion consisting of ligamentous attachments.^{4,5}

At birth, the 2 articular surfaces are flat and smooth. By puberty, ridges and corresponding grooves start to develop, becoming more marked in the 40s.¹¹ This groove and ridge interlock for stability and help guide the movement.¹⁴ Early degeneration changes have been noted (particularly in the iliac part), and this is thought to have a significant correlation with the degree of motion and the production of pain.¹²

The sacroiliac joint is a weight-bearing joint¹⁵ with both structural and dynamic contributors to the joint's stability¹⁰ that form a self-locking mechanism.¹⁶ This mechanism maintains the integrity of the low back and the pelvis during the transfer of energy from the spine to the lower extremity.¹²

Form closure describes the interlocking joint surface and those anatomical structures that supply passive stability. Force closure refers to the dynamic stabilization of the sacroiliac joint offered by the musculofascial system and the ligaments surrounding the sacroiliac joint.¹⁰ Both the lateral force of force closure and friction of form closure are needed to withstand the impact of the vertical load on the pelvis.¹⁷ During infancy and childhood, the entire stability depends on force closure; as the degenerative changes occur within the joint, more stability is dependent on form closure.^{4,10,18}

Sacroiliac joint biomechanics

Numerous motion patterns and axes of rotation have been described in many studies, and the only certainties are the following: the sacroiliac joints are diarthrodial; movement is possible, although the range of motion is small and decreases with age; this movement does play an important role in the overall functioning of the pelvis and the lower back; the motions are coupled and dependent on some degree of joint separation; the predominant motion is x-axis rotation coupled with some degree of z-axis translation^{9,15,19}; and the opposing joint surfaces direct the movement in a track-bound motion.¹⁹

For the purpose of this study, symmetrical sacral motion and asymmetrical antagonistic iliac motion were considered to be important and primary, particularly when discussing the SBPT and the 4 control tests.

Symmetrical motion is a paired joint motion where both ilia move symmetrically and some degree of sacral nutation or counternutation occurs concurrently.^{5,19} The movement of nutation (anterior inferior movement or tilting of the sacral base) and counternutation (opposite to nutation) occurs around a transverse axis posterior to the joint at the sacral tuberosity where the sacroiliac ligaments insert.^{9,20} Associated with this nutation is an approximation of the iliac crests, a separation of the ischial tuberosities,⁹ and a posterior torsion or rotary movement of the ilium on the sacrum.¹⁰

Asymmetrical motion is a paired reciprocal or antagonistic motion of the sacrum relative to the ilia or vice versa and occurs during walking.^{9,19} This motion is assessed in the spine/Gillet test. Sacroiliac joint flexion is a posterior rotation (around the x-axis) of the ilium during ipsilateral hip flexion. The sacrum is seen to nutate on the side of the flexed hip and counternutates on the weight-bearing leg. At the end of the motion, further hip flexion will cause the sacrum to rotate posteriorly and inferiorly on the weight-bearing ilium resulting in sacroiliac joint extension.⁹ Sacroiliac joint extension is the opposite motion to flexion.¹⁹ Because of the axis of rotation about which this occurs, a degree of anterior superior iliac spine outflaring and inflaring occurs simultaneously with flexion and extension, respectively.⁵

Sacroiliac joint dysfunction

The literature has noted the prevalence of sacroiliac joint dysfunction to be between 19.3% and 47.9% depending on the study group.²¹ Sacroiliac joint

dysfunction indicates hypomobility³ and is caused by an altered position of the joint surfaces, which is created by repetitive stresses and is maintained by compressive and elastic forces of the ligaments and the muscles.⁴ Numerous types of sacroiliac dysfunction have been described; however, for purposes of this study, we will only be concerned with flexion and extension dysfunctions (Table 1). A flexion dysfunction has been described as being the most common dysfunction occurring particularly on the left side.^{19,20,22} A right extension dysfunction is the second most common type of dysfunction.²⁰

Manual examination of the sacroiliac joint is the standard method used for its diagnosis; however, there is not one manual examination test that is considered to be the gold standard of sacroiliac joint dysfunction diagnosis.^{1,23} At best, when 3 of 4 tests produce positive results,^{1,24,25} the individual test results be-

come contributory rather than surrogate²⁵ and together produce good intertester reliability.²⁶ There is considerable controversy surrounding the reliability and validity of these manual examination tests. Validity and accuracy are vital because treatment type (including specific manipulative procedures) is based on the results.^{4,27}

The supine long-sitting test, the standing flexion test, the spine test, and the iliac springing test were used as the control tests in this study; see Appendix A for an explanation of each test. Numerous studies, combining various combinations of the tests used in this study, have shown that these tests have a good intertester reliability, a moderate consistency, and a good agreement; are clinically useful; and identified a similar dysfunction of the sacroiliac joint. Therefore, using a cluster of these tests will improve the specificity of a test, thereby reducing the number of false-positive results.^{1,23,25}

Table 1 Comparison between clinical features of flexion and extension dysfunctions

Flexion Dysfunction	Extension Dysfunction
Also Termed <i>Posteroinferior</i> Ilium (PI)	Also Termed <i>Anterosuperior</i> Ilium (AS)
<i>Counterclockwise</i> Iliac Rotation Around the x-Axis ($-\theta x$) and Ilium Is Posterior on the z-Axis ($-z$)	<i>Clockwise</i> Iliac Rotation Around the x-Axis ($+\theta x$) and the Ilium Is Anterior on the z-Axis ($+z$)
<i>External</i> Iliac Rotation Around the y-Axis ($-\theta y$ on Left or $+y$ on Right)	<i>Internal</i> Iliac Rotation Around the y-Axis ($+\theta y$ on Left or $-y$ on Right)
PSIS in a <i>Posteroinferior</i> Position and With Some <i>Outflaring</i>	PSIS in an <i>Anterosuperior</i> Position and With Some <i>Inflaring</i>
Innominate Is in <i>Flexion</i> and <i>Lateral Rotation</i> Relative to the Sacrum	Innominate Is in <i>Extension and Medial</i> <i>Rotation</i> Relative to the Sacrum
Axis of Rotation: Shifts <i>Superiorly</i> and Decreased <i>Anterior</i> Iliac Rotation	Axis of Rotation: Shifts <i>Inferiorly</i> and Decreased <i>Posterior</i> Iliac Rotation
Relative <i>Anteroinferior</i> Shift of the Ipsilateral Sacral Base	Relative <i>Posterosuperior</i> Shift of the Ipsilateral Sacral Base
Functional <i>Short</i> Leg Ipsilaterally	Functional <i>Long</i> Leg Ipsilaterally

Based on references [5] and [19]. Italics are used to indicate the differences between these 2 types of dysfunctions. PSIS, Posterior superior iliac spine.

Sacral base pressure test

During the SBPT, a direct pressure is applied to the sacral base attempting to induce sacral nutation; Appendix B provides a discussion of this test. This nutation creates external rotation of the foot by the transference of force through the muscular mechanisms of the pelvis and hip. Therefore, theoretically, the movement of nutation and external foot rotation does not occur if there is a sacroiliac joint dysfunction present.^{3,5} This theory is confirmed by the link between unilateral limitation of hip rotation (where the rotation is unequal between the left and right sides) and disorders of the sacroiliac joint.²⁵ Furthermore, in a non-weight-bearing patient, movement at the sacroiliac joint causes an outflaring movement at the hip joint, which results in external rotation at the feet.²⁸

In the case of flexion dysfunction, the sacrum is going to be in a position of nutation; therefore, it is hypothesized that the SBPT is going to be facilitated and that there will therefore be no significant difference in the external rotation between the dysfunctional foot and the functional foot. Consequently, in the case of the extension dysfunction, there will be a significantly decreased external rotation on the dysfunctional side. This is evident because posteriorly rotated ilia were noted to have significant greater external hip rotation compared with internal rotation on the same side, whereas anteriorly rotated ilia showed far less asymmetry.²⁵

The examination for a sacroiliac joint dysfunction is problematic because of the anatomical location of

these joints, and the lack of a gold standard makes diagnosis difficult.¹ A proper assessment and an accurate diagnosis are crucial for the practitioner before appropriate manipulative therapy can be administered.²⁹ Many different diagnostic sacroiliac joint tests have been described, yet an independent criterion standard or gold standard does not exist. Therefore, all these tests have only been compared with other clinical tests, the validity of which is unknown.² In addition, most of these tests are subjected to a high interobserver error or intertester/intratester reliability² and are very subjective in the manner in which they are performed and in their interpretation.³⁰

This study aims to evaluate the validity of the SBPT, as determined by a previous study,³ in detecting a sacroiliac joint dysfunction. The study's second aim is to establish whether the SBPT can determine the type of sacroiliac joint dysfunction that is present as defined by this study. It is hypothesized that the results obtained by the SBPT will differ between the types of sacroiliac joint dysfunctions present.

Methods

Participant selection

Sixty participants, of either sex and between the ages of 18 and 65 years, were randomly selected for this study. Lower back pain (of any description) was not required, although participants were excluded if they were diagnosed with any back pain that was organic in nature. Specific lower limb pathologies that cause limb length inequalities, external or internal rotation of the hip, or malposition of the foot/ankle in the resting position were excluded. Other exclusion criteria included pregnancy and a Quetelet index score (weight per height squared) greater than 27.

Procedure

Each participant underwent a screening process to determine whether they would be included in the study. A clinician in the clinic performed the case history, without the researcher being present, before the experiment was conducted. The rest of the examination was completed at the end of the experiment by the researcher. This limited bias with regard to the participant status.

The participant underwent the SBPT, followed by the 4 control orthopedic tests. An external examiner was present throughout the entire examination to standardize the procedure, observe, and record the result of the SBPT. Therefore, a double-blind environ-

ment was created. The result of the SBPT (external rotation of the foot) was measured with a digital inclinometer, which was placed on the lateral aspect of the foot. The SBPT was conducted and measured on both sides of the participant. The external examiner observed the feet closely throughout the application of the force to determine the presence and magnitude of other movements that occurred.

Diagnosis of the sacroiliac joint dysfunction

The 4 control orthopedic tests were used in this study to diagnose a sacroiliac joint dysfunction. The diagnosis was concluded if the spine test and at least one of the other tests were positive on the same side. If none or only one test was positive, the patient was regarded as being "clear" of sacroiliac dysfunction. The diagnosis of the type of sacroiliac dysfunction was concluded if both the spine test and the supine long-sitting test were positive on the same side.

Statistical methodology

This study used similar statistical methodology to the study on which this research is based. To determine whether there is a difference in the amount of external rotation between flexion and extension sacroiliac joint dysfunction, we used tests of hypotheses on population mean values, simply stated as 1-sided *t* tests. We tested for equality of the mean values and more importantly determined if the 2 population mean values were significantly different.³¹ It was decided that the level of significance would be set at .05.

A validity analysis was performed to confirm the validity of the SBPT. The components of validity that were used in this study include sensitivity and specificity, positive and negative predictive value, misclassification rate, and prevalence of the disorder in question. Tables 2 and 3 provide definitions and explanations for the components of validity. To overcome the problem of agreement between the tests, which could be due to chance, the κ coefficient is used.³⁴ The κ is a preferable measure of agreement between the SBPT and the control tests used to diagnose the condition. The guidelines of Landis and Koch are used to interpret the obtained κ values and are presented in Table 4.

Results

Sixty-two participants were included (31 men). The ages of the participants ranged from 20 to 34 years

Table 2 Definitions of components of validity

Component of Validity	Definition	Equation
Sensitivity	Proportions of Positive Values That the Test Correctly Identifies	$a/(a + c) \times 100$
Specificity	Proportions of Negative Values That the Test Correctly Identifies	$d/(b + d) \times 100$
Positive Predictive Value	Proportion of Patients With Positive Test Results Who Are Correctly Diagnosed	$a/(a + b) \times 100$
Negative Predictive Value	Proportion of Patients With Negative Test Results Who Are Correctly Diagnosed	$d/(c + d) \times 100$
Misclassification Rate	Percentage Error Rate	$(b + c)/n \times 100$
Prevalence	Proportion of the Subjects That Currently Have the Specific Condition	$(a + c)/n \times 100$

The terms *positive* and *negative* indicate the presence and absence of the specific condition, respectively.^{1,3,32}

(average, 24 years). The Quetelet index score average was 22.65 kg/m². For ease of discussion, a test described as giving a correct diagnosis indicates a true-positive result; alternatively, an incorrect diagnosis signifies a false-positive diagnosis.

Forty-eight participants were diagnosed with a sacroiliac joint dysfunction according to the control tests. The SBPT detected 48 and 51 sacroiliac joint dysfunctions (when performed on the left and right, respectively). However, only on 27 participants did the SBPT detect the same-sided lesion bilaterally. Of the 27 participants where the SBPT was the same bilaterally, 14 were the same as the control tests. The SBPT, when performed on the right, produced the same diagnosis as the control on more occasions than when performed on the left. However, left-sided dysfunctions were detected correctly more often by the SBPT. The most common dysfunction type correctly diagnosed by the SBPT was left-sided extension dysfunctions and then right-sided flexion dysfunctions.

Results for determining whether the SBPT can differentiate between types of dysfunction

The *t*-test results showed no statistically significant difference between the input groups, and therefore, the null hypothesis was not rejected in

all instances. Only one result was marginally insignificant (right-sided extension dysfunctions compared with the right-sided flexion dysfunctions as detected by the SBPT performed on the right); the values of external rotation between the 2 types of dysfunction were 5.3% the same ($P = .05$). A *P* value of less than .05 was considered significant. However, when all the results were considered together, flexion dysfunctions were 94.2% the same as extension dysfunctions; therefore, the difference in rotations was minute (Fig 1).

Results for reconfirming the validity of the SBPT

There were considerable differences detected in the results of the SBPT when it was performed on the right and then on the left. The agreement between the SBPT and the control tests for sacroiliac joint dysfunction diagnosis was always slight (according to κ) and therefore not statistically significant. In terms of the components of validity, the SBPT was useful in identifying the positive values of sacroiliac joint dysfunction (sensitivity) but was not useful in identifying the negative values (specificity). The SBPT did not accurately diagnose patients with positive test results (positive predictive value); however, it was fairly helpful in correctly

Table 3 Validity components^{1,33}

Result Detected by the Test	Test Performed		Total
	True Picture		
	Patient Has the Condition	Patient Is Clear	
Positive Test	A (True Positive)	B (False Positive)	A + B (Total Positive Tests)
Negative Test	C (False Negative)	D (True Negative)	C + D (Total Negative Tests)
Total	Total Subjects Diagnosed With the Condition	Total Subjects Without the Condition	N (Total Number Tested)

Table 4 Landis and Koch guidelines for κ interpretation³⁵

Value of κ	Strength of Agreement
<0.00	Poor Agreement
0.00-0.20	Slight Agreement
0.21-0.40	Fair Agreement
0.41-0.60	Moderate Agreement
0.61-0.80	Substantial Agreement
0.81-1.00	Almost Perfect Agreement
1.00	Perfect Agreement

diagnosing patients with negative test results (negative predictive value).

Discussion

Although it was hypothesized that there would be a difference in the external rotation detected between the dysfunctional types, it is perceivable that even if this situation occurred, the amount of this external rotation occurring at the feet would be minimal and not nearly sufficient to provide objective results. Small sample sizes also contributed to the lack of statistically significant results; the number of true-positive dysfunction types detected was significantly reduced from the 62 participants.

In a previous study by Breitenbach et al,³ there was a “good” strength of agreement between the SBPT and the diagnosis, and the test was determined to be clinically useful as an indicator of sacroiliac dysfunction. Therefore, there is great discrepancy between the results of Breitenbach et al and those obtained in this

study. This can be explained by the methodology change from this previous study, which was in an attempt to further objectify the SBPT and reduce bias. Therefore, the results from this study are potentially more objective and less likely to involve bias. The differences between the studies are also linked to the potential differences in the manner in which these manual tests are performed and interpreted (either the control tests and/or the SBPT).

Other plausible theories for inaccurate detection of sacroiliac joint dysfunction by the SBPT include the following:

- There is no independent criterion standard of diagnosis (or gold standard) against which these tests can be compared; therefore, all results must be considered to be explorative.³
- Some mechanism could be causing the external rotation of the feet in a sacroiliac joint dysfunction or could be affecting the movement produced by the SBPT.³
- The movements of nutation and counternutation are not transferred to the femur.³
- Congenital bony anomalies or pathologies within the area may alter the resting position of the limb before and during the application of the SBPT, as this altered position may be seen as a difference in movement from the opposite side.^{3,4}
- Other lesions or pathology (such as sacroiliitis or ankylosing spondylitis) may be present and either mimicking the sacroiliac joint dysfunction by restricting movement of joint or preventing the sacroiliac joint dysfunction from being detected.³

Fig 1. The *t*-test results from SBPT performed on left, right, and then combined. The *P* value is the probability and is converted into a percentage. This percentage is the similarity or difference between dysfunctions. The closer to 0%, the greater the difference; statistical significance is set at .05.

Sacroiliac joint dysfunction diagnosis

There is still a contradiction in literature regarding the true validity of these tests. Therefore, it must also be considered that the control tests that are used are not as reliable and valid as they are thought to be. The control tests are not gold standard tests and therefore are only giving an undetermined percentage or a fraction of the “true picture” as would be diagnosed by the gold standard. This would evidently equate to “poor” agreement between the SBPT and the control tests.

The other problems encountered in this study with diagnosis were the following:

- This study performed only the SBPT, and not the control tests, in a double-blinded fashion. This potential bias would lead to false-positive and false-negative diagnosis.
- Only 2 of these 4 tests could determine specific types of dysfunction. This caused problems when there were conflicting results between the 2 tests not only in terms of accuracy of diagnosis but with regard to sample sizes.
- The possibility of a bilateral dysfunction was not considered as part of this study. On certain occasions, the results were marginally different. This could have potentially been a bilateral dysfunction, yet a dysfunction was diagnosed on the smaller-value side.

Performance of the SBPT

During the performance of the SBPT, the direction of force must be perpendicular to the sacrum in terms of its y- and x-axis. Any change in the direction would require a change in the amount of force needed to accomplish sacral nutation, therefore resulting in a greater movement of the feet in external rotation. This could possibly facilitate a dysfunctional joint enough to make it appear to have normal function. Alternatively, it could cause a greater movement on the nondysfunctional side, therefore increasing the difference between the 2 sides. This would obviously affect the interpretation of the results. An objective means needs to be devised to standardize the amount of force used and/or the true direction of the force while performing the SBPT.

Sacral motion during respiration should be considered when performing this test. In this study, this phenomenon was not considered and patients were free to breathe as the test was being performed. The patient should be directed to exhale during the test so that the sacrum would be in a relative nutated

position, therefore facilitating the magnitude of the force applied.

The changes in degeneration and stability of the sacroiliac joints during the different decades of life result in altered mobility.^{6,8} It is hypothesized that different age groups of participants would negatively affect the results of a similar study. This study was primarily performed on participants in their third decade of life, so it was assumed that this did not have a vast influence.

Conclusion

This study found that the SBPT is not a valid test to determine sacroiliac joint dysfunction or types thereof. Future studies should draw from the results and conclusions of this study and search for that gold standard of sacroiliac joint assessment. Possible outcomes of this search would include finding one test that fulfilled the criteria to be the gold standard or a cluster of tests that becomes the gold standard. Possibly, this gold standard will be one test that incorporates the positive aspects of each of the many manual tests currently used.

Appendix A. Control orthopedic tests

The following are descriptions of the 4 control orthopedic tests. The tests described here may have different names depending on the nomenclature used. The subjects must disrobe sufficiently to reveal the necessary landmarks²³ and to ensure that the contact points will be easily palpable; the subjects have to have a Quetelet index score (weight per height squared) lower than 27.³⁶

Standing flexion test

The subject stands with feet approximately 12 in apart.³⁷ The examiner palpates directly under each posterior superior iliac spine with his thumbs, while the patient then bends forward as far as possible, keeping his or her knees extended (Fig 2). The examiner palpates the extent of cephalad movement of each posterior superior iliac spine. Normally, each posterior superior iliac spine moves the same distance in a cranial direction. If unequal motion occurs, the side that moves first and demonstrates the largest cranial excursion is a positive sign of sacroiliac dysfunction.²³ A false-positive result can occur because of restricted flexion unilaterally of the fourth or fifth lumbar vertebra or the hip articulations, hypertonicity of erector spinae, hamstring, piriformis, quad-

Fig 2. When performing the standing flexion test, the examiner must palpate the extent of cephalad movement of each posterior superior iliac spine. The left and right posterior superior iliac spines are marked with an x on this participant.

ratus lumborum, gluteus maximus, or the posterior iliotibial band.³⁷

Iliac springing test

The patient lies in a lateral recumbent position with his or her hips flexed to 45° and his or her knees to 90°. The examiner, at the patient's hip level, contacts the cephalad side of the patient's iliac crest with the forearm. The index finger of the other hand is placed on the posterior superior iliac spine, the ring finger is

Fig 3. When performing the iliac springing test, palpation is accomplished by placing the index finger on the posterior superior iliac spine (indicated by an x on the participant), the ring finger is placed on the second sacral tubercle (represented by a line), and the middle finger is placed over the sacroiliac joint.

placed on the second sacral tubercle, and the middle finger is placed over the sacroiliac joint (Fig 3). The examiner's forearm exerts a slight springing pressure on the ilium, without moving the pelvis. This causes movement at the sacroiliac joint, which is felt as a posterior distraction of the ilium at the sacroiliac joint. The test is positive if no distraction is felt.²³

Spine test (synonymous with Gillet test)

The subject stands with feet approximately 12 in apart.³⁷ The doctor's thumb is placed directly under the posterior superior iliac spine on the side to be tested and the other thumb is placed directly on the second sacral tubercle. The subject is then asked to flex the hip of the test side with a flexed knee, lifting the thigh to the abdomen²³ (Fig 4). The movement is felt as a slight

Fig 4. During the spine test or Gillet test, the participant lifts the leg ipsilateral to the examiner's contact to detect an extension dysfunction. To detect a flexion dysfunction, the contralateral leg is then lifted. The leg is lifted similar to a large marching step.

Fig 5. When the participant is instructed to rise into the long-sitting position, he or she must sit straight up without any deviations to either side. The relative lengths of the medial malleoli are once again compared against the other for any differences.

shifting or gliding motion of the posterior superior iliac spine relative to the sacral tubercle. The inferior movement of the posterior superior iliac spine is more obvious. No movement of the posterior superior iliac spine relative to the sacrum indicates an extension dysfunction or restriction.³⁸

To detect a flexion dysfunction, the above contacts are maintained, and the examiner asks the patient to flex the knee and hip of the contralateral leg.²⁸ During this part of the test, the sacral tubercle is monitored relative to the posterior superior iliac spine. If no movement is detected or if both contact thumbs move together as a unit, joint dysfunction can be suspected, which constitutes a positive spine test.³⁸

There is a compensatory movement that occurs in reaction to sacroiliac joint or hip joint dysfunction. The weight-bearing leg bends slightly at the knee and extends at the hip as the patient raises the contralateral leg to increase the motion.³⁸ The patient also pushes his or her buttock out laterally³⁸ and rotates it inferiorly and anteriorly to increase the knee raising.¹⁹ If there is lumbar paravertebral muscle spasm, false-positive results can occur.¹⁵

Supine long-sitting test

In the supine position, the finding of a shorter leg when compared with the opposite side suggests a flexion dysfunction. The therapist holds the inferior

aspect of the medial border of the medial malleoli and asks the patient to rise to a long-sitting position¹ (Fig 5). The patients may use their hands to push themselves up; however, they must push evenly.³⁷ Any apparent lengthening of the short leg implies the presence of a sacroiliac joint dysfunction and a flexion dysfunction.¹ Conversely, a long leg that appears to shorten relative to the other indicates an extension dysfunction on that side. One leg remaining consistently shorter or longer relative to the other is indicative of an anatomical leg length difference.³⁷ To rule out the potential of vertically upward slip of the innominate on the sacrum, it is recommended to give the leg on the affected side a sharp tug in the long axis while the patient is supine and then to reassess.³⁹

Appendix B. Sacral base pressure test

The patient is placed prone with the head facing straight down. The feet must hang off the end of the table and be free to move. The medial malleoli must be the same distance apart as the mastoid processes. The examiner stands on either side of the patient at the level of the pelvis, facing caudally (Fig 6). A calcaneal contact is placed on the sacral base between the first and second sacral tubercles to apply a straight posterior to anterior force. The right hand is used if on the right side of the patient. The force applied should be about 4 to 5 kg (these values are only guidelines) and should take 2 seconds to reach maximal intensity. While the force is being applied, any movement that occurs at the feet should be recorded.³

Fig 6. Performing the SBPT on the participant's right side.

A positive test (a sacroiliac joint dysfunction) is a lack of external rotation of the ipsilateral lower limb manifested by a lack of external foot rotation. A negative finding (the normal response) is indicated by the presence of external rotation of the lower limb, seen as external rotation of the foot.³ Two other movements have been described, although no explanation regarding the meaning of these movements has been offered. These movements are a slight lateral shift of the lower extremity and a slight lifting of the lower extremity, which occurs on the dysfunctional side.⁵

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