Asian Journal of Multidisciplinary Studies

ISSN: 2321-8819 (Online)
2348-7186 (Print)
Impact Factor: 0.92
Volume 3, Issue 10, October 2015

A Neurological Description and Explanation of Four Functional Tests to Differentiate Sacroiliac Joint Dysfunction from Low Back Pain

O. Nelson DeCamp[1], Steven D. Roffers[2] and David H. Morris[3]

[1]Private Practice; Lakeland, Florida, U.S.A.
Phone: +1 863-688-6679; Email: ndecampdc@aol.com
[2]Director, Chiropractic Research Alliance; Atlanta, Georgia, U.S.A.
Phone: +1 404-290-4248; Email: stevenroffers@gmail.com
[3]Medical Director, Pride Medical Inc.; Atlanta, Georgia, U.S.A.

ABSTRACT

Objective

The objective is to provide a neurological explanation and a description of four functional tests to differentiate sacroiliac joint (SIJ) dysfunction from low back pain.

Background

There are often complex and overlapping symptoms associated with lumbopelvic dysfunction that may be of singular or multiple causes. Pain provocation tests have limited reliability in clinical practice. Pain provocation tests may be falsely negative in the presence of sacroiliac dysfunction; therefore the differential diagnosis of sacroiliac joint dysfunction versus lumbar or discogenic pain remains a difficult clinical problem. A neurological explanation for sacroiliac joint (SIJ) testing procedures to improve diagnosis and correction of SIJ dysfunction in the clinical setting is provided and described.

Methods

Simple keyword searches related to the neuroanatomy and neurophysiology of the sacroiliac joints and spinal cord, including propriospinal tracts were performed over several years using Scopus, Index of Chiropractic Literature (ICL), Mantis and PubMed and Medline databases. Reference lists of the pertinent articles were also checked for additional resources as well as hand searches for information in current neuroscience and orthopedic textbooks. Abstracts referring to surgical corrections of SIJ instability (surgical fixation) were excluded.

Results

While 283 studies have been found, only 51 of them related to sacroiliac joint dysfunction were deemed applicable to this study.

Discussion

We found evidence to support that the usual pain provocation tests have limited reliability in published studies and clinical practice. Based on neuromuscular reflex changes that may occur with exacerbation of pre-existing joint dysfunction, a neurological explanation was developed and four functional tests for sacroiliac dysfunction were defined and confirmed.

Conclusion

A conceptual framework providing a neurological basis for the use of modified sacroiliac functional tests has been described and confirmed. These tests may detect a sacroiliac joint lesion that is undiagnosed by pain provocation tests, yet the lesion produces a neurological insult. Sacroiliac lesions respond to a variety of manipulative strategies and while these tests have been found useful in clinical practice, formal reliability and validity studies are needed.

Keywords: sacroiliac, neuroanatomy, neurophysiology, propriospinal, mechanoreception, cranio-sacral.

BACKGROUND

Patient reports of low back pain (LBP) do not provide for diagnosis of the primary cause of pain. Diagnosis of the cause of LBP is considered problematic by many health care practitioners, primarily due to the lack of reliable pain provocative tests that can distinguish between different causes. The effective clinical application of chiropractic intervention relies on the distinction between sacroiliac versus lumbar dysfunction and is important to patient outcomes.

Sacroiliac Joint Motion: Sacroiliac joint motion has been established in multiple trials.[1-11] Although the exact range of motion may differ among the studies, ranging from 2-10mm, it is widely accepted that motion does exist. At least five of these studies suggest a relationship between diaphragmatic respiration ("lung breathing"), sacral motion, and cerebrospinal fluid flow. At least one osteopathic study suggests a relationship between very subtle sacroiliac motion and CSF flow[7] and describes a theory termed "primary respiration". No human studies have established a relationship

between sacral motion and respiration; however in a study of anesthetized rats, entrainment of CSF pressure in respiration was demonstrated.[12]

Physical Examination and Pain Provocation Tests: It has been established that in the low back physical examination there is limited value associated with pain provocation tests.[13-18] One study showed that the more detailed the low back examination, the less reliable it may be.[19] Although a composite of tests was found in two studies to be of greater value than any single test when compared with the gold standard of anesthetic injection, the simple determination of SIJ dysfunction does not necessarily inform the practitioner as to what specific treatment to consider. The use of the Gillet test, sitting flexion, standing flexion and supine to sitting testing have all been shown to have little value in the determination of pelvic torsion. There are often complex and overlapping symptoms associated with lumbopelvic dysfunction that may be of singular or multiple causes. These dysfunctional causes may or may not provoke pain on orthopedic testing. Slipman, et al, found little value in the use of provocative SIJ maneuvers in predicting SIJ dysfunction.[17] A 2007 study by Stuber, et al, was inconclusive with regard to which tests and combinations are most effective for determination of the existence of injury to the SIJ.[20] A 2009 systematic review by Rupert, et al, regarding medical interventions for sacroiliac pain found limited evidence for the accuracy of provocative maneuvers in diagnosis of sacroiliac joint dysfunction.[21]

METHODS

With such limited tests available, an idea was developed to explore and describe the neurological basis of provocative and non-provocative functional tests for the sacroiliac joint. For several years, a search for information regarding sacroiliac mechanics, proprioception, neuroanatomy and neurophysiology has been performed using neurology and orthopedic textbooks and scientific databases: Index to Chiropractic Literature (ICL), Mantis, PubMed and Medline, and Scopus. Various combinations of keywords were used: sacroiliac joint, sacroiliac joint testing, propriospinal, plasticity, proprioception, mechanoreception, propriospinal tracts, pain provocation, cerebrospinal fluid (CSF) flow, CSF pressure change, plasticity and cranial. In addition, reference lists of retrieved articles were also searched.

RESULTS

While 283 studies were found, only 51 references related to sacroiliac joint dysfunction were useful to the topic at hand. Abstracts referring to surgical corrections of SIJ instability (surgical fixation) were excluded.

DISCUSSION

All movable joints have neurological sensing mechanisms for protective adaptation. Various compensatory muscular changes can occur along the spine in response to changes in sacroiliac dysfunction through both simple segmental spinal and propriospinal tract communication. These compensatory changes may lessen the individual's ability to adapt to both short and long-term demands placed upon it. Furthermore, such compensatory changes may become neurologically plasticized in the form of established somatic postural compensational distortions or patterns.

Biomechanical Sacroiliac Testing

Normal sacroiliac proprioception has been found to be an essential component of upper body balance and locomotive coordination. Orthopedic tests are classified as pain-provoking or non-pain-provoking. Six comparative studies found provocative testing notably more reliable than non-provocative. The provocative tests for the sacroiliac joint, listed in order of best and/or supportive results are:

1. FABER (Flexion, Abduction, External Rotation) or Patrick's Test
2. Posterior Shear (PoSh): A rapid thrust on the knee in FABER testing
3. Gaenslen's Test or pelvic torsion
4. Yeoman's Test
5. Sacral thrust (anterior sacral shear)
6. Cranial/Caudal Shear

These tests change the sacroiliac relationship and introduce pressure into the joint and associated soft tissue structures, thereby affecting afferent input from the sacroiliac joints.

Pain testing reliability depends on 1) the degree of dysfunction, 2) pain sensitivity of the patient, and 3) examiner training. These tests are relatively non-specific in that they do not help in determination of treatment. In short, orthopedic joint testing does not help the clinician determine the exact nature of the sacroiliac dysfunction in a clinically helpful way. In fact, two studies found that provocative SIJ tests may not be reliable as high as 60% of the time.[14,17]

The exacerbation of pre-existing sacroiliac dysfunction may result in the expression of associated reflex changes, clinically observed as a change in the speed of muscle reflex depolarization. The use of muscle testing after the application of various stimuli is summarized by Schmidt and Yanuck.[22] Muscle contraction speed is a useable and practical indicator of mechanical joint dysfunction. Exacerbating irritations can be externally applied to a dysfunctional sacroiliac

joint by application of the FABER (flexion, adduction, external rotation) test, or its reverse, the FADIR (flexion, adduction, internal rotation) test. While exacerbation of pain does not always occur, these tests have produced clinically observed changes in the speed of muscle contraction.[16]

NEUROLOGICAL EXPLANATION FOR SACROILIAC JOINT TESTING

Neurophysiological Considerations

Sensory systems stimulate reflex patterns and obey laws of neurological propagation. These sensory responses follow certain rules related to:

- specific sensory modality
- intensity of the stimulation
- duration of the stimulation
- location of the stimulation

When using the speed of neuromuscular contraction as a tool in the determination of spinal dysfunction, it is important that the neuromuscular test be coordinated with an applied stimulation to the specific location of the sacroiliac joint, and with enough intensity to elicit an observable reaction.

Somatotopic Cord Organization

In order to understand the neurology that forms the basis of the functional tests that will be described below, a quick review of spinal cord anatomy is warranted. Motor neuron pools within the posterior horn are arranged somatotopically, with more medial neuron pools innervating more medial (axial) postural muscles, and those arranged in more lateral laminae innervating muscles lying lateral to the postural muscles of the spine. The most medial interneurons in the intermediate zone of the cord project to medial motor nuclei that control medial (axial) voluntary muscles bilaterally. The interneurons located more laterally project to motor neurons that control ipsilateral shoulder girdle muscles. Postural integrity is maintained by reflex interneuron communication among the more medial neurons of the cord. Stimulation of these more medial tracts involved in maintaining postural balance initially decreases axial or postural muscle latency of firing while increasing latency of volitional muscle firing until postural muscle balance is established.

Propriospinal Integration

The spinal cord provides the lowest level of motor control hierarchy, containing circuitry for the mediation of various reflexes and rhythmic automation involved in locomotion and posture. Primary afferent fibers from joints, muscle spindles and Golgi tendon organs, Pacinian corpuscles, and cutaneous superficial receptors terminate in various spinal cord laminae of the posterior horn of the gray matter of the cord (see **Figure 1**) then synapse with both local interneurons for simple spinal reflex actions and with propriospinal neurons within the medial and ventral columns for actions at distal spinal segments, enabling easily-coordinated movements between pelvic and cervical musculature and indeed all spinal levels. Many studies show that reflexes can be modified to respond to specific tasks. Significant evidence now exists to suggest tremendous coordination abilities of the central nervous system (CNS) via ascending and descending tracts for the purpose of movement coordination.[12] Postural dynamics before the reticular portion of the brain modulate responses with input from the cerebellum, vision, and semicircular canal responses.

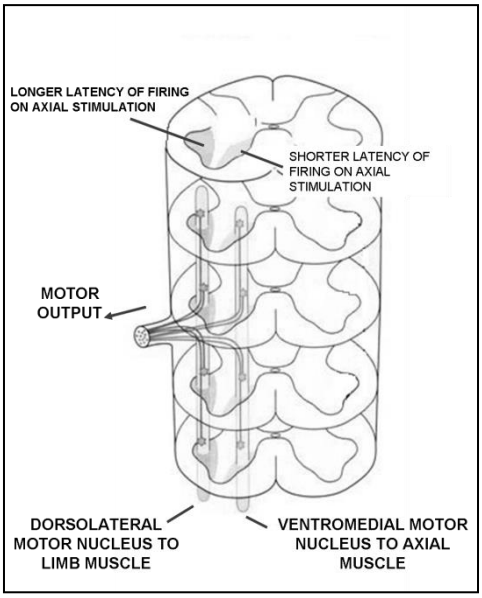

FIGURE 1: Propriospinal integration of the spinal cord

DESCRIPTION OF FOUR FUNCTIONAL TESTS FOR SIJ DYSFUNCTION

Functional testing that does not rely solely on pain provocation in the determination of sacroiliac dysfunction is described. This testing can distinguish lumbar from sacroiliac dysfunctions, and incorporates respiratory function.

Neurological FABER Exam:

Photo: Neurological FABER Exam

On the side being tested, the supine subject's arm is raised in extension vertically to 90 degrees. The elbow should be locked and the shoulder should be raised off the examination table. This arm position will prevent recruitment of postural muscles after the command to hold is given. The arms are now pre-hyperpolarized. This method will restrict testing to the shoulder joint and muscle receptors involved in simulating cross-crawl patterning. The examiner commands the subject to "hold" while immediately attempting a short caudal pull one to two inches on the distal forearm of the subject. The command to "hold" hypopolarizes volitional muscles the same way catching a ball requires one to get the arms ready for the catch. This is a typical feed-forward mechanism. The subject should display an immediate neuromuscular reflex resistance to the initial pull from the examiner. Failure to exhibit this immediate reflex requires analysis and correction of the associated shoulder joint complex or cervical region associated with brachial plexus dysfunction. The arm is again tested while the orthopedic FABER (pain provocation) position is stressed by examiner and subject. A positive finding is a perception by the examiner of a "slow" or "weak" response as compared to the previously strong shoulder and arm muscles.

Neurological FADIR Exam:

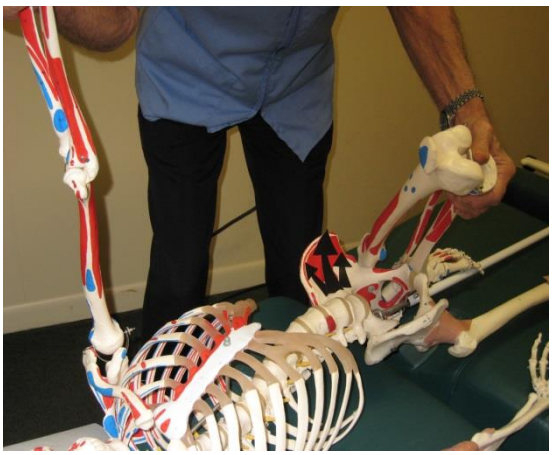

Photo: Neurological FABER Exam

The arm is again tested as in the neurological FABER test while the orthopedic FADIR (pain provocation) position is stressed by examiner and subject. A positive finding is a perception by the examiner of a "slow" or "weak" response as compared to the previously strong shoulder and arm muscles. When such muscular compensatory action is insufficient to brace this joint, the joint mechanoreceptors may fire with very little stress added.

Neurological Sacroiliac Shear Exam:

Photo: Cranial Shear

Photo: Caudal Shear

The arm is again tested as in the Neurological FABER test, but with the cranial or caudal shear as described for the orthopedic shear exam. There is a known need for transverse muscle activity to fight the shear loading of the sacroiliac joints in gravity. Pain may be elicited in the sacroiliac joint with this shear dysfunction by a rapid sharp thrust into the lower extremity, either cranially or caudally and using the command "hold" with the testing arm.

Respiration Neurological Sacroiliac Exam: Breathing relies on axial muscle activation. Inhalation occurs after diaphragmatic depression, which increases abdominal pressure. An interesting study shows a direct relationship between CSF pressure and respiration in anesthetized rats, demonstrating entrainment of CSF pressure in respiration.[12] A relationship has been established between respiratory excursion and slight pelvic motions. Although no direct studies have been performed demonstrating sacral motion associated with breathing, it is suggested that changes in any of the above tests may be detected by simply having the subject hold the inhalation or the full exhalation during the exam, in an attempt to find a relationship between phase of respiration and degree of neurological irritation.

CONCLUSION

A conceptual framework, providing a neurological basis, for the use of modified sacroiliac functional tests has been described. These tests may detect a sacroiliac joint lesion that is undiagnosed by pain-provoking tests, yet the lesion produces a neurological insult. Sacroiliac lesions respond to a variety of manipulative strategies and while these tests have been found useful in clinical practice, formal reliability and validity studies are needed.

REFERENCES

1. Otter R, A review study of the differing opinions expressed in the literature about the anatomy of the sacroiliac joint: European Journal of Chiropractic 1985;33:221-242.
2. Harrison DE, Harrison DH, Troyanovich S. The Sacroiliac Joint: a Review of Anatomy and Biomechanics with Clinical Implications. J Manipulative Physio Ther 1997;20:607-617.
3. Slipman C, Patel R, Shin C, Braverman D, Lenrow D. Pain Management: Studies Probe Complexities of Sacroiliac Joint Syndrome. J Biomechanics 2000 April.
4. Mooney V, Understanding, examining for, and treating sacroiliac pain. J Musculoskeletal Medicine July 1993;37-49.
5. Greenman P. Innominate shear dysfunction in the sacroiliac joint. Manual Medicine 1986;2:114-121.
6. Sutherland W. The Cranial Bowl. 1939; Private Publishing-Free Press Co.
7. Magoun,H. Osteopathy in the Cranial Field.1976; Journal Publishing Co., Kirksville MO.
8. Dejarnette B. Sacro-Ocipital Technic. 1967-1984; self published.
9. Dejarnette B. Cranial Technic 1968-1980; self published.
10. Upledger J, Vredevoogd J. Craniosacral Therapy. 1983; Eastland Press.
11. Chaitow L. Cranial Manipulation Theory and Practice. 2nd Edition 2005, Elsevier Ltd.
12. Miller KE, Douglas VD, Richards AB, Chandler MJ, Foreman RD. Propriospinal neurons in the C1-C2 spinal segments project to the L5-S-1 segments of the rat spinal cord. Brain Res Bull 1998;47(1):43-7.
13. Mooney V, Understanding, examining for, and treating sacroiliac pain. J Musculoskeletal Medicine July 1993;37-49.
14. Laslett M, Williams M. The Reliability of Selected Pain Provocation Tests for Sacroiliac Joint Pathology. Spine 1994;11:1243-1249.
15. Dreyfuss P, Michaelsen M, Pauza K, McLarty J, Bogduk N. The Value of Medical History and Physical Examination in Diagnosing Sacroiliac Joint Pain. Spine 1996;21:2594-2602.
16. Broadhurst N, Bond M. Pain Provocation Tests for the Assessment of Sacroiliac Joint Dysfunction. J Spinal Disorders 1998;11:341-345.
17. Slipman C, Sterenfield E, Chou L, Herzog R, Vresilovic E. The Predictive Value of Provocative Sacroiliac Joint Stress Maneuvers in the Diagnosis of Sacroiliac Joint Syndrome. Arch Phys Med Rehab 1998;79:288-291.
18. Toussaint R, Gawlik C, Rehder U, Ruther W. Sacroiliac Dysfunction in Construction Workers. J Manipulative Physio Ther 1999;22:134-138.
19. Hestboek L, Leboeuf-Yde C. Are Chiropractic Tests for the Lumbo-Pelvic Spine Reliable and Valid? A Systematic Critical Literature Review. J Manipulative Physio Ther 2000:23;258-275.
20. Stuber KJ. Specificity, sensitivity, and predictive values of clinical tests of the sacroiliac joint: a systematic review of the literature. Journal of the Canadian Chiropractic Assn. 2007, 51:30-41.
21. Rupert MP, Lee M, Manchikanti L, Datta S, Cohen SP. Evaluation of sacroiliac joint interventions: a systematic appraisal of the literature. Pain Physician, 2009 Mar-Apr; 12(2):339-418.
22. Schmidt WH Jr, Yanuck SF. Expanding the neurological examination using functional neurologic assessment: part II Neurologic basis of applied kinesiology. Int. J Neurosci 1999, 97:77-108.