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Original Article

An Evidence-Based Approach to the Orthopedic Physical Exam – Part 1: The Lumbopelvic Spine

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Abstract

Low back pain is the most common musculoskeletal complaint. Many clinicians attempt to identify the source of a patient's low back pain to improve diagnostic accuracy and inform management strategies. The purpose of this article is to review the evidence-based orthopedic physical exam for mechanical low back pain. The main categories of low back pain discussed in this review will be: joint dysfunction, discogenic pain, and radiculopathy. This article will also provide an introduction to evidence-based practice and will focus on using likelihood ratios to maximize diagnostic accuracy for the various types of low back pain. It is suggested that clinicians utilize evidence-based diagnostic tools in conjunction with clinical expertise and patient preferences to deliver optimal patient care.

KEY WORDS (MeSH terms): Low Back Pain, Mechanical; Sacroiliitis; Radiculitis; Lumbar Disc Disease; Nerve Root Compression; Degeneration, Intervertebral Disk; Evidence Based Practice;

Introduction

This article is the first in an ongoing four-part series of narrative reviews that intend to provide content related to performing an evidence-based physical examination in each of the following anatomical regions: the lumbopelvic spine, the upper extremity, the cervical & thoracic spine, and the lower extremity.

The foundation of clinical care relies on an accurate diagnosis, and formulating an accurate diagnosis requires clinicians to judiciously use the best available tests. In the world of orthopedic physical exam of the lumbopelvic spine, there are many physical exams (orthopedic tests)

reported in the literature; while some of these tests are valuable, many are not. The purpose of this article is to provide an introduction into the evidence-based selection of orthopedic tests within the lumbopelvic spine and discuss orthopedic tests that have demonstrated superior performance.

All avenues of health care are undergoing a paradigm shift toward evidence-based practice. Evidence-based practice explicitly integrates three basic principles: 1.) the best available research evidence, 2.) the clinician's expertise (judgement/experience), and 3.) the patient's values or preferences [1]. This approach to clinical decision-making enhances the opportunity for quality care and optimal clinical outcomes.

The diagnostic process involves taking a patient history, developing a working list of differential diagnoses, and selecting specific tests to confirm or deny potential diagnoses. The probability that a specific condition is producing the patient's complaint is known as the "pre-test probability." The usefulness of any diagnostic test is the influence that the test has on the probability that the patient's complaint stems from the suspected condition (e.g. a patient's radicular leg pain is probably from an acute disc herniation). The most useful orthopedic tests will have a large influence on whether a patient's complaint stems from any given condition, while a poor test will have little-to-no influence on this probability. We will briefly use an example outside of the lumbopelvic region to discuss how clinical tests influence probabilistic thinking.

A patient's sore throat (pharyngitis) could be of viral or of streptococcal bacterial origin. For the sake of simplicity, we will say that the probability that the sore throat is due to a streptococcal infection is 25%; this is the "pre-test probability." If a rapid strep test is performed and comes back positive, it will have a large influence on whether the clinician believes this patient's complaint is the result of a streptococcal infection. Most sources would say that the test increased the "post-test probability" to nearly 100%.

The ability of a test to influence the probability that a condition is present is known as a likelihood ratio. More recently, likelihood ratios are being used to describe the usefulness of a multitude of tests, including orthopedic tests. A major benefit in using likelihood ratios is that they incorporate a test's sensitivity and specificity into one single number, which clinicians can use to quickly and easily evaluate how "good" or "useful" a test is for their needs. Likelihood ratios come in two forms: positive likelihood ratios (+LR) and negative likelihood ratios (-LR); simply use a +LR when the test result is positive or the -LR when the test result is negative. We have provided a brief review of how to interpret positive and negative likelihood ratios in Table 1 [2]. In general, the larger a +LR is the better the test; conversely, the smaller a -LR is the better the test.

+LR	-LR	Interpretation
>10	<0.1	Large conclusive shifts in probability
5 – 10	0.1 – 0.2	Moderate shifts in probability
2 – 5	0.2 – 0.5	Small but sometimes important shifts in probability
1 – 2	0.5 – 1.0	Small and rarely meaningful shifts in probability

+LR = positive likelihood ratio; -LR = negative likelihood ratio

Table 1 – Interpretation of Likelihood Ratios

Traditionally, the goal of an orthopedic physical exam is to identify the source of abnormal tissue that is the cause of a patient’s clinical presentation. While evidence is emerging that using a biopsychosocial model is superior to simply establishing a pathoanatomical cause of pain [3], this article will emphasize which orthopedic tests are most useful in identifying somatic tissue injury as a source of lumbopelvic pain, including lumbopelvic causes of lower extremity pain.

Methods

Information used to write this narrative review of evidence-based orthopedic physical examinations of the lumbopelvic spine were collected from the sources listed in Table 2. As this article focused on background information, authoritative textbooks on the topic of evidence-based physical examinations were the primary source of information, and source articles that were referenced in these texts were obtained for further information related to exam statistics (i.e. likelihood ratios). Source articles were evaluated for quality using the QUADAS scores; when multiple sources existed for a given test, the information with the highest QUADAS score was used for the article. Therefore, we emphasized using the results of the most rigorous studies published on the topic of physical examination procedures for the lumbopelvic spine. Additionally, we used an iOS application, known as CORE - Clinical ORthopedic Exam by Clinically Relevant Technologies, to perform our literature review; this application links orthopedic exams with their source articles on PubMed.gov and provides a synopsis of the exam statistics yielded from each physical exam procedure.

Simel DL, Rennie D. The Rational Clinical Examination: Evidence-Based Clinical Diagnosis. Chicago: McGraw-Hill Professional; 2009
Cleland JA, Koppenhaver S. Netter's Orthopedic Clinical Examination: An Evidence-Based Approach, 2 nd Ed. Philadelphia, PA. Saunders Elsevier; 2011
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Cool Ce. Orthopedic Manual Therapy: An Evidence-Based Approach. 2 nd Ed. Upper Saddle River, NJ. Pearson Education; 2012
Murphy DR. Clinical Reasoning in Spine Pain Volume 1 -- Primary Management of Low Back Disorders Using the CRISP Protocols: A Practical Evidence-Based Guide. Pawtucket, RI. CRISP Education and Research; 2013

Table 2: Sources Used for this Narrative Review

Discussion

Categories of Lumbopelvic Disorders

There are two biological factors that have been shown to produce low back disorders: somatic factors and neurophysiological factors. The focus of this article will be on the somatic factors of lumbopelvic disorders, which include: joint dysfunction, discogenic pain, and radiculopathy [4]. We will approach the orthopedic exam of the lumbopelvic region using these three major categories.

Joint Dysfunction

The cause of joint pain is complex. Traditionally, clinicians have sought to locate the source of pain by focusing on injured (somatic) tissues as the cause of nociceptive input and pain perception. Joint pain arises, at least in part, from dysafferentation of a joint; dysafferentation involves an imbalance of nociceptive and mechanoreceptive input being projected from the involved joint, into the central nervous system [5]. It is important to note that joint dysfunction is described differently by many different professions and may also be known as: a chiropractic subluxation, an osteopathic lesion, a manipulable lesion, or joint fixation [6].

While there are many individual joints within the lumbopelvic region that may produce joint dysfunction, we will break them into two categories: 1.) lumbar facet joints and 2.) sacroiliac joints.

- Lumbar Facet Joint Pain

The lumbar facet joints, also known as zygapophyseal joints, allow for mobility and load transmission in the lumbar spine and are commonly reported as a source of localized low back pain [7]. Facet pain has been shown to be the primary pain-generator in approximately 30% of all chronic low back pain patients and is associated with age-related degenerative changes to the spine [7,8]. The clinical presentation of lumbar facet pain is often referred to as lumbar “facet syndrome” and commonly involves the following clinical features: ipsilateral paraspinal pain which may project into the buttock, thigh, or groin, decreased range of motion with lumbar extension and/or rotation, and increased pain with prolonged standing or sitting [9,10]. Importantly, lumbar facet syndrome may present with a variety of clinical presentations, and the idea that a distinct set of criteria constitutes a formal lumbar “facet syndrome” has been called into question and likely does not exist [9].

Many of the tests that purport to evaluate the lumbar facet joints do so by inducing a version of lumbar extension and/or rotation. Unfortunately, very few orthopedic exams have been evaluated to assess for lumbar facet pain; below is a list of the exams that have demonstrated value in assessing for low back pain emanating from the lumbar facets joints.

- Extension-rotation test (Kemp test): this test is frequently cited as a test for lumbar facet pain. Kemp test has been reported to have a +LR = 1.29 and -LR = 0.0 [11]. These test statistics indicate that a positive Kemp test has very little impact on the probability that a patient’s low back pain is arising from the facet joint, but a negative Kemp test has a large impact on ruling out facet pain as the source of this patient’s low back pain complaint.
- Posterior-anterior pressure test (P-A test, Springing test, Spring test): this test simply involves the clinician applying posterior-to-anterior (P-to-A) pressure to the region of the lumbar facet joints as the patients lies prone. While studies exist that describe this exam as having modest inter-rater and intra-rater reliability, we were unable to locate any studies that evaluated the validity of this test for the assessment of lumbar facet pain.
- Clinical prediction rule for facet pain: while there is no single “gold standard” orthopedic exam that has been shown to confidently identify the presence of facet pain, the combination of other facet pain-related factors has been shown to be useful. Five or more of the following seven criteria has been shown to have a +LR of 9.7 and a -LR of 0.17 [6, 12].
 1. Age $\geq$ 50 years
 2. Low back pain that is primarily located at the paraspinal region
 3. Positive Kemp test
 4. No low back pain is produced with performing a sit-to-stand
 5. Low back pain is best relieved when walking and/or;
 6. Low back pain is best relieved when sitting
 7. Low back pain due to disc derangement has been ruled out

- Sacroiliac Joint Pain

The sacroiliac articulations are unique in that they transfer forces between the spinal segments and the pelvis. These large joints are a common source of non-radicular low back pain and represent approximately 15-30% of all cases of mechanical low back pain [13,14]. The clinical presentation of sacroiliac joint pain, also known as sacroiliitis, is variable and traditionally presents with pain in one or both S-I joints. S-I joint pain may also refer pain into the posterior thigh and/or hip region and commonly manifests with restricted passive motion (“joint play”) at the involved joint [15]. Again, many orthopedic tests purport to evaluate the S-I joint [16], but very few have established validity. Table 3 contains a review of orthopedic exams that have established clinical validity related to S-I joint pain [17].

Orthopedic Exams to Evaluate for Sacroiliac Joint Pain	+LR	-LR
Gaenslen’s test (right leg)	1.84	0.66
Gaenslen’s test (left leg)	2.21	0.65
Thigh thrust test (posterior pelvic pain provocation test)	2.80	0.18
Sacral thrust test	2.50	0.50
Sacroiliac compression test	2.20	0.46
Sacral distraction test (separation test)	3.20	0.49

+LR = positive likelihood ratio; -LR = negative likelihood ratio

Table 3: Orthopedic Exams to Evaluate for Sacroiliac Joint Pain

These S-I joint tests have been performed in unison, and a clinical prediction rule has been developed [17]. The results of this study developed a clinical prediction rule, yielding a +LR of 4.3, when patients were positive for any 3 (of the 6 total) sacroiliac joint tests. While this +LR of 4.3 does not represent a massive shift in the probability that a patient’s S-I joint is the cause of their low back pain or thigh pain, it is currently the best cluster of orthopedic physical exams available to help identify S-I joint pain [17].

Additionally, patients with ankylosing spondylitis (AS) commonly manifest with bilateral S-I joint pain. Ankylosing spondylitis occurs in about 1% of the overall population [18], is about three times more common among males, and onsets during young adulthood (commonly before the age of 40). This condition typically presents with gradually-worsening low back pain and/or S-I joint pain, which alternates between the S-I joints and buttock regions, bilaterally. The pain that accompanies AS is chronic in nature, is worse in the morning, and is mildly relieved with physical activity [19].

A clinical prediction rule has been developed to help clinicians identify patients who are most likely to have AS (see Table 4) as the cause of their low back pain [20]. This clinical prediction rule determined that patients with 3 or more (of the following 4 features) had a +LR of 12.4 for the presence of AS.

1. Morning stiffness in the S-I joint that lasts longer than 30 minutes
2. Improvement in low back pain (S-I pain) with exercise but not with rest
3. Awakening from sleep in the second ½ of the night due to low back pain (S-I pain)
4. Alternating buttock pain (gluteal pain)

Table 4: Features Associated with Ankylosing Spondylitis

Discogenic Pain (Disc Derangement)

Discogenic pain is reported to be the most common source of low back pain, and it is associated with approximately 40% of all chronic low back pain cases [21]. This form of pain arises from the development of tears within the annulus fibrosis of the intervertebral disc, which may cause inflammation and pain once it advances to the peripheral regions of the disc [22]. This pain sensation, however, is different than pain due to radiculopathy. Radicular pain is derived from the nerve root tissue while discogenic pain emanates from the disc material, itself. Disc derangement, the biomechanical causation of discogenic pain, results from repetitive lumbar flexion, but compressive and rotational forces are also known risk factors. The outer 1/3 of the annulus is densely innervated with nerve fibers. For this reason, subtle tears may have an asymptomatic presentation, while more severe tears into the outer annulus are known to produce discogenic pain [23].

Discogenic pain is diagnosed via the combination of: clinical presentation and the patient's response to end-range loading tests [24]. Clinicians should focus on two aspects when treating discogenic pain: 1.) to reduce the intensity and/or frequency of the patient's pain symptoms and 2.) to achieve a "centralization" of the patient's pain complaint. The centralization phenomenon involves a change in the patient's pain distribution pattern where the distribution becomes more proximal (towards the trunk) or nearer to midline.

Clinical presentation of the centralization phenomena is fundamental to the diagnosis of discogenic pain [25]. Robin McKenzie is credited with the first introduction of diagnosis and treatment of disc derangement, which prompted him to create the McKenzie Method, also known as Mechanical Diagnosis and Therapy (MDT). End-range loading tests involve spinal movements, in various directions, in search of a movement that produces pain at end-range, but does not produce pain during the arc of motion. During analysis, both a direction of benefit and direction of detriment are established to guide treatment decisions. The direction of benefit, also known as the "directional preference", is opposite that of the patient's antalgia; it is associated with reduction of pain symptoms, increased range of motion, and a sensation of obstruction or blockage at end-range. The direction of detriment is in the same direction of the antalgia [26]. It is associated with pain simultaneously during end-range and the arc of motion, increased symptoms of pain, and possible excessive range of motion. A common patient presentation is the pattern of lumbar kyphotic antalgia [27,28], which is associated with an extension directional preference and a flexion direction of detriment. During treatment for this pattern, the patient is instructed to perform a series of extension exercises, beginning in the prone position with eventual progression into the standing position.

Table 5 lists the positive and negative likelihood ratios associated with repeated end-range loading, which is a key assessment procedure involved with identifying discogenic low back pain. The ratios for the common clinical presentation, loss of lumbar spine extension, are also noted. Regarding repeated end-range loading tests with positive findings, the +LR of 6.7 indicates a moderate to high probability of the patient's low back pain to be discogenic in origin (see Table 5) [29,30].

Clinical Features Associated with Discogenic Low Back Pain	+LR	-LR
Centralization upon Repeated End-Range Loading (directions = lumbar extension, flexion, or lateral bending)	6.7	0.63
Loss of Lumbar Spine Extension ("extension loss")	2.01	0.84

+LR = positive likelihood ratio; -LR = negative likelihood ratio

Table 5: Clinical Features Associated with Discogenic Low Back Pain

While the orthopedic physical exam may be effective for the diagnosis of non-discogenic low back pain, there is limited evidence supporting the usefulness of orthopedic tests when diagnosing discogenic pain [31]. Due to the lack of robust orthopedic exams to establish that a patient's low back pain is of a discogenic origin, clinicians are left having to rely more heavily on their clinical experience to make this diagnosis. Additionally, a possibly means of obtaining a discogenic pain diagnosis is to utilize advanced diagnostic imaging, usually MRI, to evaluate for disc degeneration and endplate changes. An aggregative analysis of these studies found a -LR of 0.21, indicating moderate competency to rule out a diagnosis of discogenic pain in the absence of MRI findings [31].

As shown in Table 6, positive signs of centralization have been shown to be indicative of disc derangement upon MRI [29,32]. The positive findings for disc derangement on MRI included: end plate signal intensity changes, morphological disc changes, disc signal loss, and anatomical changes (see Table 6) [33].

Centralization of Pain	Features of discogenic pain on MRI Yes (+)	Features of discogenic pain on MRI No (-)	Total
Yes (+)	31	2	33
No (-)	3	2	5
Totals	34	4	38

+LR 1.8(0.8-4.2) -LR 0.18(0.05-0.6)

Numbers represent study subjects included in each category.

Table 6: Relationship Between the Centralization Phenomenon and Evidence of Discogenic Features on MRI

Radiculopathy

Lumbar radiculopathy is often the result of compression or inflammation of a nerve root. Radicular pain typically projects pain into the leg (below the knee), is more intense than the patient's back pain, and may also present with neurological dysfunction, such as lower extremity paresthesia or a loss of motor and/or sensory function in the lower extremity [34]. While there are various causes of lumbopelvic radicular pain, the two most common causes of radiculopathy are 1.) an acute spinal disc herniation and 2.) lumbar spinal canal stenosis [35].

Acute Lumbar Disc Herniation

A spinal disc herniation, also known as a herniated nucleus pulposus, is likely to produce intense low back pain that is combined with radicular pain and is most common in patients who are 30-50 years of age. Patients with pain emanating from an acute disc herniation have a prolonged history of low back pain with a recent onset of unilateral lower extremity radicular pain, commonly described as "sciatica" [36]. The presence of a disc herniation puts pressure on the associated lumbar nerve root and may also produce pain via inflammatory mediators attracted to the site of herniation. A symptomatic disc herniation produces characteristic findings upon neurodynamic testing, which are also known as "nerve root tension tests" [35]. Procedures that evaluate for a spinal disc herniation are intended to place tension on the tethered nerve root with the purpose of reproducing the patient's radicular pain complaint [36]. The orthopedic exams that have demonstrated the greatest clinical utility are listed below with their associated positive and negative likelihood ratios in Table 7 [37-40].

Orthopedic Exams to Evaluate for Symptomatic Disc Herniation	+LR	-LR
Straight Leg Raise Test (SLR) [37]	2.23	0.05
Crossed Straight Leg Raise (CSLR or Well Leg Raise) [38]	14.3	0.50
Slump Test [39]	1.82	0.32
Femoral Nerve Stretch Test [40]	5.7	0.34
Crossed Femoral Nerve Stretch Test [40]	≥9.0	0.91

+LR = positive likelihood ratio; -LR = negative likelihood ratio

Table 7: Orthopedic Exams to Evaluate for Symptomatic Disc Herniation

It is worth noting that a positive finding for the straight leg raise (SLR) test involves the reproduction of the patient's radicular pain between 30-60 degrees of elevation from the table. It's recommended that SLR test and the crossed straight leg raise (CSLR) test be performed concurrently. While the SLR test is highly sensitive (97%) for disc herniation, it is not particularly specific (57%). This means that a negative SLR is more useful at ruling out an acute disc herniation, but a positive SLR should be followed-up with a specific exam. An exam that is specific for disc herniations is the CSLR test. While the CSLR has a relatively poor sensitivity (43%), a positive CSLR is highly specific (97%) for an acute disc herniation.³⁸ In summary, a negative SLR is most useful for *ruling out* a disc herniation as the cause of radicular pain, while the CSLR is most useful for *ruling in* an acute disc herniation.

Clinicians should be aware that the overwhelming majority (98%) of all lumbar disc herniations occur in the lower lumbar spine, while the remaining 2% involve the L1-L4 nerve roots [36]. Lower lumbar disc herniations may cause neurological disturbance in the regions of the lower extremities supplied by the L5 or S1 nerve roots. Neurological disturbances involving L5 or S1 nerve root irritation are likely to produce pain, paresthesia, or numbness along their respective dermatomal distributions (see Figure 1) [41]. Lumbar disc herniations may also produce muscle weakness and abnormal deep tendon reflexes in the lower extremities (see Table 8) [36,42].

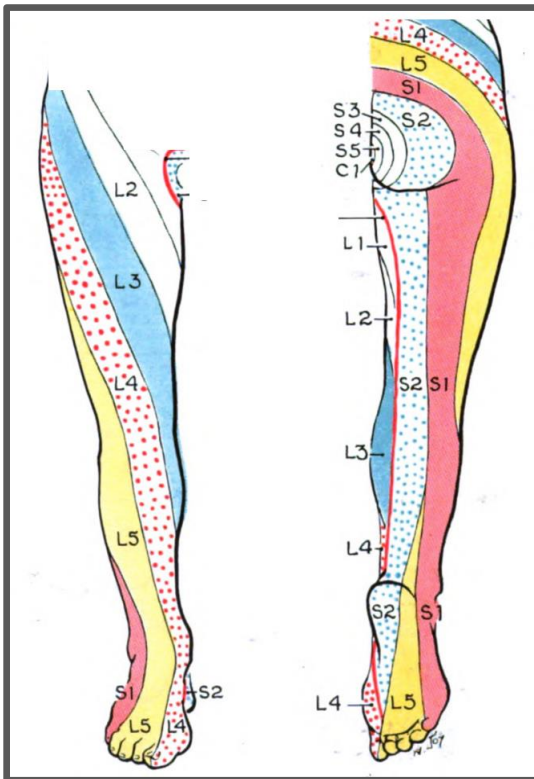


Figure 1: Dermatome Patterns of the Lower Extremities

Nerve Root	Pain or Paresthesia (sensory)	Weakness (motor)	Reflex
L2 & L3	Anteromedial thigh	Hip flexion (L2) and Knee extension (L3)	Diminished knee jerk (patellar reflex)
L4	Anterior thigh and medial foot	Knee extension	Diminished knee jerk (patellar reflex)
L5	Lateral leg and dorsum of foot	Great toe and ankle dorsiflexion	Changes are uncommon or are absent
S1	Posterolateral, leg, heel, and foot	Ankle and great toe plantarflexion	Diminished ankle jerk (Achilles reflex)

Table 8: Review of Selected Lumbar Spine Nerve Root-Related Exam Findings

Sensory impairment from nerve root compression is most notable in the distal extremities; therefore, clinicians are advised to include sensory evaluation on the medial aspect of the foot, the dorsum of the foot, and the lateral aspect of the foot via pin-prick and light touch examinations [36].

Notably, evaluating for weakness on dorsiflexion (L5) or plantar flexion (S1) should be performed while the patient is supine on the examination table; this method has been shown to be more reliable than assessing for weak dorsiflexion by having the patient “heel stand” or “toe walk” [43].

The SLR and CSLR tests are most appropriate for evaluating these lower lumbar disc herniations, while the femoral nerve stretch test and crossed femoral nerve stretch test are most appropriate for evaluating patients who are suspected of having the rarer mid-to-upper lumbar disc herniations (L2-L4 nerve roots) [36].

Astute clinicians should be aware that not all disc herniations detected on advanced imaging (CT or MRI) are symptomatic and relevant to the patient’s care. A systematic review identified the presence of disc protrusions in 29% of all asymptomatic 20-year-olds and 43% of asymptomatic 80-year-olds who underwent advanced imaging [44]. This highlights the importance of correlating clinical exam findings with findings from advanced imaging.

Guidelines overwhelmingly recommend that patients experiencing pain from an acute lumbar disc herniation should stay physically active and should initiate a six-week trial of conservative care, while clinicians are recommended to avoid imaging during this initial six-weeks of care [45]. Importantly, patients who present with red flags, demonstrate progressive neurological dysfunction, or do not improve following six-weeks of conservative care should pursue advanced imaging or more invasive management procedures [45].

Lumbar Spinal Stenosis

Lumbar spinal stenosis is another common cause of radiculopathy that is most likely to present as a source of pain among older individuals (>50 years) secondary to degenerative changes of the spine, such as osteophytosis or ligamentum flavum hypertrophy. These degenerative changes may narrow the spinal canal or the intervertebral foramen, which causes compression or irritation of the nerve roots of the cauda equina. Lumbar spinal stenosis characteristically produces neurogenic claudication, which is radicular or cramping pain in the legs while standing or walking, along with other neurological defects such as numbness or weakness of the lower extremities [36,46]. A systematic review of commonly-reported features of lumbar spinal stenosis (LSS) has been performed, and the most relevant features are explained in Table 9 [47].

Clinical Features Associated with Lumbar Spinal Stenosis	+LR	-LR
Older than age 65	2.5	0.34
No pain when seated	7.4	0.57
Pain improves when sitting forward (lumbar flexion)	6.4	0.52
Bilateral buttock or leg pain	6.3	0.54
Neurogenic claudication	3.7	0.23
Wide-based gait	13	0.60
Positive Romberg test	4.5	0.67

+LR = positive likelihood ratio; -LR = negative likelihood ratio

Table 9: Clinical Features Associated with Lumbar Spinal Stenosis

While radicular pain may arise from either an acute lumbar disc herniation or lumbar spinal stenosis, there are a few key differences between these conditions, which may help clinicians quickly prioritize whether a patient's radicular pain is originating from either condition. Patients with lumbar spinal stenosis tend to be older adults, while patients with an acute disc herniation tend to be middle-aged adults. Radicular complaint secondary to lumbar spinal stenosis is most likely exacerbated with lumbar extension, while the radicular pain originating from an acute disc herniation is most likely to be exacerbated with lumbar flexion [36]. Lastly, the radicular pain associated with lumbar spinal stenosis tends to be a chronic pain condition and presents with a bilateral pain distribution; this contrasts with the radicular pain associated with disc herniation which tends to be unilateral, of an acute onset, and of short duration ($\leq$ six weeks) [36].

Limitations

This paper is a narrative review of literature; therefore, the selection of relevant reference articles may have been subject to selection bias, and the search results are less reproducible than systematic methods. While an attempt was made to select reference articles with the highest methodological rigor, these articles were not formally evaluated or graded.

Conclusion

As health care continues to evolve, evidence-based practice (EBP) is becoming increasingly supported and adopted across health care professions [48]. While clinicians engaged in EBP are challenged with staying current with the published literature, it is important to remember that research is not the only focus – use of EBP must also incorporate the clinician's experiences as well as the individual patient's desires or values [49]. The intent of this article is to provide clinicians, who are involved with evaluating low back pain-related disorders, with a review of useful information related to performing an orthopedic exam for these disorders. We would like to emphasize how incorporating evidence-based orthopedic exams is intended to save clinicians' time, while improving their diagnostic accuracy. Currently, a plethora of orthopedic tests are said to be useful for assessing low back pain, but it is worth noting that most of these tests have yet to be evaluated to establish validity. We are not claiming that the orthopedic exams left out of this report are without value and should be omitted, but clinicians should be aware that findings from other orthopedic tests may be tenuous. Performing a focused orthopedic examination while using a short list of evidence-based tests is intended to provide the busy clinician with the most useful information in the shortest amount of time. When applying the tests with useful likelihood ratios

or useful clinical prediction rules, clinicians can be increasingly more confident that they have achieved an accurate diagnosis.

Effective patient care revolves around a sound diagnosis and treatment plan. We recommend that clinicians become familiar with the current state of the evidence surrounding the numerous orthopedic tests related to diagnosing the various forms of low back pain. We have assembled a review sheet (see Appendix 1), which may be useful within a clinical setting. In the end, incorporating the highest quality of orthopedic exams into practice is intended to aid clinicians in their ability to provide the highest level of patient care and improve patient outcomes.

List of Abbreviations

+LR = positive likelihood ratio
-LR = negative likelihood ratio
S-I = sacroiliac joint
SLR = straight leg raise test
CSLR = crossed straight leg raise test
L2 = second lumbar nerve root
L3 = third lumbar nerve root
L4 = fourth lumbar nerve root
L5 = fifth lumbar nerve root
S1 = first sacral nerve root

Competing Interests

The authors declare that they have no competing interests related to this work.

Author's Contributions

CBR contributed to the conception of this project, performed the literature review, and participated in the drafting and revisions of this work. RW contributed to the literature review, drafting, and revisions of this work. Both CBR and RW met criteria to substantiate their authorship of this manuscript.

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Appendix 1 – Exam Summary for Low Back Disorders

Lumbar Facet Pain		
Clinical Presentation: ipsilateral paraspinal pain which may project into the buttock, thigh, or groin, decreased range of motion with lumbar extension and/or rotation, and increased pain with prolonged standing or sitting		
Extension-Rotation Test (Kemp test)	+LR = 1.29	-LR = 0.0
P-A Pressure Test (Springing test)	+LR = N/A	-LR = N/A
≥ 5 positives of the following: 1. Age ≥ 50 years 2. Low back pain that is primarily located at the paraspinal region 3. Positive Kemp test 4. No low back pain is produced with performing sit-to-stand 5. Low back pain is best relieved when walking and/or; 6. Low back pain is best relieved when sitting 7. Low back pain due to disc derangement has been ruled out	+LR = 9.7	-LR = 0.17
Sacroiliac Joint Pain		
Clinical Presentation: pain in one or both S-I joints, which may project into the posterior thigh and hip region		
≥ 3 positives of the following: 1. Gaenslen's test (right leg) 2. Gaenslen's test (left leg) 3. Thigh thrust test 4. Sacral thrust test 5. Sacroiliac compression test 6. Sacral distraction test	+LR = 4.3	-LR = 0.80
Discogenic		
Clinical Presentation: lumbar kyphotic antalgia associated with an extension direction of benefit and flexion direction of detriment		
Centralization with repeated end-range loading	+LR = 6.7	-LR = 0.63
Loss of lumbar spine extension	+LR = 2.01	-LR = 0.84
Disc Herniation		
Clinical Presentation: pain radiating into the leg (below the knee) that is more intense than the back pain itself possibly accompanied by neurological dysfunction such as lower extremity paresthesia or loss of motor or sensory function		
Straight Leg Raise Test	+LR = 2.23	-LR = 0.05
Crossed Straight Leg Raise	+LR = 14.3	-LR = 0.50
Slump Test	+LR = 1.82	-LR = 0.32
Femoral Nerve Stretch Test	+LR = 5.7	-LR = 0.34
Crossed Femoral Nerve Stretch Test	+LR = ≥9.0	-LR = 0.91
Lumbar Spinal Stenosis		
Clinical Presentation: radicular or cramping pain in the legs while standing or walking, along with neurological deficits such as numbness or weakness of the lower extremities		
Older than age 65	+LR = 2.5	-LR = 0.34
No pain when seated	+LR = 7.4	-LR = 0.57
Pain improves when sitting forward (lumbar flexion)	+LR = 6.4	-LR = 0.52
Bilateral buttock or leg pain	+LR = 6.3	-LR = 0.54
Neurogenic claudication	+LR = 3.7	-LR = 0.23
Wide-based gait	+LR = 13	-LR = 0.60
Positive Romberg test	+LR = 4.5	-LR = 0.67

Original Article

Improvement in functional constipation while under chiropractic care in a pediatric patient with primary vesicoureteral reflux: a case report

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Abstract

Background: Primary vesiculoureteral reflux (VUR) is the most common pediatric urologic abnormality. Severity is graded I (mildest) to V (most severe). Increasing severity, bilaterality, and presence of dysfunctional elimination syndrome, particularly constipation, decrease the likelihood of spontaneous resolution.

Objective: Describe the clinical presentation, treatment, and response of a 31-month-old female patient previously diagnosed with grade I right-sided VUR and grade IV left-sided VUR and chronic constipation to application of chiropractic manipulative therapy (CMT), abdominal massage, and probiotic supplementation.

Clinical Features: The patient was originally diagnosed at seven months with bilateral grade V VUR after hospitalization for *Escherichia coli* septicemia. She presented to a chiropractic clinic four days after her most recent visit to a pediatric urologist, who reiterated that her chronic constipation was the most negative prognostic factor for future non-surgical improvement in her grade IV left VUR.

Intervention and outcome: This patient was treated via instrument adjusting and manual CMT, abdominal massage, and probiotic supplementation over ten visits. During care, the child's frequency of evacuation increased, her pain and fear of evacuation decreased, and stool consistency normalized.

Conclusion: Chronic constipation in a pediatric patient with VUR improved after initiation of a CAM care plan.

Background

Primary vesiculoureteral reflux (VUR) is defined as the retrograde flow of urine from the bladder into the ureter(s) or the renal pelvis [1]. Primary VUR is a heterogeneous disease which may be related to congenital renal dysplasia, aberrant bladder contractility or function, or a predisposal to urinary tract infections (UTIs) [2]. It is the most common urologic abnormality in children [3]. Some studies indicate a prevalence of 25-40% in young children, and as high as 65% in infants up to six months [3]. The International Reflux Study in Children produced a widely accepted radiographic grading scale for reflux severity. Grade I, the mildest form, indicates the backflow of urine into the distal ureter; grade V represents the most severe form, indicating gross dilation of the ureter, renal pelvis, and renal calyces (Figure 1). [4]

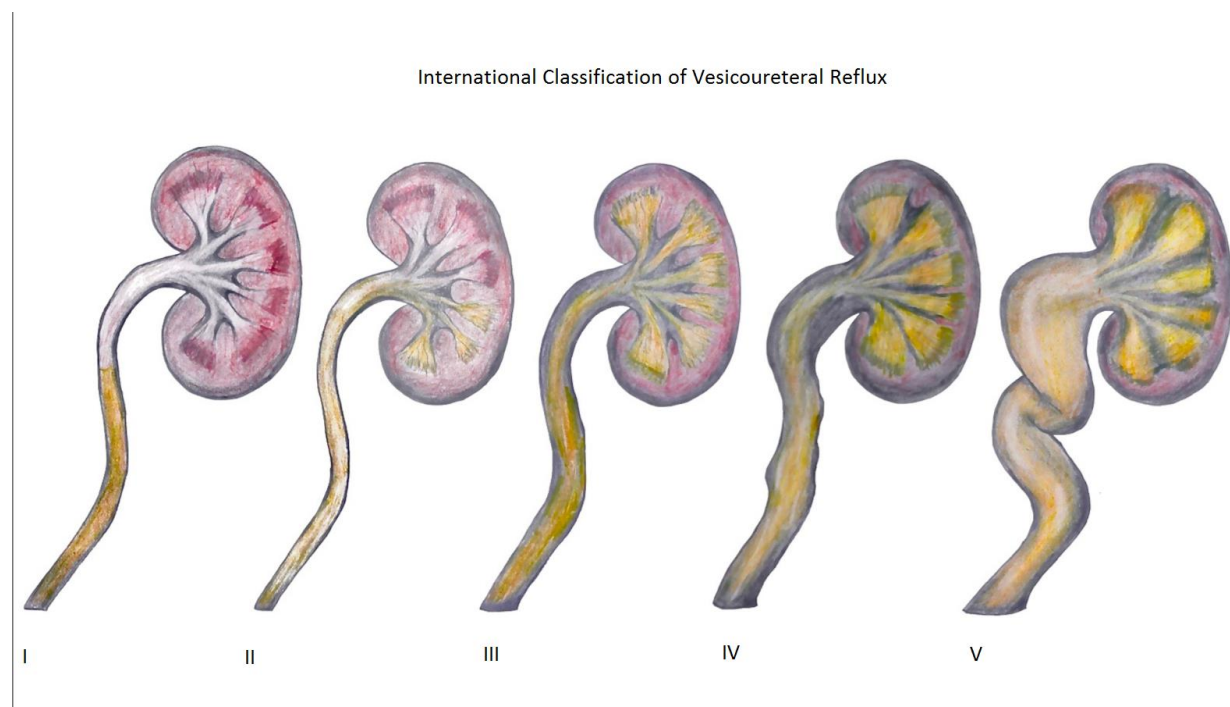


Figure 1: International Classification of Vesicoureteral Reflux [1,2]. Illustration by Alec Schielke, DC

Vesiculoureteral reflux has a 25-80% chance of spontaneous remission as the child matures [1,2, 8]. Several factors have been identified which make resolution less likely and slower to occur. Among these are the severity (grade) of the reflux, the presence of recurrent urinary tract infections (UTIs), and the comorbidity of chronic functional constipation [1,5].

Functional constipation refers to constipation without organic cause. It is one of the most common gastroenterological problems of childhood, and is defined as two or fewer defecations per week,

consisting of large, hard, and painful bowel movements causing stool- withholding postures and abdominal pain [6]. Constipation is a hallmark of dysfunctional elimination syndrome (DES), which is now considered to play a large part in predicting resolution of reflux and even the success of corrective surgery if deemed necessary [1,6,7,8].

DES refers to a broad spectrum of functional disturbances that may affect the urinary tract. These include attempts to suppress bladder contractions, or sphincter relaxation, by inappropriately contracting the pelvic floor muscles and tightening the sphincter. This in turn produces an increase in voiding pressure and an inability to completely drain the bladder, thereby encouraging reflux. Many authors now regard dysfunctional elimination behavior as not just related to but potentially causative of VUR [5,6,7,8,10]. Several studies have noted that higher rates of dysfunctional elimination syndrome (DES) and chronic constipation are seen in girls [4]. Even after being diagnosed with VUR, and while on continuous antibiotic prophylaxis (CAP), girls have a greater risk of “breakthrough” UTIs than do boys, due to the higher frequency among girls of DES and constipation [6,7,8].

One author reports that 30% of children with constipation experience urinary incontinence or UTIs; these are children without the concomitant diagnosis of VUR [9]. A hard, enlarged fecal mass can impact on the bladder or bladder neck, increasing storage pressure in the bladder and creating a residual urine volume perfect for microbial overgrowth [10]. In children whose urinary tracts are already compromised functionally by VUR, constipation in childhood increases the likelihood of urinary incontinence, bladder overactivity, discoordinate voiding, a large capacity and poorly emptying bladder, recurrent UTI, and deterioration of VUR” [1]

Case Presentation

A 31-month old patient was brought to a chiropractic clinic by her mother with a complaint of chronic functional constipation secondary to VUR. The child was diagnosed with grade V bilateral VUR at age seven months when she was hospitalized with a high fever. *Escherichia coli* septicemia was diagnosed, secondary to a urinary tract infection, and the patient was hospitalized and started on intravenous antibiotics. A voiding cystourethrogram (VCUG) revealed bilateral grade V reflux (Figure 2). Upon discharge, the patient was placed on CAP with Bactrim, and prescribed Miralax (to increase stool bulk) and Lactulose (osmotic agent to soften stool.) The child underwent repeat VCUGs every six months to evaluate for renal scarring and reflux grade status.



Figure 2: Voiding Cystourethrogram: The patient’s initial voiding cystourethrogram (VCUG), shown above, depicts bilateral grade V reflux. Subsequent VCUG tests have graded the patients left kidney at a IV while the right kidney has improved to a grade I.”

Her most recent VCUG in early 2015 showed an improvement in reflux on the right (to grade I) but little improvement on the left (now grade IV). The pediatric urologist managing her case reiterated the importance of controlling her constipation to maximize the chance of the reflux resolution, and possibly prevent surgical intervention. The child’s mother decided to consult a chiropractor about a trial of spinal manipulative therapy (SMT) to treat her daughter’s constipation. The urologist was open to this idea.

At the time of presentation to the chiropractor, the patient was having a bowel movement only every seven to ten days. The bowel movements were hard, painful, large, and protracted, and began with a prodrome of the child climbing into her mother’s lap and screaming and crying. Upon examination, the patient appeared as a normally developed two-and-a-half-year-old child with a slight build. She scored in the 35th percentile for weight, 33rd for height, and 42nd for head circumference. Vital signs were normal. Abdominal examination revealed a taut, rounded contour over the entire abdomen, with tenderness and guarding on both light and deep palpation. The

child's mother noted that it had been at least two days since her last evacuation. The child was mildly anxious, and resistant to abdominal pressure. No obvious masses or pulsations were noted.

Chiropractic examination revealed sacral base posteriority on the right side with significant decrease in posterior to anterior (P-A) passive joint motion. In addition, the patient exhibited decreased lumbar extension with bilateral paraspinal hypertonicity in the upper lumbar region. Treatment on the initial visit was performed by the chiropractor on a Zenith drop table. Thrusts were applied P-A over the right sacral base and bilaterally on the L1 and L2 mammillary processes. The patient was then placed supine on a pelvic bench with her knees flexed as the chiropractor performed external manual massage of the large intestine, starting in the right lower quadrant and proceeding clockwise along the flow direction of the large intestine. The parent was then taught this maneuver and asked to demonstrate it correctly. They were then directed to repeat it at home 1-3 times daily to patient tolerance. In addition, it was suggested that the parents administer a child-dosed probiotic daily, based on evidence of its stool-softening qualities as well as the child's long-term antibiotic use. [6]

Initially, the child was seen weekly for adjustments and abdominal massage. Her bowel movements increased in frequency after the first and third adjustments, but not after the second. At this time the chiropractor recommended adding dried prunes to the child's diet, as well as prune juice with prune pulp added. The parent was complaint, and fortunately the child enjoyed prunes. From the third visit on, the patient's evacuations became more frequent and less dramatic. The parent stated that her child's stools were softer, defecation was quicker, and there was no more crying as evacuation became imminent. By the sixth visit, the mother stated that her child was defecating "normally" every three days and that defecation had become pain- and anxiety-free for the child. By the 13th week of care, the child's bowel movements were occurring every other day. At this point, care was reduced in frequency due to geographic hardship and holiday schedules. When the child returned for care after a four- week absence from the clinic, the parent reported one nine-day period without a bowel movement. However, the stools had not returned to their former hard consistency, and the child did not evince the fear behaviors previously noted. The parents plan to continue care for their daughter every two to three weeks as possible.

Discussion

Functional constipation is considered to be multifactorial in origin and difficult to eradicate [6,11]. This young patient had had no improvement in her chronic constipation from the stool bulk enhancer or the osmotic stool softening agent she had been prescribed. Her parents were highly invested in adding a complementary and alternative medical (CAM) approach to her established treatment protocol for VUR. The pediatric urologist who had warned them about the gravity of unmanaged constipation in the resolution of VUR was supportive of their desire to add CAM care, which made their decision easier.

A review of the chiropractic literature on children and constipation yielded 14 case reports, one case series, one review of the literature, and a recent integrative review of the chiropractic literature. No randomized controlled trials (RCTs) have been performed to study the effectiveness of spinal manipulative therapy (SMT) in the reduction or elimination of constipation [12]. Each case report provides anecdotal evidence of clinical success, and posits several plausible mechanisms by which SMT might effect a change in colonic motility, pelvic floor contractility,

and coordination and sensitivity of the sphincters. The balance needed between the sympathetic and autonomic nervous systems in order to allow coordinated normal defecation may be directly interfered with by vertebral and /or sacral segmental dysfunction, particularly in the area of sacral nerves 2-4 and the pudendal nerve. Alternately, the negative effect may be via noxious input from mechanoreceptor derangement or other afferent “white noise”. In either case, a positive response to SMT does not seem implausible.

The logic for employing abdominal massage was twofold. First, there is some evidence in the literature that abdominal massage can positively impact constipation, although no RCTs have been performed [13]. Second, we hoped to reduce this young patient’s apprehension of and discomfort with having her abdomen touched or pressed. We felt that her fear of the sensation of any type of pressure on or in her lower abdomen might have contributed to her dysfunctional response (tightening the pelvic floor and sphincters when she felt the urge to defecate). In adults, preliminary work has been done on pelvic floor retraining via computer feedback which has shown a positive effect on constipation [14].

In addition, we chose to suggest administration of a probiotic supplement after consideration of her long-term antibiotic use via CAP, and the known effects of antibiotics on the balance of gut flora. We also considered findings in the literature which supported the efficacy of a mixture of *Lactobacillus* and *Bifidobacterium* in “...increasing stool frequency and improving stool consistency” in adults [15]. For both the abdominal massage and the probiotic therapy, we felt strongly that giving the parents an active role in potentially ameliorating their daughter’s chance to avoid surgery was important enough to balance the lack of higher-level studies definitely proving that either approach was guaranteed to work. Neither abdominal massage nor probiotic supplementation has been linked to adverse events when properly administered. The child’s urologist was comfortable with both interventions as adjuncts to the trial course of SMT.

Finally, we must consider the placebo effect. Both pediatric and adult patients with functional gastrointestinal disorders often show high success rates for placebo (60% in one study) [16]. However, even if some of the overall improvements in this case were attributed to a placebo effect, the objective improvement in this patient’s functional constipation, as measured by increased frequency of evacuation, enhanced bulk and softness of stool, and decreased pain around and during defecation, has been exciting and rewarding for the family as well as the clinicians.

Limitations

All the limitations of the case report format apply here, and thus we are very restricted in drawing inferences from this one patient as to the efficacy of SMT in the management of pediatric functional constipation. However, the significant and ongoing improvement in this patient’s presentation suggests that higher-level investigation of SMT for childhood constipation may be warranted.

Consent

Written informed consent was obtained from the patient's guardians for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

VB conceived of the case report, researched the literature before beginning patient care, reviewed and annotated the literature search for case report, was supervising physician on the case, drafted the introduction and discussion, and wrote final version of paper.

JC researched the literature before beginning patient care, performed the literature search after case report was conceived, performed his own annotations of literature search, designed patient management protocol, was the treating intern throughout care, and participated in each revision of manuscript.

TW read and annotated literature search, participated in patient care supervision when VB was absent, and assisted with revisions of introduction and discussion.

All authors read and approved the final manuscript.

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Original Article

Physician & Physician Assistant Attitudes and Referral Habits Concerning Chiropractic

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Abstract

Objectives: This study looks to utilize survey methods to evaluate the factors which may influence the attitudes and referral habits to chiropractors among physician and physician assistants (PAs) within an integrated health care environment where access to chiropractic services is referral-dependent. This study compares the self-reported data on referral habits to actual referral data.

Methods: This study was approved by the Washington DC VAMC institutional review board. Subjects were members of the medical staff of the Martinsburg VA Medical Center. They completed a written informed consent. Data was collected using a tool developed for this study. Data was then placed in numeric categories and analyzed using SPSS 13.0. Statistical analysis consisted of descriptive statistics, bivariate correlation, and factorial analysis of variance.

Results: The analyses were carried out on 26 completed surveys. The mean average knowledge of chiropractic (self-rated) and opinion of chiropractic was 4.8 on a 0-10 scale with a range from 1-9. 42% of subjects referred to chiropractors. The average satisfaction of the referring provider with the results of referral was 8 (0-10 scale). The presence of chiropractor on staff had a positive effect on both opinion and referral habits.

Conclusions: The tool developed does effectively gather the data sought. Having a chiropractor on staff does positively impact the opinions medical providers have concerning chiropractic, as well as the referral habits to chiropractors. Demographically PAs have an overall higher opinion of chiropractic than physicians. The more medical providers know about

chiropractic, the higher their opinion. The majority of providers who refer more do so because they feel it is the best treatment in that case. Overall satisfaction with referrals to the chiropractic service is very high (8/10).

Introduction

With the increasing popularity of chiropractic care in the United States, inter-professional relationships between conventional trained physicians and doctors of chiropractic (DCs) will have an expanding impact on patient care.¹ Which factors are most associated with a positive attitude about chiropractors? Studies have shown that younger doctors are more likely to have positive attitudes concerning chiropractic.^{2, 3, 4} Other variation in physicians' knowledge and referral behavior might be due to historical and political circumstances, ethnic traditions, availability and regional demand.⁵ Sikand found that female doctors are more likely to discuss or refer for complementary and alternative medicine (CAM).⁶ No studies were found evaluating differences in attitudes between medical providers who work in hospitals with chiropractors on staff versus those who work in hospitals without staff chiropractors. The Department of Veterans Affairs (VA) is the perfect living laboratory for examining this question. It is a large integrated health care system with a naturally created experimental and control group due to the fact that some VA medical centers have chiropractors on staff, while others do not.

This study served as a pilot of a newly designed questionnaire and protocol to allow for future comparison. This study also examined the level of correlation between different characteristics and positive attitudes and referral habits.

Methods

MDs, DOs, and Physicians Assistants (PAs) were surveyed using a tool developed for this study (Appendix A). Questions covered demographic information (age, specialty, time elapsed since training), attitudes about chiropractic and referral habits to chiropractors. The data from the survey was paired with the provider's actual referral data from the Veterans Health Information Systems and Technology Architecture (VISTA) system. A comparison was made between self-reported and actual data.

An 11 point numeric scale (-5-+5) was used for rating the opinion of chiropractic and chiropractors, as well as the effect that having a chiropractor on staff has on the opinion of or referral habits to chiropractors. A six category, nominal scale, was used for reporting the number of patients seen and the frequency of referrals. From the VISTA system, actual referral data was placed in the same nominal scale.

The questionnaire was reviewed by colleagues and administered to a small group who provided feedback to improve question content and readability. Changes were made to improve the tool based on comments. The small sample showed validity and concurrence between self-report and actual referral data. It was determined that a sample size of 20% of the facilities medical providers would be sufficient for a pilot based on Baker's findings that 10-20% of the sample size of a study is reasonable for pilot enrollment.⁹

Statistical analysis was completed using factorial analysis of variance and bivariate correlation. Parallel forms reliability and paired sample T-test were used to test the similarity and difference between the survey referral data and the VISTA referral data. Correlation was used for all factors to isolate effects. Results from the statistical analysis were used to compare the factors influencing referral rates and attitudes, and to determine the relationship between actual referral data and the provider's self-assessment of referral patterns.

Details of Subjects

For the purposes of this study, the entire population of staff MDs, DOs and PAs of VA Medical Center (VAMC) in Martinsburg, WV were eligible as long as they consented and had been on staff for at least three months prior to surveying. The age range of subjects is between 20 and 80 years of age. Providers who had practiced at VAMC Martinsburg less than three months prior to surveying were excluded.

Subjects were members of the medical staff at VAMC Martinsburg. Informed consent was obtained as well as clearance by the Institutional Review Board (IRB), Research and Development (R&D) committee and the bargaining unit (union) representatives. The study was announced during staff meetings. Staff were also approached privately by department by the principle investigator (PI) or research assistant for participation. In order to minimize selection bias, every provider in a department or service was invited. If willing to participate and sign the informed consent document, they completed the questionnaire. The questionnaires were completed and sealed in an envelope and delivered to the research assistant.

This group was selected for several reasons. The first being convenience of using staff all at one medical center as a pilot and allowing for less variability in work conditions. Second, by using only these three provider types only one union had to approve. Those with less than 3 months of service were excluded because the actual referral data was averaged over 3 months retrospectively to minimize bias or focal anomalies in referral rate. Those with less than 3 months of service could not be averaged in the same manner and were, for that reason, excluded.

Results

In total 26 subjects completed the survey and returned it to the research team (Table 1). There are 116 physicians and physician assistants on staff at VAMC (88 MDs, 5 DOs, and 23

PAs) so this represents 22.4% of the provider population. Of the respondents, 14 were MDs, while 12 were PAs. In addition, eight respondents were primary care providers, 12 were specialists and 2 were emergency department providers. Three were hospitalists and three were compensation and pension doctors, who perform disability examinations. Demographic breakdown on the participants revealed that 14 subjects were male with the remaining 12 being female. Only 22 answered concerning their age, of these five were 20-34, nine were 35-44, five were 45-54, and three were 55-64. Over half of the respondents (57.7%) had practiced for 10 or fewer years. The mean average knowledge of chiropractic (self-rated) was 4.8 on a 0-10 scale with a range from 1-9.

	N	Minimum	Maximum	Mean	Std. Deviation
provider	26	0	1	.54	.508
specialty	26	0	4	1.54	1.272
gender	26	0	1	.46	.508
age	22	1	4	2.27	.985
exp	24	1	6	2.79	1.817
Staff chiro	26	0	1	.96	.196
knowledge	26	1.0	9.0	4.808	2.2498
opinion	26	1.0	9.0	4.808	2.2498
effectop	26	0	5	1.85	1.953
patients	26	1	6	4.08	1.598
outpatients	26	0	100	79.23	33.217
consult	24	0	5	.92	1.412
why	26	1	3	2.23	.815
satisfaction	16	5	10	8.00	2.033
effectref	24	0	5	2.25	2.069
education	23	2	5	3.43	1.037
effective	26	1	10	4.88	2.215
autonomy	26	3	3	3.00	.000
Vista consult	26	.00	1.00	.3077	.47068
Valid N (listwise)	8				

Table 1: Descriptive Statistics

The opinion of chiropractors had the same mean and range. Almost 70% see 35 or more patients per week. Approximately 80% of these patients were outpatients. 42% of subjects

reported referrals to a chiropractor. The average satisfaction with the treatment was 8 on a 0-10 scale (Table 2). The effect of the presence of a staff chiropractor on opinion of chiropractic and on referral habits was rated on a -5 to 5 scale and the mean for the effect on referrals was 2.25 and the mean for effect on opinion was 1.85. The findings were assessed utilizing SPSS 13.0.

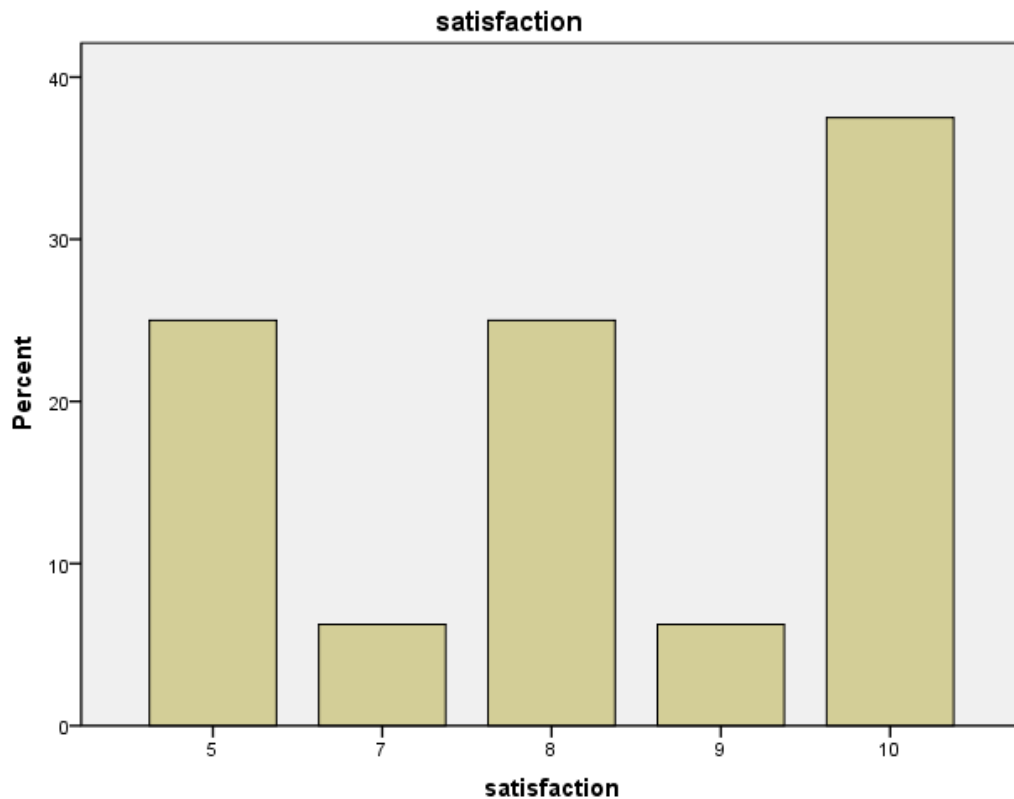


Table 2: Satisfaction

Statistics

Pearson Correlation was significant at the 0.05 level between provider type and opinion about chiropractic/chiropractors as well as between number of patients seen per week and opinion about chiropractic/chiropractors, and the awareness of research on efficacy of chiropractic and opinion about chiropractic/chiropractors. There was significance at the 0.01 level for self-perceived level of knowledge about chiropractic and opinion about chiropractic/chiropractors and level of education of chiropractors and opinion. Significance at the 0.01 level was also observed between the number of consults and the reason for the consult.

Factorial ANOVA revealed no significant effects when using opinion of chiropractic as an independent variable and age, gender, provider type, specialty, knowledge of chiropractic, staff chiropractor, experience, and satisfaction with chiropractic treatment as fixed variables.

The same was true when evaluating number of chiropractic consults ordered using the same fixed variables.

Actual referral data was gathered from the VISTA system from 12/01/2010 through 05/30/2011. During that time there were 162 consults placed to the chiropractic service (106 from MDs, 6 from DOs, 19 from PAs, 28 from nurse practitioners (NPs), 1 from a psychologist, and 3 from physical therapists (PTs)). Of these consults the majority (136 or 84%) were from primary care (nine from the Operation Enduring freedom/Operation Iraqi Freedom clinic (6.6%), 24 from the women's clinic (17.6%). The emergency department was responsible for nine consults (5.6%). Geriatrics and long term care referred four patients (2.5%) and medical and surgical specialists referred nine (5.6%). Physical therapists referred three patients to the chiropractic clinic (1.9%). Bivariate Correlation by paired sample between the self-reported referral data and the actual referral data from the VISTA system was significant at the 0.01 level.

		consult	vista consult
consult	Pearson	1	.682(**)
	Correlation		
	Sig. (2-tailed)		
	N		
vista consult	Pearson	.682(**)	1
	Correlation		
	Sig. (2-tailed)		
	N		
		24	26

** Correlation is significant at the 0.01 level (2-tailed).

Table 3: Correlation between self-reported referral rates and actual referral rates

Discussion

There is currently very little data on medical attitudes and referral habits to chiropractors in an integrated medical center setting. Even less is known about the differences in attitudes and referral habits between medical centers with chiropractors on staff and those without. This is especially important in looking at the real access to care in the VA when there are many medical centers without staff chiropractors. This study is the essential groundwork for looking at inter-facility differences.

The data collected shows that there is a relationship between the self-perceived knowledge about chiropractic and the opinion of chiropractic, with those knowing less having a

lower opinion. This supports previous studies which show that greater knowledge is associated with acceptance and respect between professions,¹⁰ and studies which show that providers with more knowledge of chiropractic have higher opinions of it². Additionally the knowledge of research on the efficacy of chiropractic for different conditions and the opinion of chiropractic show a significant relationship. The relationship between knowledge and opinion is a positive one and shows that those who are less aware of the research have a lower opinion, or that those with a lower opinion are less aware of the research. This relationship is important because Goldszmidt et al noted that self-reported knowledge of chiropractic was poor: the proportion of general practitioners (GPs) who reported a high level of knowledge about chiropractic was only 10%.¹¹ This lack is significant because patients are influenced by what their physician recommends¹² and therefore the physicians' perception of Chiropractic influences the patients' perception of Chiropractic. This is further compounded by the fact that patients do not generally share the fact they visit complementary practitioners with their general practitioners (because of the perception that the GP would disapprove). While an important factor influencing general practitioners' opinions about chiropractic appears to be patients' experience, which may bias physician opinions and subsequently influence referral habits.⁵ This creates a feedback loop which reinforces past behavior as future behavior.

There is also a relationship between whether the provider is an MD or a PA and their opinion of chiropractic with PAs having a higher opinion of chiropractic on average than physicians. This supports the findings of Isberner et al that most (66%) of the PAs they surveyed felt that while we need to be cautious in our claims, a number of CAM therapies hold promise for the treatment of symptoms, conditions, and/or diseases.¹³ Houston et al found a significant relationship between knowledge level and recommendation for CAM among PAs.¹⁴

The majority of consults placed were placed by providers who believed it was the best treatment available. Additionally, as mentioned previously those who do refer to chiropractors have a high satisfaction with the results of the consult (mean of 8/10). The providers who see the most patients per week seem to have the lowest opinion of chiropractic, and also report the least knowledge of chiropractic.

Provider's self-reported knowledge of chiropractic is significantly correlated with the answers to questions about chiropractic education ($p=0.001$) and research ($p=0.034$). This shows validation of the self-reported knowledge of chiropractic. Interestingly though, the number of referrals made to chiropractors was not significantly correlated to opinion, knowledge, or even satisfaction with chiropractic. However, with the small sample size it is difficult to generalize results, and in larger studies relationships may appear which are not apparent in this study.

When comparing the self-reported referral data with actual referral data from the VISTA system there is a significant correlation. This will allow future surveys to be anonymous as there

will not be the need to collect names in order to pair the self-reported referral data to the actual data. This will decrease the risk to the subjects.

The actual referral data showed that the vast majority of consults do come from primary care providers. This is to be expected because chiropractors in the VA function as specialists, and because of the primary care gatekeeper model the VA follows. The majority of the respondents were not primary care providers. This may have had an effect on some of the results as many of the specialists surveyed had never referred to the chiropractic service. Most noted it was not because of negative feelings about chiropractic, but because neuromusculoskeletal conditions were not in their general sphere of interest. It was noted that if a patient had a complaint unrelated to their specialty, they would normally be referred back to the primary care provider, who would then consult as needed. Sawni and Thomas noted that pediatricians in general practice were more likely than specialists to believe their patients use CAM, to refer for CAM, and to want more CME courses in CAM.¹⁵ Borkan et al stated that the physician-patient relationship of physicians in general practice vs. subspecialties may be more open, and physicians in general practice may be more aware of the limitations of biomedicine or deal with less severe, but often chronic, conditions for which CAM may be more appropriate.¹⁶

Another interesting finding in the actual referral data is the high referral rates of the women's health providers, and the OEF/OIF providers. This would suggest a significantly higher rate of female veterans and younger veterans being referred for chiropractic care than would be expected by the relative size of these special populations. This is consistent with anecdotal data concerning the demographics of VA chiropractic clinics. It additionally is very consistent with general chiropractic patient demographics that females utilize chiropractic at a higher rate.^{17,18}

Limitations

Limitations of this study include sampling error as some providers were reluctant to complete their survey, as they did not want to give their name. This was necessary to compare the self-reported data to actual data to ensure validity of the tool; names will not be required in the future studies. Another limitation would be that many of the specialists do not refer to chiropractors because they practice in specialties that do not treat neuromusculoskeletal (NMS) conditions. The VA utilizes a Primary Care Physician (PCP) gatekeeper model, where patients are referred to specialists by their PCP. In this system chiropractors operate as specialists on a consultant basis. Therefore, future studies may focus more on the referral habits of primary care, and emergency department providers.

Other limitations include the small sample size which does not allow for generalizability of the results of this study. However, the sample size is sufficient for a pilot of the survey

instrument. There is also the obvious fact that all providers surveyed practice in a medical center that has a chiropractor on staff. This does not allow a meaningful comparison as there is no control group from a medical center without chiropractors on staff. This data will gain more meaning in future studies when compared to data collected from multiple medical centers with and without chiropractors on staff.

Although there was no control group available in this study for having a chiropractor on staff, the providers self-reported overwhelmingly that having a chiropractor on staff improved their opinion of chiropractic and chiropractors. It was also reported that having a chiropractor on staff increased referrals to chiropractic services.

Conclusion

This study, although limited by a small sample size, accomplishes the primary task of piloting a survey instrument for determining opinions about chiropractic, referral habits concerning chiropractic, demographic characteristics and how all of these are related to one another and to the presence of a chiropractor on staff. Additionally, data was collected and analyzed which can be compared with other VA medical centers to determine the effect having a chiropractor on staff makes toward opinions and referral habits. The results of this study show that providers who know more about chiropractic have a higher opinion of chiropractic, that the satisfaction providers have with chiropractic referral is high, and that the majority of providers who refer to chiropractors do so because they believe it to be the best treatment for that patient. These factors suggest that the presence of a chiropractor on staff will have a positive effect on opinions about chiropractic and therefore on access to chiropractic for patients.

Future studies should evaluate data from hospitals that have staff chiropractors as well as those who don't. It will be important to evaluate hospitals which are regionally similar and diverse as well as of similar and different sizes. Other factors to consider would be how academically affiliated, and how research oriented the hospital is. Future studies should take advantage of web based surveying applications for easier sampling, and presumably higher penetration with the questionnaires.

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Appendix A

Questionnaire for Chiropractic Perception

Please check only one selection unless prompted otherwise. Please pick the selection that best relates to you.

Name _____ ☐ MD ☐ DO ☐ PA
Specialty _____

Gender ☐ M ☐ F Age ☐ 20-34 ☐ 35-44 ☐ 45-54 ☐ 55-64 ☐ 65-74 ☐ 75+

Years in practice ☐ 0-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐ 21-30 ☐ 31+

Does your facility have a chiropractor on staff? ☐ Yes ☐ No ☐ I don't know

How much do you know about chiropractic?

0 1 2 3 4 5 6 7 8 9 10
Nothing I know everything about it

What is your opinion of chiropractic/chiropractors?

-5 -4 -3 -2 -1 0 1 2 3 4 5
Very negative No opinion Very positive

Has the presence of a chiropractor on the medical staff had an effect on your opinions about chiropractic/chiropractors?

-5 -4 -3 -2 -1 0 1 2 3 4 5
Very negative No effect/ No chiropractor Very positive

How many patients do you see in an average week?

☐ 0-14 ☐ 15-24 ☐ 25-34 ☐ 35-44 ☐ 45-54 ☐ 55+

Outcome measures in chronic migraine management: clinical use and potential cost savings: a case study

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ABSTRACT

Introduction: Chronic migraine (CM) is a common primary headache. There are no gold standard prophylactic treatments for CM. OnabotulinumtoxinA is currently the only FDA approved prophylactic therapy for treatment of CM. Patients are seeking alternative treatments for headaches including spinal manipulative therapy (SMT). SMT has been indicated in two large systematic reviews reporting moderate evidence as a treatment for migraine headaches.

Clinical Features: A 44 year-old Caucasian male reported to the hospital-based chiropractic clinic with frequent debilitating headaches in a unilateral presentation, sensitivity to light and sound, nausea, and occasional emesis.

Interventions and Outcomes: He began quarterly OnabotulinumtoxinA injections. A new primary care provider initiated etodolac and consulted the chiropractic clinic. Following eight weekly chiropractic visits, the headache disability index was re-administered and scored at 32/100, a 20 point reduction from initial.

Conclusion: The use of outcome measures helped to identify effective changes in treatment for a patient undergoing pharmacologic and manual therapy interventions for chronic migraine. Utilization of consistent outcome measures across disciplines may assist providers in quantifying and comparing self-rated disability within and between different treatment modalities.

Introduction

Chronic migraine (CM) is a common primary headache disorder characterized by attacks lasting 4-72 hours, occurring 3 consecutive months for (>15) days/month, with features of migraine headache (e.g. aura, nausea, vomiting) on (≥ 8) days/month (1). CM is estimated to impact 1.4-2.2% of the adult population, resulting in significant disability and diminished quality of life. (2,3) As a result, \$1 billion in medical expenditures and \$16 billion in lost productivity each year is related to migraine. Currently, there are no gold standard prophylactic treatments for CM. Following the results of the PREEMPT trials, OnabotulinumtoxinA is currently the only FDA approved prophylactic therapy for treatment of CM. Despite concerns about the clinical efficacy of the PREEMPT clinical trials, statistically significant improvements were noted with regard to headache symptoms, function, and health-related quality of life (HR-QOL) outcomes in comparison to placebo. (5,9)

As described by Bronfort et al., increasing numbers of patients are seeking alternative treatments for headaches including spinal manipulative therapy (SMT)(10). Although there may exist more support for SMT in treating cervicogenic headaches, SMT has been indicated in two large systematic reviews reporting moderate evidence as a treatment for migraine headaches. (6,7) One possible mechanism is the onset of headache types through noxious stimulus. Painful tissues eliciting this stimulus may include joint capsules, muscles, and ligaments, all innervated by the cervical spine nerve roots. (10) The following case illustrates substantial benefit with respect to function, and potentially cost-savings, through the combination of OnabotulinumtoxinA and other treatment modalities.

Case Report

A 44 year-old Caucasian male reported to the hospital-based chiropractic clinic with frequent debilitating headaches in a unilateral presentation, sensitivity to light and sound, nausea, and occasional emesis. He was diagnosed with migraines at age 18. The migraines remained stable for 20 years but increased in intensity beginning November of 2010. He was consulted to Neurology at that time because he had trialed amitriptyline, zolmitriptan, and NSAIDs without benefit. In addition, he had been using SMT at a frequency of one treatment every 6-8 weeks for a year, resulting in 3-4 days without a migraine.

Throughout 2011, on the recommendation of neurology, the patient kept a headache journal which illustrated >15 migraines per month, substantiating the diagnosis of CM. He trialed propranolol, which reduced his daily tension headache to one every three days, and Sumatriptan, which provided abortive relief for his migraine attacks. In November 2011, he began quarterly OnabotulinumtoxinA injections which continued through August of 2014. His HIT-6 improved from 64 to 60 during the first 8 months of OnabotulinumtoxinA injections, but no follow up outcome measures were performed after this time period. He switched Primary Care Providers (PCP) on September 25, 2014. The new PCP initiated etodolac and consulted the chiropractic clinic.

He reported to the chiropractic clinic on October 10, 2014. At the initial evaluation, he scored 52/100 on the Headache Disability Index (HDI) and reported successful use of sumatriptan as an abortive therapy 2-3 times a week, but he was still missing work following its use. Following

eight weekly chiropractic visits, the HDI was re-administered and scored at 32/100. He continued to experience migraines at a frequency of 5 per month; however, when they occurred, he was able to abort them with sumatriptan and continue working. The patient worked 60-70 hours per week as an emergency medical technician which may have contributed to headache triggers in the form of work-related stress and prolonged static postures. Based on the patient response to SMT as evidenced by a 20 point improvement in HDI and decrease in migraine frequency, the treatment plan was altered to no longer include OnabotulinumtoxinA injections. Between December 2014 and February 2015, he reported weekly for additional treatment consisting of manual therapy and modifications to his home exercise program. Table 1 provides a summary of the care and treatment modalities provided to the patient during his time in the chiropractic clinic. His HDI improved to 16/100 in February 2015, and as a result, the frequency of treatment decreased to one visit every two weeks.

Over the next four months, he reported every other week for supportive care and exercise modification. His headache condition remained stable, suggesting an effective home exercise program. In May 2015, he was asked to follow up in one month. At the June visit, his presentation was mildly aggravated as a result of increased work frequency over the past month and non-compliance with his exercises; despite this, his HDI was recorded at 24/100.

Manipulation	Manual Therapy	Therapeutic Exercise	HDI	Education
C1,2; T2/4	Suboccipitals	Deep neck flexion	52	
C1,2; T2/4	Suboccipitals			
C1,2; T2/4	Suboccipitals			Posture education
C1,2; T2/4	Suboccipitals			Posture education
C1,2; T2/4	Suboccipitals			Posture education
C1,2; T2/4	Levator scapula	Added scapular triplanar matrix		Brugger posture breaks
C1,2; T2/4	Levator scapula			
C1,2; T2/4	Levator scapula			
C1,2; T2/4	Levator scapula		32	
C1,2; T2/4	Levator Scapula			
C1,2; T2/4	Levator scapula	Added self trigger point release		Tennis ball trigger-point self-release
C1,2; T2/4	Levator scapula			
C1,2; T2/4	Levator scapula			
C1,2; T2/4	Levator scapula			
	Posterior scalene		16	Patient concerned about not having treatment
T2/4	Posterior scalene			
T2/4	Posterior scalene	Cat camel		

T2/4	Posterior scalene			Reduced frequency to every 2 weeks in order to mitigate anxiety related to no treatment
T2/4	Posterior scalene			
T2/4	Posterior scalene	Scapular depression and retraction 3 pt.		Ordered theracane
T2/4	Posterior scalene			
T2/4	Posterior scalene	Diaphragmatic breathing		Educated about stress and paradoxical breathing
T2/4	Posterior scalene			
T2/4	Posterior scalene			
T2/4	Posterior scalene			Continued to do well without aggravation
T2/4	Posterior scalene		24	He stopped the HEP and worked 29 days in a row

Table 1: Summary of Care

Discussion

This case illustrates how outcome assessments can impact our care and clinical decision making. Prior to reporting to the chiropractic office, the patient employed sumatriptan, propranolol, and quarterly OnabotulinumtoxinA injections; however, he completed his first outcome assessment upon initiation of OnabotulinumtoxinA injections. Throughout healthcare, emphasis is often placed on self-reporting mechanisms of subjective improvement; however, the literature has provided us with outcome assessments that objectively quantify the impact of a disease state on a patient's function (11-16).

Utilization of standardized outcome measures allows for healthcare providers to accurately compare the patient's response between modalities. The literature provides many different options for measuring self-rated headache disability which have good reliability and utility (11-16). The Headache Disability Index (HDI), Headache Disability Questionnaire (HDQ), and Headache Impact Test-6 (HIT-6) are part of the headache outcome measures commonly used in research and practice (17-19). The HDI was chosen because it assesses performance of basic functions including daily routines, concentration, socialization, travel, reading and recreation. The neurology clinic used the HIT-6 upon initiation of the OnabotulinumtoxinA injections and then again at 6 month follow up. A four point improvement was documented; however, a five point improvement is the threshold for clinical significance. Following the six month report, the use of the outcome measure was discontinued. During the PREEMPT trials, the HIT-6 illustrated significant improvement. At the start of the trial, 93.5% of the OnabotulinumtoxinA and 92.7% of the placebo groups reported scores of >60 on the HIT-6. During the trial, the patients completed the HIT-6 at 4 week intervals. Following the 24 week trial, 67.6% and 78.2%

respectively illustrated scores >60 on the HIT-6 suggesting significant improvement and statistically significant difference between groups ($p<.001$) (20). Clinically, it would seem appropriate to employ this same approach in order to gauge monthly progress, regression, or plateauing with respect to the treatment plan. In our case, the HIT-6 was only administered twice; therefore, a conclusion of clinical significance cannot be established.

In addition to the considerations above, it would have been interesting to obtain and evaluate the outcome measure before and after medication changes. The patient could have completed an outcome assessment before and after the addition of propranolol, before and after the addition of sumatriptan, and before and after receiving each OnabotulinumtoxinA treatment. As a result, the patient and provider could track improvements, declines, and plateaus in self-rated disability associated with each specific intervention.

We were unaware that the patient had completed the HIT-6 outcome measure with neurology. If this had been known, it would have been appropriate to administer the same outcome measure at regular monthly intervals. In the chiropractic clinic, outcome assessments were issued; however, the periodization was inconsistent. The HDI did provide a standard for evaluation and additional evidence of self-rated functional improvement. Ideally, the HDI would be issued at defined intervals and at any point that the care plan changed. We could then assess the impact in the change of care.

The literature established OnabotulinumtoxinA as an approved mechanism for reducing acute medical use, physician visits, hospitalizations, and emergency department visits (21); however, cost comparison data has not been established comparing OnabotulinumtoxinA to other interventions. While we cannot draw any conclusion from a single case, it is interesting to consider potential savings with the substitution of chiropractic care for OnabotulinumtoxinA during a nine month treatment period.

The PREEMPT trials represent the largest studies in CM, and their results indicate efficacy in improving clinical and quality of life measures (20). Less clear are the impacts on outcomes such as migraine-related healthcare utilization and net cost associated with treatment (21). In 2013, the cost of OnabotulinumtoxinA treatment was estimated to be \$1,225.51 per treatment session. Use of OnabotulinumtoxinA provided a decrease of emergency department visits by 55%, urgent care visits by 59%, and hospitalizations by 57% accounting for a mean reduction of \$1,219.33 per patient over a six month time period (21). The case noted above resulted in 25 chiropractic visits and the codes 98940 and 97110 were billed in each instance. According to the Wellmark Blue Cross and Blue Shield of Iowa fee schedule, total expenditure for the chiropractic care would have been \$1,525 over a nine month time period. Over the same time period, three OnabotulinumtoxinA cycles would have taken place costing \$3,676.52. Using chiropractic care in lieu of OnabotulinumtoxinA would result in \$2,151.52 (\$3,676.52 - \$1,525) of cost savings over a nine month period of time.

Following a thorough chart and medication review, the following are potential confounding factors: The American Academy of Neurology provides evidence based guidelines for the treatment and prevention of migraine headaches. These guidelines indicate that some non-steroidal anti-inflammatory drugs and selective serotonin reuptake inhibitors, serotonin norepinephrine reuptake inhibitors, and Tricyclic antidepressants have been established as Level B preventive therapies for chronic headaches (22). Etodolac was added September 2014 for

comorbid knee arthralgia. Prior to the primary care appointment in September 2014, compliance with sertraline was suboptimal secondary to side effects, and was subsequently changed to fluoxetine. These pharmacologic changes may have contributed to migraine prophylaxis and as such would be confounding factors (23).

Conclusion

The use of outcome measures helped to identify effective changes in treatment for a patient undergoing pharmacologic and manual therapy interventions, as well BotulinumtoxinA injections for chronic migraine. Utilization of consistent outcome measures across disciplines may assist providers in quantifying and comparing self-rated disability within and between different treatment modalities. While this one case lacks the power of significance, it provides perspective for thought and further study. As healthcare resources become more costly and scarce, it makes sense that continued use of a modality should be substantiated by functional improvement of the patient's condition.

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The Trapped Medial Meniscus Tear An Examination Maneuver Helps Predict Arthroscopic Findings

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JACO Editorial Reviewer: Clark Labrum DC, DABCO

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Author's Abstract

Background: Numerous clinical examination maneuvers have been developed to identify meniscus tears of the knee. While meniscus injuries vary significantly in type and severity, no maneuvers have been developed that help to distinguish particular tear characteristics.

Purpose: This nonconsecutive case series highlights a distinctive clinical finding that correlates with inferiorly displaced flap tears of the medial meniscus that become trapped in the medial gutter of the knee, as identified through magnetic resonance imaging (MRI) and arthroscopy.

Study Design: Cohort study (diagnosis); Level of evidence, 3.

Methods: Eight patients with trapped medial meniscus tears were identified from a single surgeon's academic orthopaedic sports medicine practice between January 2009 and January 2012. Each patient underwent clinical evaluation, MRI, and arthroscopic treatment for meniscus injury. Clinical notes, MRI images, radiology reports, and operative findings were reviewed and compared in a descriptive fashion.

Results: Each patient displayed a positive clinical examination finding of medial knee pain inferior to the joint line with flexion and the application of valgus stress in the setting of a torn medial meniscus and intact medial collateral ligament (MCL). Preoperative MRI revealed a distinctive flap tear of the medial meniscus flipped inferiorly to lay trapped between the tibia and

deep fibers of the MCL. On arthroscopy, flap tears were found displaced inferiorly and trapped in the medial gutter in 6 of the 8 patients. Displaced meniscal fragments in the remaining 2 patients were found within the medial compartment.

Conclusions: Inferiorly displaced flap tears of the meniscus that have been displaced to the medial gutter can be localized through a careful examination technique.

Clinical Relevance: Early identification of this injury pattern may help reduce the likelihood that the trapped fragment will be missed during arthroscopy.

JACO Editorial Summary:

- Knee arthroscopy for a meniscus tear is one of the most commonly performed surgical procedures in the United States, with medial tears reported more commonly than lateral tears.
- Horizontal tears can produce fragments that become inverted and subsequently “trapped” between the medial aspect of the tibial plateau and the deep fibers of the medial collateral ligament (MCL) this particular type of medial meniscal tear may be more difficult to recognize during arthroscopy and if missed, results in ongoing knee pain postsurgery.
- The aim of this case series was to highlight that the finding of medial-sided pain with knee flexion and the application of a valgus stress, in the setting of an intact MCL, may indicate an inferiorly displaced flap tear of the medial meniscus.
- This maneuver was performed with the patient supine while the knee was flexed between 30 and 120 degrees by applying a valgus stress to the lateral aspect of the knee with the examiner’s free hand. In a positive test, the patient would experience a new or significant increase in pain directly adjacent and inferior to the joint line on the medial side of the tibia.
- Weaknesses of the study include the lack of prospective design and control group, the small sample size, and the fact that the examiner was not blinded to MRI findings.

Summary:

As MRI accuracy improves, so does the risk of overreliance on this technology. One research study found that sole reliance on MRI without application of clinical judgment would have led to inappropriate treatment in 35% of knees studied. Other studies suggest experienced examiners are superior to MRI in identifying surgically treatable meniscal lesions. As fiscal constraints placed on medical management increase, MRI may be reserved for situations in which an experienced clinician requires further information before arriving at a diagnosis.

The clinical diagnosis of meniscal tears has been found to be more accurate when combinations of tests are used. Traditional maneuvers such as the McMurray test and the Apley compression test have low diagnostic accuracy when performed in isolation. However, by combining joint line tenderness and the McMurray test, researchers were able to lift sensitivity and specificity to over 90% for detection of a medial meniscus tear, and sensitivity to 75% and specificity to 99% for a lateral tear.

One proposal in 2006 included a history of mechanical symptoms combined with 4 examination maneuvers, however, a consensus does not exist regarding a composite evaluation for meniscal injury.

When the patient reported a positive history and experienced pain with hyperextension, maximum flexion, pain or click with the McMurray test, and joint line tenderness to palpation, there was a 92.3% positive predictive value of finding a meniscal tear.

Testing for medial-sided knee pain with flexion and application of valgus stress should be considered in patients for whom there is a concern of medial meniscal injury to avoid missing trapped inferiorly displaced flap tears on arthroscopy.

Abstracts & Literature Review

Current Concepts Review Injuries to the Ankle Syndesmosis

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Author's Abstract

- Despite being common, syndesmotic injuries are challenging to diagnose and treat.
- Anatomic reduction of the ankle syndesmosis is critical for good clinical outcomes.
- Intraoperative three-dimensional radiography and direct syndesmotic visualization can improve rates of anatomic reduction.
- The so-called gold-standard syndesmotic screw fixation is being brought increasingly into question as new fixation techniques emerge.
- Syndesmotic screw removal remains controversial, but may allow spontaneous correction of malreductions.

JACO Editorial Summary:

- This article is an interesting and well written narrative review. The purpose was to review the diagnosis and management of injuries to the ankle syndesmosis. These types of injuries are seen in 5-10% of ankle sprains and 23% of ankle fractures. The article notes that there is notable disagreement in the medical world on how to best diagnosis and manage these injuries. Treatment can range from conservative to surgical and can include manual reduction, reduction forceps, lag screws, and Kirschner wire fixation.
- An informative review of the anatomy is provided by the authors. They note the syndesmosis maintains the boundaries of the ankle mortise, while allowing rotation, translation, and migration of the fibula. Complex movements of the fibula occur with

various foot positions. The syndesmosis complex includes four ligaments, the interosseous ligament, the anterior inferior tibiofibular ligament, the posterior inferior tibiofibular ligament, and the inferior transverse ligament. The joint receives blood largely by the anterior branch of the peroneal artery which can be damaged with ankle injuries.

- The most common mechanism of injury to this joint is external rotation and hyperdorsiflexion. These injuries are commonly seen with sport mishaps, slips and falls.
- Isolated syndesmotic injuries are commonly referred to as high ankle sprains. When diagnosing these, it is important to obtain a detailed history including the present and past injuries and the mechanism of injuries. Stress tests can assist in establishing the diagnosis. The authors review several such tests including;
 - The external rotation stress test which requires stabilization of the leg with the knee in 90 degrees of flexion while an external rotation load is applied at the foot.
 - The squeeze test is done by compressing the proximal part of the fibula to the tibia resulting in separation.
 - A crossed-leg test requires crossing the injured leg over the uninjured one while seated, then the application of gentle downward pressure to the knee of the injured leg.
 - The forced dorsiflexion test forces the ankle into dorsiflexion, then again while compressing the distal tibia and fibula together. Compression can be done manually or with sport tape. Decreasing pain during compression indicates syndesmotic injury.
- In instances of fracture, syndesmotic stability can be assessed with two common tests during reparative surgery. The hook test is performed by the surgeon using a bone hook to pull the lateral malleolus lateral. Confirmation of movement under fluoroscopy of more than 2 mm is considered positive. The external rotation test is also done under fluoroscopy and involves rotating the foot externally while assessing for an increased medial clear space. The authors report that while both test have excellent interobserver agreement, the sensitivity was poor.
- Conservative treatment options were reported to be most appropriate for isolated syndesmotic injuries and a three phased treatment plan was presented.
 - Phase I - Protection, rest, ice, compression, elevation, along with pain control, limited weight bearing and light ankle motion exercises.
 - Phase II - Strength and proprioceptive exercises with progression from low intensity - high repetition, to high intensity with low repetition exercises.
 - Phase III - Rigorous strength exercise with focus on sport specific needs. Phase III is generally only needed for athletes.

- Ankle fractures with syndesmotom injury have routinely been repaired surgically, however one study found no significant difference between those with syndesmotom fixation and those that had no syndesmotom fixation. Clamps used for reduction prior to screw stabilization can cause rotational misalignment. Standard radiographs and fluoroscopy can not reliably detect such malposition making them a common complication of operative fixation.
- Fixation methods include single or double screws, suture button fixation, or posterior malleolar fixation. There are pros and cons to each technique.
- Conservative treatment outcomes tend to show that syndesmotom sprains have longer healing periods than lateral ankle sprains. In the operative area, the suture button is initially more expensive than the syndesmotom screw fixation; however, screws often need to be removed once healing is accomplished. Besides malreduction other surgical complications include screw breakage, which reportedly occurs in 7% to 29% of screw fixation cases. To avoid this complication, fixation screws are often removed at 6 to 12 weeks. Obese and neuropathic patients have a higher risk of complications. Heterotopic ossification occurs in a large number of patients, especially if fixation was accomplished with bioabsorbable screws.
- The authors conclude that the available data leaves many questions left unanswered, however, it does question the concept of syndesmotom screw fixation as a gold-standard treatment method. The authors provide recommendations with graded evidence:

• Radiographic evaluation is effective in diagnosing moderate to severe syndesmotom injuries, but often fails to detect subtle ones.	B
• It is important to intraoperatively stress all surgically treated ankle fractures to evaluate latent syndesmotom injury.	C
• Patients with distal tibiofibular diastasis and persistent symptoms despite conservative management can benefit from delayed operative treatment.	C
• Posterior malleolar fixation can restore syndesmotom stability.	C
• Anatomic reduction of the syndesmosis may not be reliably determined with intraoperative fluoroscopy or standard radiographs.	C
• Anatomic reduction of the syndesmosis is essential for improving functional outcomes and avoiding posttraumatic osteoarthritis.	C

• Several strategies, such as intraoperative three-dimensional imaging, postoperative computed tomography, and imaging of the contralateral syndesmosis, improve rates of anatomical reduction.	C
• Syndesmotic screw removal may provide immediate improvement to outcome scores, yet screw removal is not without risks.	C
• Use of 3 to 4 quadricortical syndesmotic screws should be considered for patients who are at a higher risk of fixation failure.	I
• Most isolated syndesmotic injuries can be treated conservatively.	I

Grade A indicates good evidence. Grade B, fair evidence. Grade C, conflicting or poor-quality evidence. Grade I, insufficient evidence to make a recommendation

Summary:

This review covered a topic that has not received a lot of attention or high level research. The knowledge provided can assist the chiropractic physician in diagnosing and managing syndesmotic injuries. While this work is very informative, the reader should note that this is not a systematic review, nor should the recommendations be confused with those of properly constructed guidelines. As such, the information and recommendations should be considered in that light and, if possible, compared to higher level quality research sources.

Radiology Corner

Case Presentation-41 Year Old Female with Medial Foot Pain

Cliff Tao DC, DACBR

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A 41 year old female recreational runner complains of left medial foot pain. There is bilateral prominence at the medial aspect of the navicular tarsal on visual inspection, with tenderness and some redness on the left side. Bilateral foot radiographs are taken and the pertinent images are shown in Figure 1. What is your diagnosis?



Figure 1: Bilateral dorsoplantar radiograph of the feet

Diagnosis

Type 2 accessory navicular bone of the left foot, type 3 accessory navicular of the right foot.

Discussion

Accessory navicular bones are the most common accessory bone in the foot, occurring in up to about 20% of the population, and are frequently bilateral. Of the 3 types commonly known and outlined in Table 1, type 2 is associated most frequently with symptoms. The type 2 accessory navicular is formed from an accessory ossification center, which usually ossifies at about 9 to 11 years of age. These are usually triangular in shape and are at least partially united to the navicular by a synchondrosis with hyaline and/or fibrocartilage.

Type 1		• Os tibiale externum • Usually asymptomatic • Sesamoid bone within posterior tibial tendon • 30% of accessory navicular bones
Type 2		• 55% of accessory navicular bones • Most commonly symptomatic • Triangular shaped • Synchondrosis
Type 3		• Cornuate or gorilliform navicular • Prominent navicular tuberosity • May be symptomatic due to bunion formation

Table 1: Types and characteristics of accessory navicular bones.

Symptomatic patients frequently have posterior tibial tendon dysfunction, especially in middle-aged or older patients. Children or early adults with navicular pain from a type 2 accessory navicular bone usually do not have tendon abnormality.

Magnetic resonance imaging (MRI) is generally indicated to evaluate for extent of injury and plan treatment, and to rule out other sources of pain such as posterior tibial tendinopathy, osteonecrosis, or fracture. Marrow edema, greater in the accessory bone than in the navicular tarsal bone is the hallmark finding (Figure 2). Severity of injury increases with synchondrosis

fluid, and with widening of the synchondrosis. Ultrasound is also a useful imaging tool, but only in the skilled operator. Computed tomography (CT) does not offer much benefit over plain radiographs due to limited soft tissue evaluation.

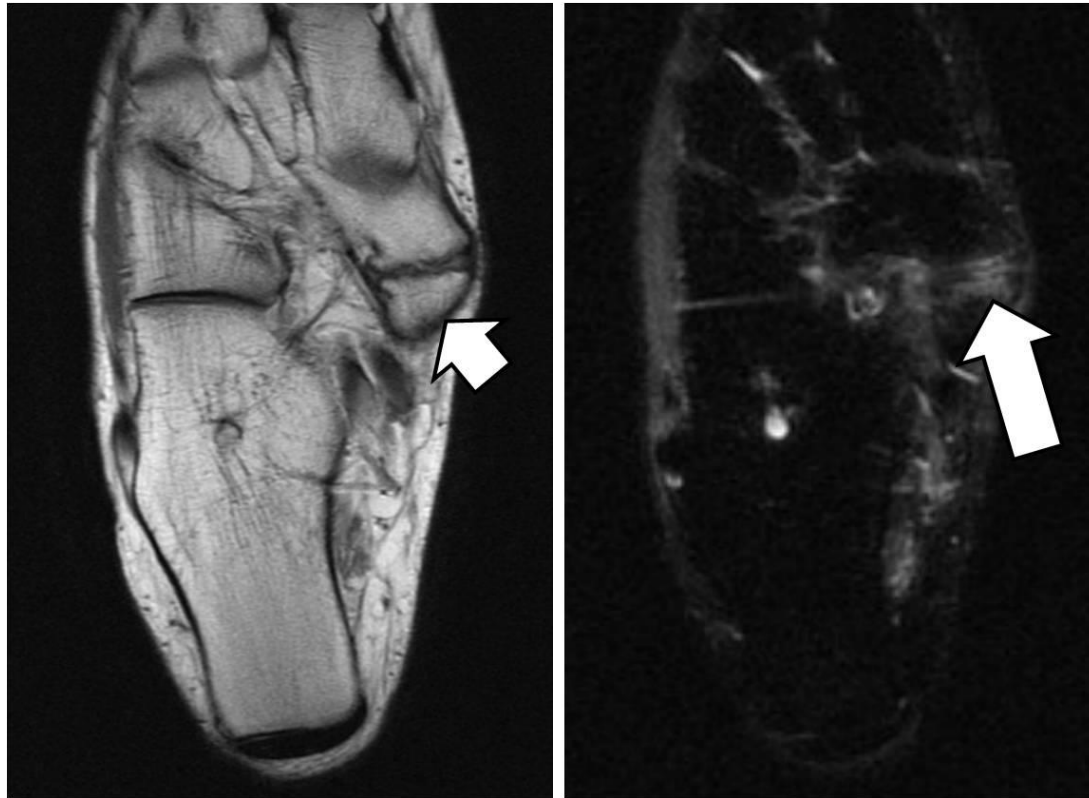


Figure 2: T1 axial (left), short arrow showing type 2 accessory navicular bone, and fat-suppressed T2 axial (right), long arrow showing marrow edema in the accessory bone (different patient than in Figure 1).

Treatment begins conservatively, ranging from just activity modification, to non-weightbearing cast immobilization. Secondary conservative treatment should include chiropractic adjustments and/or manipulations, dietary changes, and pain relief with physiotherapy modalities and/ or medications. Failure of conservative treatment is an indication for surgery, where the ossicle is excised, commonly via the Kidner procedure.

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Ortho Quiz

by Steven L. Kleinfield D.C.,F.A.C.O.

- 1) In this type of fracture, the skin may be pierced by bone or by a blow that breaks the skin at the time of the fracture. The bone may or may not be visible in the wound:
 - a. Oblique fracture
 - b. Compound fracture
 - c. Transverse fracture
 - d. Comminuted fracture
- 2) In this type of fracture, the bone shatters into three or more pieces:
 - a. Oblique fracture
 - b. Compound fracture
 - c. Transverse fracture
 - d. Comminuted fracture
- 3) This type of fracture involves both bones of the forearm. There is usually a displaced fracture of the radius and a dislocation of the ulna at the wrist
 - a. Torus fracture
 - b. Monteggia fracture
 - c. Galeazzi fracture
 - d. Colle's fracture
- 4) This type of fracture involves both bones of the forearm. There is usually a fracture in the ulna and the proximal aspect (head) of the radius is dislocated:
 - a. Torus fracture
 - b. Monteggia fracture
 - c. Galeazzi fracture
 - d. Colle's fracture
- 5) This type of forearm fracture, also known as a buckling fracture has a compressing of one side of the bone which causes the other side to bend away from the growth plate
 - a. Torus fracture
 - b. Greenstick fracture
 - c. Colle's fracture
 - d. Smith's fracture

Current Events

- The Academy of Chiropractic Orthopedists announces the on-line Part I examination dates will be May 19, 2017 and July 20, 2017.
- The Academy of Chiropractic Orthopedists Part II examination will be held in late September or Early October 2017. Part I must be completed before the candidate is eligible to sit Part II. Contact the Academy's executive director Dr. Jerry Wildenauer to obtain the necessary information.

Information about sitting the Board is available from the Executive Director Dr. Jerry Wildenauer.

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Answers to Ortho Quiz

1. **b.** Compound fracture
<http://orthoinfo.aaos.org/topic.cfm?topic=a00139>
2. **d.** Comminuted fracture
<http://orthoinfo.aaos.org/topic.cfm?topic=a00139>
3. **c.** Galeazzi fracture
<http://orthoinfo.aaos.org/topic.cfm?topic=a00039>
4. **b.** Monteggia fracture
<http://orthoinfo.aaos.org/topic.cfm?topic=a00039>
5. **a.** Torus fracture
<http://orthoinfo.aaos.org/topic.cfm?topic=a00039>