The Open Access, Peer-Reviewed and Indexed Publication of the Academy of Chiropractic Orthopedists
September 2017 – Volume 14, Issue 3

Editorial Board
Editor-In-Chief
Shawn M. Neff, DC, MAS, FACO

Managing Editor
Tracey A. Littrell, DC, DACBR, DACO, CCSP

Associate Editors
James Demetrious, DC, FACO
David Swensen, DC, FACO
Alicia M. Yochum, RN, DC, DACBR, RMSK

Current Events Editor
James R. Brandt, DC, MS, FACO

Editorial Advisory Board
James R. Brandt, DC, MS, FACO
Ronald C Evans, DC, FACO
James Demetrious, DC, FACO
Michael Henrie, DO
Robert Morrow, MD
Bruce Gunderson, DC, FACO

Editorial Review Board
Scott D. Banks, DC MS
Thomas F. Bergmann, DC
Jeffrey R. Cates, DC, FACO
Donald S. Corenman, MD, DC, FACO
Anthony Vincent D’Antoni, MS, DC, PhD
Daniel P. Dock, DC, FACO
Simon John Forster, DC, DABCO
Evan M. Gwilliam, DC, MBA
Nathan Hinkeldey, DC, DACRB
Charmaine Korparaal, M.Tech: Chiropractic
Thomas Mack, DC, FACO
Loren C. Miller DC, FACO
Raymond S Nanko, DC, MD, DAAPM, FACO
Casey Okamoto, DC
Gregory C. Priest, DC, FACO J
Chris Romney, DC, FACO
Stephen M. Savoie, DC, FACO
Brandon Steele, DC
David Swensen, DC, FACO
John M. Ventura, DC, FACO
Michael R. Wiles, DC, Med, MS
Steve Yeomans, DC, FACO
Ward Beecher, D.C., FACO
Gary Carver, DC, FACO
Rick Corbett, DC, DACBR, FCCO(C)
Clinton Daniels, DC, MS, DAAPM
James Demetrious, DC, FACO
Neil L. Erickson, DC, DABCO, CCSP
Jaroslaw P. Grod, DC, FCCS(C)
Tony Hamm, DC, FACO
Dale Huntington, DC, FACO
Ralph Kruse, DC, FACO
Joyce Miller, DC, FACO
William E. Morgan, DC, DAAPM
Deanna O'Dwyer, DC, FACO
Joni Owen, DC, FACO
Christopher Roecker, DC, MS, DACO, DACSP
Roger Russell, DC, MS, FACO
Alec Schielke, DC
John Stites, DC, DACBR, DABCO
Cliff Tao, DC, DACBR
Michelle A Wessely BSc, DC, DACBR
James A. Wyllie, DC DABCO
Alicia M. Yochum, RN, DC, DACBR, RMSK

Articles, abstracts, opinions and comments appearing in this journal are the work of submitting authors, have been reviewed by members of the editorial board and do not reflect the positions, opinions, endorsements or consensus of the Academy.
Editor's Desk

❖ Shawn M. Neff, DC, MAS, FACO

Original Articles


Abstracts and Literature Review


Radiology Corner


Ortho Quiz

❖ Kleinfield SL: Ortho Quiz. JACO 2017, 14(2):49

Current Events

❖ Conferences

Answers to Ortho Quiz

❖ Check your knowledge on page 51
Welcome to the September 2017 issue of the Journal of the Academy of Chiropractic Orthopedists. As summer draws to a close and fall is upon us, we get back to the normal routine of daily life and thoughts start to shift towards the holidays of fall and winter. This is also a wonderful time to reach out to me if you have an interest in submitting a manuscript for the December 2017 or March 2018 issues of JACO.

If you are new to writing for professional journals or have an idea but would like to partner with a more seasoned chiropractic researcher/writer, you should certainly take advantage of the program we have that pairs you with a member of our editorial board as a coauthor. This is a fantastic way to move that case you think should be published from your to-do-list to the pages of a peer reviewed journal. This service is currently free to our readers.

I hope you all enjoy this issue. It is full of useful information to inform your practice.

Sincerely,

-Shawn
**Chiropractic Management of Non-cardiac Chest Pain and Posterior Rib Misalignment: A Case Report**

Chad M. Hagen, DC\(^1\), Julie A. Hartman, DC, MS, DICCP, CCRP\(^2\)

chad.hagen@palmer.edu, julie.hartman@palmer.edu

\(^1\)Instructor, Palmer College of Chiropractic, Davenport, Iowa

\(^2\)Project Manager, Palmer Center for Chiropractic Research, Davenport, Iowa

Published: September 2017
*Journal of the Academy of Chiropractic Orthopedists*
September 2017, Volume 14, Issue 3

This is an Open Access article which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The article copyright belongs to the author and the Academy of Chiropractic Orthopedists and is available at: [http://www.dcortheacademy.com](http://www.dcortheacademy.com). © 2017 Hagen/Hartman and the Academy of Chiropractic Orthopedists.

**Abstract**

Objective: The purpose of this case report is to describe the resolution of non-cardiac related chest pain in a patient with costovertebral joint dysfunction using the sacro occipital technique.

Clinical Features: A 66 year-old Caucasian male presented with chest pain rated 8 of 10 on Numeric Rating Scale (NRS) and exacerbated with inspiration. Case history and physical examination were performed which revealed no indications of acute myocardial infarction (AMI). Sacro occipital technique trapezius fiber analysis and palpation were used to localize a left costovertebral joint fixation at T6 and associated trigger point superficial to the articulation.

Intervention and Outcome: The patient was treated using a modified anterior thoracic adjustment with the contact hand placed under the rib articulation as A to P thrust was administered. The patient reported pain rated 2 out of 10 on the NRS at post-evaluation the following day. Exam revealed restored motion to the T6 costovertebral articulation on inspiration and exhalation with a decrease in pain and tenderness of the trapezius fiber.

Conclusion: This case report describes the chiropractic management of a 66 year-old male with a complaint of non-cardiac chest pain resulting from a costovertebral joint misalignment.
Key Words (MeSH terms)
Chiropractic, chest pain, rib misalignment, sacro occipital technique

Introduction

When a patient presents to any health care provider with a complaint of chest pain the priority is to rule out life-threatening conditions. In 2008, the Center for Disease Control reported that chest and abdominal pain were the most common reasons for emergency department (ED) visits for persons 15 years and older.\(^1\) Chest pain specifically is the second most common reason for ED visits (more than 4 million visits per year).\(^2\) Cardiac disease is the primary concern, but after a thorough history and examination (including temperature, heart rate, respiration, and bilateral blood pressure) about 50\% of cases appear to be non-cardiac in nature.\(^3\)\(^;\)\(^2\) It is not surprising that nonspecific chest pain was also the most common reason for discharges from the ED in adults over age 45.\(^4\)

The patients who have had acute myocardial infarction (AMI) ruled out often are discharged without a specific diagnosis. The term chest wall syndrome (CWS) has been used as a type of diagnosis by default, or when life-threatening conditions have been ruled out.\(^5\) Other terms that have been used to describe this type of chest pain include costochondritis, anterior chest wall syndrome, atypical chest pain, rib dysfunction, Tietze’s syndrome, painful rib syndrome and musculoskeletal chest pain.\(^5\)\(^;\)\(^6\) Even though these are relatively benign conditions, patients with these diagnoses experience impairment in daily activities, emotional distress and anxiety, and frequent contact with the health care system.\(^5\)\(^;\)\(^7\) The estimated cost in the Unites States for patients who are suspected of having AMI but instead are diagnosed with a benign condition is approximately $8 billion annually.\(^8\)

Musculoskeletal conditions may represent an underdiagnosed etiology of non-cardiac chest pain.\(^7\) Segmental dysfunction of the lower cervical and upper thoracic spine (C4-T8) has been demonstrated to refer pain to portions of the anterior chest wall.\(^9\)\(^;\)\(^10\) Additionally, rib dysfunction is recognized as a source of chest wall pain as the ribs articulate posteriorly at the costovertebral articulations and anteriorly at costosternal articulations.\(^6\) Compared to the body of literature surrounding low back pain and neck pain, there is relatively little evidence to guide the management of musculoskeletal thoracic spine or chest wall pain.\(^10\)

The purpose of this case report is to describe the resolution of non-cardiac chest pain in a patient with costovertebral joint dysfunction using the sacro occipital technique.

Clinical Presentation
A 66 year-old Caucasian male presented to a private chiropractic clinic with a complaint of chest pain rated at 8 out of 10 on a numeric rating scale (NRS) and was exacerbated with inspiration. He was an established chiropractic patient that denied new trauma or illness prior to the onset of chest pain, which occurred one day prior to seeking evaluation. The patient was employed as a machinist for a local energy company, a physical job often necessitating body contortion to accommodate various welding jobs. He reported a past medical history of smoking 24 pack years, and a diagnosis of prostate cancer which was successfully treated and in remission for 1 year. The patient had no history of heart disease or other risk factors and maintained a healthy weight.

Upon examination the patient had blood pressure and pulse within normal limits and no shortness of breath was noted. Pain was exacerbated with full inspiration but not with increased activity. No other indications of acute myocardial infarction (AMI) were observed.

Palpatory examination revealed point tenderness and a palpable trigger point on the left 6th costosternal articulation and decreased motion of the 6th rib with inspiration and exhalation (Figure 1). Sacro occipital technique trapezius fiber analysis was also used to locate a posterior rib fixation via a nodule on Fiber 4 (Figure 2).

**Treatment Intervention**

Treatment for this patient consisted of a modified anterior thoracic adjustment to mobilize the rib fixation at T6. The patient was instructed to use ice in the event of exacerbation. The patient returned the following day for re-evaluation. He reported diminished chest pain rated 2 out of 10 on the NRS with no pain upon inspiration and no further exacerbations. Point tenderness over the T6 costosternal joint was decreased and motion of the posterior rib was notably improved. Sacro occipital technique trapezius fiber analysis was performed with noted reduction in pain and size of nodule at Fiber 4 on the left. No additional manipulations were performed at follow up visit.
At the time of publication, 15 months had passed since the initial onset with no recurrence of chest pain or signs of costovertebral joint dysfunction. The patient was, and continues to be under regular chiropractic care with office visits averaging every 2 to 4 weeks.

Discussion

As AMI can be life-threatening, it is paramount that a proper history and examination be performed to rule out cardiac causes of chest pain. Only then should musculoskeletal etiologies be explored. Galinski et al examined pain severity in patients with AMI. They found no relationship between pain severity and AMI in patients arriving at the ED with chest pain, indicating pain severity alone is not useful when ruling out cardiac causes of chest pain. Typically, protocols for ruling out AMI do not lead to a specific diagnosis, but suggest a musculoskeletal cause of pain. In another study that examined a diagnostic decision making process, the main indicators for musculoskeletal chest pain were absence of cardiac findings, items from case history and pain upon chest wall palpation. It is important to note that an earlier study found chest wall palpation was not a reliable diagnostic tool alone. However, when used in combination with case history and full examination, palpation was an additional component in making a diagnosis of musculoskeletal chest pain.

Another type of palpation that was used in the diagnosis of this patient was sacro occipital technique trapezius fiber analysis. Major Bertrand DeJarnette, an engineer, osteopath, and chiropractor, discovered and developed sacro occipital technique. DeJarnette examined the body as a whole structure and created categories based on imbalance. Sacro occipital technique also uses a variety of diagnostic systems such as occipital fibers and trapezius fibers. The practitioner palpates these fibers for nodules which are theorized to correspond with areas of the body in dysfunction. While sacro occipital technique has various unique adjusting methods, it is not limited to any one specific osseous correction. In this particular case, the chiropractor used sacro occipital technique trapezius fiber analysis in addition to joint motion palpation, physical examination, and patient history to make a diagnosis. Sacro occipital technique trapezius fiber analysis was also used as an outcome measure, in addition to NRS.

Treatment of rib dysfunction has also been documented by manual therapists in other health care professions. Germanovich and Ferrante described osteopathic treatment of rib dysfunction in a case series of 3 patients who presented with symptoms similar to those of the patient described in this case report. First they were treated with an ultrasound-guided intercostal nerve block at the level of dysfunction to prevent pain and guarding. Once the nerve block was administered, osteopathic manipulation was used for a manual reduction of the rib. The combination of treatments was more effective for long term relief than monotherapy.

A 2015 systematic review of noninvasive musculoskeletal thoracic spine or chest wall pain management found evidence to support inclusion of chiropractic treatment in the management of MSK chest pain. Patients who received multimodal care (chiropractic treatment and patient
education) were 40% more likely to report clinically important improvements in their chest pain. The authors concluded combined efforts from cardiology and chiropractic in a multidisciplinary approach could help to provide a better understanding of benign chest pain, improve patient outcomes, and lead to faster recovery. Cost analysis of chiropractic treatment of patients with non-cardiac chest pain illustrated lower overall hospital and healthcare services in the group that received chiropractic care compared with patients in the self-management group.

The exact mechanism by which manipulative therapy may decrease non-cardiac chest pain is not entirely clear. The authors suggest a misalignment at the costovertebral joint can cause biomechanical stress at the corresponding costosternal joint, which is perceived as chest wall pain by the patient. Future studies are needed to examine the potential for improved outcomes in patients discharged from EDs who are referred for chiropractic care and the impact of chiropractic management of CWS.

**Limitations**

As this is a single case report, generalized conclusions cannot be drawn from this patient to others presenting with non-cardiac chest pain resulting from costovertebral joint dysfunction. Additionally, there has been no follow-up beyond 15 months and it remains unclear whether or when the patient’s pain might recur. A larger scale study would be needed to make determinations regarding efficacy, safety, or cost-effectiveness of the treatment described.

**Conclusions**

This case report describes the chiropractic treatment of a 66 year-old male with a complaint of non-cardiac chest pain resulting from costovertebral joint dysfunction. Once AMI was ruled out, chiropractic evaluation was utilized to find costovertebral fixation. Costovertebral fixation was found to correspond with the costosternal joint at which the patient had experienced chest pain. The patient experienced resolution of chest pain within 24 hours of costovertebral joint mobilization.

**Consent**

Written informed consent was obtained from the patient for publication of this case report. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

**List of Abbreviations**

AMI—Acute myocardial infarction
CWS—Chest wall syndrome
ED—Emergency department
NRS—Numeric rating scale

Competing Interests
The authors declare that they have no competing interests.

References


Original Article

An Evidence-Based Approach to the Orthopedic Physical Exam – Part 3: The Head, Neck, and Thoracic Spine

Christopher B. Roecker, DC, MS, DACO¹, Casey S. Okamoto, DC²

¹Assistant Professor, Palmer College of Chiropractic Life Science & Foundations Department
² Doctor of Chiropractic, VA Medical Center Minneapolis, MN

Published: September 2017
Journal of the Academy of Chiropractic Orthopedists
September 2017, Volume 14, Issue 3

This is an Open Access article which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The article copyright belongs to the author and the Academy of Chiropractic Orthopedists and is available at: http://www.dcorthoacademy.com, © 2017 Roecker/Okamoto and the Academy of Chiropractic Orthopedists.

Abstract

Head, neck, and thoracic spine-related disorders are frequent causes of neuromusculoskeletal complaints. Establishing an accurate diagnosis for these conditions is expected to guide clinical management and improve patient care. This narrative review of the literature will provide an overview of the evidence-based orthopedic physical exams for many head, neck, and thoracic spine-related disorders. We have highlighted orthopedic physical exams that have demonstrated the highest diagnostic utility and pointed out when no such test exists. We encourage clinicians to utilize the best available orthopedic tests in an attempt to maximize their diagnostic accuracy and provide optimal patient care.

Key Words (MeSH terms)

Evidence Based Practice; Chiropractic; Spine; Differential Diagnosis; Pain, Neck; Pain, Back; Cervical Radiculopathy; Injuries, Whiplash

Introduction

Evaluating patients for the presence of an orthopedic condition is a complex process. This process requires clinicians to collect information from the patient’s history and combine it with
information from the physical exam. The clinician selects from a variety of orthopedic physical exams, applying those with the highest utility based on the patient’s unique presentation.\(^1\) By selecting useful orthopedic tests, the clinician can rule in or rule out a given condition, narrowing the list of differential diagnoses. Unfortunately, not all orthopedic tests aid in quality patient assessment; some have been shown to provide useful information, while others have been shown to provide misleading or confusing information. Additionally, many orthopedic tests have yet to be evaluated and their clinical utility remains unknown.

When orthopedic tests are evaluated for usefulness, results are compared to more complex procedures, such surgery or advanced imaging, and a variety of diagnostic test parameters are provided. These results have traditionally been reported via sensitivity, specificity, or positive and negative predictive values.\(^2\) It has been noted that these types of tests do not always translate well into clinical practice.\(^3\) Why these test results do not translate well into practice is not well understood, but it may be due to the cumbersome nature of having to known multiple test statistics, as with sensitivity and specificity, or that statistics such as positive or negative predictive values require clinicians to be aware of the underlying prevalence of disease.\(^3\)

Fortunately, there is a test statistic that allows clinicians to move beyond sensitivity and specificity or positive and negative predictive values, helping clinicians to quickly understand the usefulness of an orthopedic test; these test results are likelihood ratios. Likelihood ratios incorporate and orthopedic test's sensitivity and specificity into a single, easy to use, number.\(^1\) If a test result is positive, the positive likelihood ratio (LR+) is used, and when a test is negative, the negative likelihood ratio (LR-) is used. In short, the tests with the most usefulness have a high LR+ and/or a low LR-.\(^1, 4\) Table 1 provides an overview on interpretation of positive and negative likelihood ratios. The current transformation of healthcare towards an evidence-informed model, discussed in Parts 1 and 2 of this 4-part series, has correlated with an increase in the reporting and use of likelihood ratios for orthopedic exams.

### Table 1: Interpreting Likelihood Ratios

<table>
<thead>
<tr>
<th>Interpretation</th>
<th>LR+</th>
<th>LR-</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Very useful</strong> -- yield large and often conclusive shifts in probability</td>
<td>&gt;10</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td><strong>Moderately useful</strong> -- yield substantial shifts in probability</td>
<td>5 - 10</td>
<td>0.1 - 0.2</td>
</tr>
<tr>
<td><strong>Rarely useful</strong> -- yield small shifts in probability</td>
<td>2 - 5</td>
<td>0.2 - 0.5</td>
</tr>
<tr>
<td><strong>Not useful</strong> -- yield unimportant shifts in probability</td>
<td>1 - 2</td>
<td>0.5 - 1.0</td>
</tr>
</tbody>
</table>
The purpose of this article is to provide an overview of the various orthopedic physical exam procedures used for assessment of head, neck, and thoracic spine conditions, to report when no such tests exist, and to inform of commonly used tests have yet to establish diagnostic utility.

Methods

This project is a narrative review of the evidence-based orthopedic physical exams reported to be used in the evaluation of head, neck, and thoracic spine-related disorders. Information used to write this article was collected from various sources, listed in Table 2. As the aim of this narrative review was to focus on background information, authoritative textbooks on the topic of evidence-based orthopedic exams were emphasized. The original source articles were obtained when additional information was needed and to verify information. All sources were assessed for quality using a QUADAS grading system. When multiple sources existed for a particular test, we reported information from the article with the highest QUADAS scores. Additionally, we used the iOS application titled CORE Orthopedics by Clinically Relevant Technologies to assist in our review of the literature; this was chosen because it has the ability to link a wide-variety of orthopedic exam procedures with their original source articles, via hyperlinks to the associated articles on PubMed.gov, which expedited the process of identifying source data for the orthopedic exams discussed in this narrative review.

Table 2 – Sources Used for this Narrative Review

<table>
<thead>
<tr>
<th>Source</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinically Relevant Technologies, CORE</td>
<td>Clinical ORthopedic Exam, version 5.3.3, iOS application, last updated on October 20, 2015</td>
</tr>
<tr>
<td>Cook CE, Hegedus EJ.</td>
<td>Orthopedic Physical Examination Tests: An Evidence-Based Approach, 2nd Ed. Indianapolis, IN. Pearson Education; 2013</td>
</tr>
</tbody>
</table>
Discussion

Unsurprisingly, there exists a wide range of orthopedic physical exam procedures with equally wide-ranging measure of clinical utility (levels of usefulness). While orthopedic test results may appear to be straightforward, reported as positive or negative, such dichotomous results are overly simplistic. Orthopedic tests do reveal positive or negative findings, but the degree of accuracy varies from test-to-test and the assumption of uncertainty should be considered in clinical practice.\(^5\)

Much has been written on the complexities surrounding the management of spine-related disorders. This article will present an approach to the diagnosis and management of head, neck, thoracic spine, and upper extremity conditions that are related to the spine, based upon the Clinical Reasoning in Spine Pain (CRISP) model reported by Murphy.\(^6,7\)

**Introduction to the Clinical Reasoning in Spine Pain Approach**

The Clinical Reasoning in Spine Pain (CRISP) approach to caring for patients with spine pain is intended to provide a framework for evaluating patients to arrive at an accurate diagnosis and understand contributions to the patient’s experience. Three questions are used to aid the practitioner in arriving at an accurate understanding of the patient’s condition:\(^7\)

1. Do the patient’s symptoms reflect a visceral disorder or life-threatening pathology?
2. What is the origin of the pain?
3. Is anything happening to this person, as a whole, that may alter the patient’s pain experience?

**Do the symptoms reflect a visceral disorder or life-threatening pathology?**

Due to the potential lethality of failing to recognize a visceral disorder or serious pathology, it is sound judgement to rule out these “red flags” prior to moving on to a neuromusculoskeletal cause of the patient's pain. Table 3 provides an overview of the red flags that may be associated with head, neck, or thoracic spine pain.

<table>
<thead>
<tr>
<th>Condition and Associated Clinical Features</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Neoplasia</td>
<td>Infection</td>
</tr>
<tr>
<td>• Past cancer diagnosis</td>
<td>• Fever and/or chills</td>
</tr>
</tbody>
</table>

Table 3: Features That Indicate a Serious Pathology May Be causing Head, Neck, or Thoracic Spine Pain
Pain that awakens the patient from sleep  
No position of relief  
Fever  
Cachexia  
Constitutional signs or symptoms  
Point tenderness  
Immunosuppression  
Pain upon percussion  
Cervical Artery Dysfunction / Dissection  
History of neck trauma  
Severe neck pain, particularly in the occipitocervical region, that is sudden, severe, and sustained  
Vertigo  
Diplopia  
Dizziness  
Drop attack  
Dysarthria  
Dysphagia  
Ataxia  
Numbness  
Nausea  
Nystagmus  
Sudden onset of severe headache  
(“thunderclap” or the “worst headache I’ve ever had”)  
Limited cervical spine flexion on examination  
Neck pain or stiffness  
Loss of consciousness  
Vomiting  
Onset during exertion  
History of hypertension  
Fracture  
History of acute trauma  
Reduced bone mineralization (osteoporosis)  
Point tenderness  
Pain upon percussion  
Meningitis  
Headache  
Fever  
Nuchal rigidity  
Photophobia  

Cervical Artery Dysfunction

Cervical artery dysfunction (CAD) is a general term used to represent a range of pathologies that may produce cervico-cranial ischemia. Much debate and confusion exists regarding the safety and utility of orthopedic test (AKA provocative exams) for the evaluation of cervical artery dysfunction. While several exams have been reported to evaluate for CAD, these exams have either never been studied to establish diagnostic utility, or have been shown to have no clinical usefulness (e.g. +LR = 0).

Many of the exams that report to evaluate for CAD involve placing physical stress on the arteries of the cervical spine (e.g. end-range motion). Placing additional stress on potentially damaged or dysfunctional cervical arteries may worsen a potentially life-threatening clinical situation. The
lack of established benefit, combined with a potential for harm, leads us to recommend against performing orthopedic exams for the evaluation of CAD. Patients presenting with signs and symptoms that are suggestive of CAD should be referred for medical evaluation. Please see the “Cervical Artery Dysfunction / Dissection” section of Table 3 for a review of the signs and symptoms associated with CAD.\(^9\)

Canadian C-Spine Rule

The Canadian C-Spine Rule is a highly sensitive (98-100% sensitive) decision rule that is used to determine when cervical spine radiography is not necessary in an alert and stable trauma patient.\(^10\) This brief algorithm (see Figure 1) has been validated to provide high-quality information related to determining the need for cervical spine radiography.\(^11\) Because this decision rule is intended to help clinicians decide when radiography is not necessary, the focus of this test is on its negative likelihood ratio (LR-). Remember, a low LR- (<0.1) is most useful and the Canadian C-Spine Rules demonstrate an average LR- = 0.18.\(^11,12\) It should be pointed out that this decision rule should not be used in patients with any of the following: a Glasgow Coma Scale score <15, unstable vital signs, age <16 years, acute paralysis, known vertebral disease, past cervical spine surgery, or pregnancy. Also, this decision rule does not consider “simple motor vehicle collision” to include: being hit by a large truck, rollover accidents, being hit by a high speed vehicle, or being pushed into oncoming traffic.\(^10\)

Figure 1. Canadian C-Spine Rules*
*Please review the details regarding when this decision rule should not be utilized in the source article or in the paragraph above.

**Spinal Percussion Test**

Spinal percussion is a simple test that is used to evaluate for spinal fractures. This test has been evaluated for its utility in the identification of acute osteoporotic vertebral body compression fractures and has been shown to have a sensitivity of 87.5% and a specificity of 90%, which equates to a LR$^+$ = 8.7 as well as a LR$^-$ = 0.14.$^{13}$ These diagnostic statistics are encouraging and support the inclusion this quick, simple, and accurate test for the evaluation of suspected vertebral body compression fractures.

**What is the pain’s origin?**

Categories of Head, Neck, and Thoracic Spine Disorders include disc derangement, joint dysfunction, radiculopathy, myelopathy, and myofascial pain syndrome (trigger points).$^7,13$

**Patient History for Cervical Spine Conditions**

The patient’s clinical presentation serves to narrow the list of possible causative conditions; therefore, narrowing the list of relevant orthopedic tests. Table 4 provides an overview of the patient’s history and the associated category of pain generating condition (initial hypothesis).

**Table 4: Patient History and Initial Hypotheses**

<table>
<thead>
<tr>
<th>History</th>
<th>Initial Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diffuse neck pain that is nonspecific and exacerbated upon neck movement</td>
<td>Joint dysfunction</td>
</tr>
<tr>
<td></td>
<td>Cervical muscle strain or sprain</td>
</tr>
<tr>
<td>Traumatic onset of neck pain, exacerbation when vertical, relief with</td>
<td>Cervical spine instability$^{14}$</td>
</tr>
<tr>
<td>external support or when unloaded (supine), dysesthesias of the face</td>
<td></td>
</tr>
<tr>
<td>upon neck movement, muscle spasm</td>
<td></td>
</tr>
<tr>
<td>Neck pain in a younger patient, made worse by static postures, commonly</td>
<td>Disc derangement$^7$</td>
</tr>
<tr>
<td>lower cervical flexion, and improved with movement</td>
<td></td>
</tr>
<tr>
<td>Neck pain combined with unilateral paresthesia into the upper extremity</td>
<td>Cervical radiculopathy</td>
</tr>
</tbody>
</table>
Neck pain combined with bilateral upper extremity motor and sensory symptoms, possible lower extremity ataxia | Cervical myelopathy
---|---
Diffuse pain of an achy quality that may radiate between the periscapular region, shoulder, neck, and head | Myofascial pain syndrome (trigger points)
Neck and/or upper thoracic spine pain, anterior head carriage, forward rounded shoulders, | Upper crossed syndrome


**Facet Syndrome**

The zygapophyseal or facet joints are estimated to drive between 36% to 55% of axial neck pain.\(^{15-17}\) The prevalence could be as high as 60% in cases of whiplash associated disorders (WAD).\(^{18}\) A zygapophyseal joint is composed of an inferior and superior articular process, articular cartilage, a joint capsule and synovial membrane, menisci, and fibrous or fatty inclusions called meniscoids.

Facet mediated pain is caused by trauma to the zygapophyseal joint or to degenerative changes. Trauma may cause compression of the zygapophyseal joint and articular cartilage or stretch of the joint capsule beyond its physiological limit. Likewise intervertebral disc degeneration and associated loss of disc height can result in disproportionate stress on the zygapophyseal joints, leading to cartilage degeneration and osseous proliferation. In some patients the meniscoids, fibrous folds of synovial membrane, can become trapped between the zygapophyses causing a painful locking sensation.\(^{19}\) Pain referral patterns for the cervical spine are shown in Figure 2 and for the thoracic spine in Figure 3.

Though many orthopedic tests for the cervical spine apply compressive, distractive, torsional, and shearing forces to the zygapophyseal joints, they do so incidentally while testing for other pathology (e.g., nerve compression). To our knowledge no specific orthopedic tests have been shown to be accurate in diagnosing zygapophyseal joint pain. Murphy suggests four tests that may be clustered with the aim of increasing diagnostic utility.\(^{7}\)

- Palpation for segmental tenderness (PST)
- Manual joint palpation (MJP)
- Extension-Rotation Test - applied in the mid- and lower cervical spine
- Flexion-Rotation Test - applied in the upper cervical spine
Figure 2. Referred Pain Patterns for the Cervical Zygaphophyseal Joints


Figure 3. Referred Pain Patterns for the Thoracic Zygaphophyseal Joints

Figure adapted from Dreyfuss P, Tibiletti C, Dreyer SJ. Thoracic zygaphophyseal joint pain patterns. A study in normal volunteers. Spine. 1994 Apr 1;19(7):807–11.
The zygapophyseal joints have been demonstrated to produce specific referral patterns when injected with contrast medium or when the dorsal rami innervating the joint are electrically stimulated. Such referral patterns, either revealed as part of the history or elicited during provocative maneuvers, may be considered when making a diagnosis.

Cervical Instability

Instability of the cervical spine is a poorly-defined set of conditions that involves ligamentous, muscular, or bony disturbances. Cervical instability involves tissue injury, which reduces the ability of the spine to maintain its normal anatomical relationships and protect the underlying neurological structures. While acute trauma or degenerative changes are common cause of cervical instability, it is important to remember instability may be associated with other mechanisms. Clinicians should stay mindful that developmental anomalies, such as Down syndrome, or inflammatory conditions, such as rheumatoid arthritis, are also associated with atlanto-axial instability. Table 5 provides an overview of the orthopedic tests reported to evaluate for cervical spine instability.

Table 5: Orthopedic Tests for Cervical Instability

<table>
<thead>
<tr>
<th>Test</th>
<th>+LR</th>
<th>-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified Sharp-Purser Test(^{23})</td>
<td>17.3</td>
<td>0.32</td>
</tr>
<tr>
<td>• Tested for atlantoaxial instability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alar Ligament Stability Test(^{24})</td>
<td>Left = 18</td>
<td>Left = 0.29</td>
</tr>
<tr>
<td></td>
<td>Right = as high as possible (∞)</td>
<td>Right = 0.31</td>
</tr>
<tr>
<td>Anterior Stability Test (of the atlanto-occipital joint)(^{24})</td>
<td>65</td>
<td>0.35</td>
</tr>
<tr>
<td>Tectorial Membrane Test(^{24})</td>
<td>94</td>
<td>0.06</td>
</tr>
<tr>
<td>Posterior Atlanto-Occipital Membrane Test(^{24})</td>
<td>As high as possible (∞)</td>
<td>0.04</td>
</tr>
</tbody>
</table>
Whiplash Associated Disorders

Whiplash Associated Disorders (WAD) refer to injuries of the neck caused by an acceleration/deceleration injury. WAD injuries are chiefly associated with neck pain but sequelae may also include dizziness, upper extremity pain and paresthesia, and headache. It has been estimated that 300 per 100,000 people are seen in United States and Australian emergency departments for WAD each year, most of which occur following a motor vehicle accident (MVA). It is thought that symptoms are more likely the result of sprains and strains of neck ligaments and muscles rather than trauma to the zygapophyseal joints and intervertebral discs, though this does likely occur.

Whiplash Associated Disorders are diagnosed and graded based on the presence of symptoms and physical exam findings. Table 6 provides an outline of the criteria for each of the WAD grades.

Table 6: Whiplash Associated Disorder Grading

<table>
<thead>
<tr>
<th>Grade 0 WAD</th>
<th>No neck complaints and no physical signs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I WAD</td>
<td>Injuries involving complaints of neck pain, stiffness, or tenderness, without physical signs.</td>
</tr>
<tr>
<td>Grade II WAD</td>
<td>Neck complaints accompanied by decreased range of motion and point tenderness</td>
</tr>
<tr>
<td>Grade III WAD</td>
<td>Neck complaints accompanied by neurologic signs (e.g., decreased or absent myotatic reflexes, weakness, or sensory deficits)</td>
</tr>
<tr>
<td>Grade IV WAD</td>
<td>Neck complaints accompanied by fracture or dislocation</td>
</tr>
<tr>
<td></td>
<td>Attendant symptoms such as deafness, dizziness, tinnitus, headache, memory loss, dysphagia, and temporomandibular joint pain can be present in all grades.</td>
</tr>
</tbody>
</table>

Disc Derangement

Disc derangement is a cause of discogenic pain. Static postures can place asymmetrical loads on the nucleus pulposus, resulting in relative displacement of the intradiscal material. Such an asymmetry may result in stiffness and pain upon movement in a given direction and could predispose or exacerbate tearing of the annulus fibrosus, the outer ⅓ of which is highly innervated.

Disc derangement is diagnosed based on a combination of historical factors and an end-range loading (ERL) exam. Patients with a disc derangement will often present with pain that is worse in the morning, improving toward mid-day and with movement. Younger people are more likely to experience a disc derangement as their discs are richer in hydrophilic proteoglycans and are thus better able imbibe fluid, resulting in a higher intradiscal pressure. The pain is provoked by static postures, most commonly lower cervical flexion but possibly others depending on the orientation of the derangement.

An ERL exam refers to the active and sometimes passive loading of the cervical spine in extension, flexion, lateral bending, rotation, protraction, and retraction in order to discern a direction of benefit and a direction of detriment. Once a direction of benefit has been identified the spine is repeatedly loaded in that direction with the goal of diminishing symptom severity or moving the symptoms nearer to midline (i.e., centralization). The ERL exam uses a progression of force from least to most invasive, allowing for active loading prior to passive (clinician assisted) loading.  

Radiculopathy

A herniated nucleus pulposus (HNP) is the most common cause of cervical spine radiculopathy and the C6 and C7 nerve roots are the most commonly involved nerve roots at 60% and 25%, respectively. Acute trauma to the brachial plexus or nerve roots may also produce upper extremity radiculopathy, such as in the case of a “burner” or a “stinger,” following traumatic depression of the shoulder.

There are several orthopedic tests that reportedly test for upper extremity radiculopathy. Many have been evaluated to establish their diagnostic utility, but others have not. Table 7 outlines many of the orthopedic tests that are commonly reported to evaluate for cervical radiculopathy.

Table 7: Orthopedic Tests for Cervical Radiculopathy

<table>
<thead>
<tr>
<th>Test</th>
<th>+LR</th>
<th>-LR</th>
</tr>
</thead>
</table>

21
<table>
<thead>
<tr>
<th>Test</th>
<th>Left</th>
<th>Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spurling’s Compression Test(^{29})</td>
<td>4.9</td>
<td>0.69</td>
</tr>
<tr>
<td></td>
<td>4.5</td>
<td>0.66</td>
</tr>
<tr>
<td>Valsalva Maneuver(^{30})</td>
<td>3.67</td>
<td>0.82</td>
</tr>
<tr>
<td>Brachial Plexus Compression Test(^{31})</td>
<td>4.1</td>
<td>0.37</td>
</tr>
<tr>
<td>Cervical Hyperflexion Test(^{30})</td>
<td>1.51</td>
<td>0.27</td>
</tr>
<tr>
<td>Cervical Hyperextension Test (Jackson’s Test)(^{32})</td>
<td>2.7</td>
<td>0.81</td>
</tr>
<tr>
<td>Cervical Distraction Test(^{29})</td>
<td>As high as possible ((\infty))</td>
<td>0.6</td>
</tr>
<tr>
<td>Upper Limb Tension Test A (median nerve bias)(^{30})</td>
<td>1.24</td>
<td>0.14</td>
</tr>
<tr>
<td>Upper Limb Tension Test B (radial nerve bias)(^{30})</td>
<td>1.07</td>
<td>0.84</td>
</tr>
<tr>
<td>Shoulder Abduction Test(^{29})</td>
<td>Left = 2.2</td>
<td>Left = 0.71</td>
</tr>
<tr>
<td></td>
<td>Right = 1.9</td>
<td>Right = 0.77</td>
</tr>
<tr>
<td>Quadrant Test</td>
<td>Untested</td>
<td></td>
</tr>
<tr>
<td>Shoulder abduction test (Bakody Sign)</td>
<td>Untested</td>
<td></td>
</tr>
<tr>
<td>Cervical Compression Test (Foraminal Compression Test)</td>
<td>Untested</td>
<td></td>
</tr>
<tr>
<td>Shoulder Depression Test</td>
<td>Untested</td>
<td></td>
</tr>
</tbody>
</table>

\(+LR = positive likelihood ratio; -LR = negative likelihood ratio; ERLS = External Rotation Lag Sign\)

\(\infty = infinity; this\ results\ from\ an\ inability\ to\ calculate\ likelihood\ ratios\ when\ the\ sensitivity\ or\ specificity\ of\ a\ test\ is\ 100\%\)

**Clinical Prediction Rule for Cervical Radiculopathy**

A clinical prediction rule has been developed to assist clinicians in diagnosing the presence of cervical radiculopathy.\(^{30}\) This clinical prediction rule involves 4 orthopedic exam findings and
the presence of 3 or more yields a LR+ = 6.1. Table 8 provides an overview of this clinical prediction rule.

### Table 8: Cervical Radiculopathy Clinical Prediction Rule

<table>
<thead>
<tr>
<th>Factors Predicting Response</th>
<th>+LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cervical rotation &lt;60°, toward the involved side</td>
<td>≥3 features</td>
</tr>
<tr>
<td>2. Positive Upper Limb Tension Test A (median nerve bias)</td>
<td>equals a +LR of 6.1</td>
</tr>
<tr>
<td>3. Positive Cervical Distraction Test</td>
<td></td>
</tr>
<tr>
<td>4. Positive Spurling’s A Test</td>
<td></td>
</tr>
</tbody>
</table>

*Adapted from*

### Predictors of Treatment Response

#### Cervical Traction Test Cluster

A clinical prediction rule has been developed that has been shown to help identify patients who are most likely to benefit from cervical spine traction. Table 9 outlines the features most useful for identifying patients who have the greatest likelihood of responding favorable to cervical traction.

### Table 9: Factors Associated with Positive Response to Cervical Spine Traction

<table>
<thead>
<tr>
<th>Factors Predicting Response</th>
<th>+LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lower cervical spine (C4-C7) produces peripheralization of the chief complaint</td>
<td>≥3 predictors equals a +LR of 4.81</td>
</tr>
<tr>
<td>2. Positive Shoulder Abduction Test</td>
<td></td>
</tr>
<tr>
<td>3. Positive Upper Limb Tension Test A</td>
<td></td>
</tr>
<tr>
<td>4. Positive Distraction Test</td>
<td></td>
</tr>
</tbody>
</table>
Myelopathy

Cervical Spondylotic Myelopathy

Cervical spondylotic myelopathy (CSM) results from the degeneration changes in the cervical spine, such as osteophytosis, hypertrophy of the ligamentum flavum, or zygapophyseal joint degeneration, and is the most common spinal cord disorder in individuals over the age of 45. These degenerative changes produce encroachment upon the spinal cord (spinal stenosis) resulting in compression and irritation. The features of CSM are frequently reported to involve deep aching neck pain and upper extremity radicular pain or clumsiness. Additionally, patients may manifest with signs of an upper motor neuron lesion in the upper and lower extremities.

The Japanese Orthopedic Association Score (JOA) allows clinicians to measure the severity of the myelopathy, and categorizes the severity of the patient’s clinical features. Patients with mild CSM features (JOA score <12) may be managed with conservative spine care, but patients with a moderate or severe JOA score (JOA score ≥12) should receive a surgical consultation.

A select cluster of clinical exam findings have the ability to dramatically increase the accuracy of diagnosing CSM. These five clinical exam findings are outlined in Table 10. Patients presenting with at least three of these five features have a high probability for CSM (94-99% probability) and should follow-up with a cervical MRI to evaluate for potential cord compression.

Table 10: Features Associated with Cervical Spondylotic Myelopathy

<table>
<thead>
<tr>
<th>Clinical Features</th>
<th>+LR</th>
<th>-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gait Deviation (abnormally wide based gait, ataxia, spastic gait)</td>
<td>3.4</td>
<td>0.85</td>
</tr>
<tr>
<td>2. Positive Hoffmann’s Test</td>
<td>4.9</td>
<td>0.74</td>
</tr>
<tr>
<td>3. Inverted supinator Sign</td>
<td>29.1</td>
<td>0.82</td>
</tr>
</tbody>
</table>
4. Positive Babinski Test | As high as possible (∞) | 0.93
5. Age >45 years | 1.2 | 0.48


∞ = infinity; this results from an inability to calculate likelihood ratios when the sensitivity or specificity of a test is 100%; +LR = positive likelihood ratio; -LR = negative likelihood ratio

**Syringomyelia**

Syringomyelia is a rare cause (9-130 per 100,000) of myelopathy in which a cyst or “syrinx” forms in the spinal cord parenchyma, causing compression of the decussating spinothalamic tracts and, in severe cases, the posterior columns. Though most syrinxes form before the age of 30, an affected individual may not experience symptoms until several years later.⁷

The majority of syringomyelia cases involve the cervical cord, but cases have also been reported in the thoracic and lumbar regions.⁹⁰ Most cases of syringomyelia are associated with Type I Chiari malformations, but may also form following trauma, tumor, or infection.⁴⁰,⁴¹

Though a syrinx can remain asymptomatic, those that grow large enough to compress the surrounding neural structures will cause a host of sensory and even motor abnormalities. As the syrinx compresses the decussating spinothalamic fibers, dissociated sensory deficits may occur. In such cases the patient will experience diminished temperature and pain sensation while light touch and joint position sense is spared. The shoulders and upper extremities are classically affected in what is described as a “shawl” distribution. If the syrinx grows large enough compression of the posterior columns can result in diminished vibration and joint position sense.⁷,⁴¹ Upper motor neuron signs (e.g., Babinski, Hoffmann’s) are often present in cases of cervical myelopathy. See Table. 3 for a review of clinical exam findings which can be clustered to increase diagnostic accuracy.

**Myofascial Pain Syndrome**

Myofascial pain syndrome is caused by a myofascial trigger point (MTrP), described as “…hyperirritable spots, usually within a taut band of skeletal muscle or in the muscle’s fascia that is painful on compression and can give rise to characteristic referred pain, tenderness, and autonomic phenomena.”⁴² MTrPs are common and may present as a primary pain generator or in concert with other painful conditions like whiplash, joint dysfunction, and headaches. Skootsky,
et al. reported that of 56 patients presenting to a general internal medicine clinic for a painful condition, 30% met the clinical criteria for myofascial pain syndrome.\textsuperscript{43} A diagnosis of MTrPs is often made based on history, clinical presentation, and palpation. Objective measures like high definition ultrasound, magnetic resonance elastography, computed tomography, and electromyography may be used to identify MTrPs, but are more likely to be utilized in the context of research.\textsuperscript{44} Simons and Travell identified 7 clinical features of a trigger point.\textsuperscript{42}

1. A taut band within the muscle.
2. Exquisite tenderness at a point on the taut band
3. Reproduction of the patient’s pain
4. Local twitch response
5. Referred pain
6. Restricted range of motion
7. Autonomic signs (e.g., piloerection, erythema, or tearing)

To this list, others have added weakness of the affected muscle. It has also been suggested that only features 1-3 are essential for diagnosing a trigger point, while the others may or may not be part of the presentation.\textsuperscript{44} A review on the variability of criteria used to diagnose MTrPs identified 19 different diagnostic criteria. The four most common features were tender spot in a taut band of skeletal muscle, patient pain recognition, predicted pain referral pattern, and local twitch response.\textsuperscript{45} While studies regarding interrater reliability have found that palpation can be an effective tool to identify MTrPs, it should be noted that specific features (e.g., referred pain sensation) are more reliably agreed upon than others (e.g., eliciting a local twitch response).\textsuperscript{46,47}

**Thoracic Outlet Syndrome**

Thoracic outlet syndrome (TOS) is a controversial condition reported to involve compression of the neurological or vascular structures that exit the thoracic outlet, which include the brachial plexus, subclavian artery, and subclavian vein.\textsuperscript{46} Compression of these neurovascular structures originates from various anomalies (e.g. cervical rib or prolonged transverse process), repetitive trauma, acute trauma, poor posture, or more rarely from tumors or infections.\textsuperscript{47} TOS is commonly categorized as primarily compressing the neurological structures or the vascular structures. The neurological form of TOS is reported to be the most common form, whereas the vascular form of TOS represents only about 5% of all cases.\textsuperscript{46,47} Clinicians should be aware that the vast majority of all orthopedic tests used to evaluate for suspected TOS are addressing this more rare vascular form of TOS and that these orthopedic tests have been reported to have high rates of false positives.\textsuperscript{48}

Thoracic outlet syndrome most commonly affects young adults and is four times more likely to affect females.\textsuperscript{46} TOS may manifest with a variety of signs or symptoms, but characteristically produces upper extremity sensory abnormalities, such as paresthesia or heaviness, and may also
cause skin changes (color or temperature) to the upper extremity.⁴⁷ These features are typically exacerbated during upper extremity abduction or other physical activities, such as throwing, painting, or driving.⁴⁶,⁴⁹ Table 11 provides an overview of the tests that are used to evaluate for the presence of TOS.

Table 11: Orthopedic Tests to Evaluate for the Presence of Thoracic Outlet Syndrome

<table>
<thead>
<tr>
<th>Test</th>
<th>+LR</th>
<th>-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevated Arm Stress Test (Roos Test)⁵⁰</td>
<td>1.20</td>
<td>0.53</td>
</tr>
<tr>
<td>Wright’s Hyperabduction Maneuver (Wright’s Test)⁴⁶</td>
<td>1.38</td>
<td>0.46</td>
</tr>
<tr>
<td>Supraclavicular Pressure⁴⁶,⁵¹</td>
<td>Only a specificity of 85-98% has been reported</td>
<td></td>
</tr>
<tr>
<td>Costoclavicular Maneuver (Eden’s Test)⁵¹</td>
<td>Only a specificity of 53-100% has been reported</td>
<td></td>
</tr>
<tr>
<td>Cyriax Release⁴⁶</td>
<td>Only a specificity of 77-97% has been reported</td>
<td></td>
</tr>
<tr>
<td>Upper Limb Tension Test A (median nerve bias)³⁰</td>
<td>Upper limb tension tests are occasionally reported to evaluate for neurogenic TOS (17826254), but have never been evaluated for this purpose</td>
<td></td>
</tr>
<tr>
<td>Upper Limb Tension Test B (radial nerve bias)³⁰</td>
<td>Only a sensitivity of 100% has been reported</td>
<td></td>
</tr>
<tr>
<td>Cervical rotation lateral flexion test⁵²</td>
<td>Only a sensitivity of 100% has been reported</td>
<td></td>
</tr>
<tr>
<td>Allen’s Test (Allen maneuver)</td>
<td>described, but never evaluated</td>
<td></td>
</tr>
<tr>
<td>Adson’s Test</td>
<td>described, but never evaluated</td>
<td></td>
</tr>
<tr>
<td>Halstead Maneuver</td>
<td>described, but never evaluated</td>
<td></td>
</tr>
</tbody>
</table>
Shoulder Abduction Test (Reverse Bakody Test)\textsuperscript{53} described, but never evaluated

∞ = infinity; this results from an inability to calculate likelihood ratios when the sensitivity or specificity of a test is 100%; +LR = positive likelihood ratio; -LR = negative likelihood ratio; TOS = thoracic outlet syndrome

Scoliosis

Scoliosis is defined as the abnormal lateral curvature of the spine with a Cobb angle of greater than 10 degrees\textsuperscript{53,54} and affects approximately 3% of all pediatrics ages 10 to 16 years.\textsuperscript{55} While this condition may develop as result of congenital or developmental osseous or neurologic abnormalities, most cases of scoliosis develop during adolescence and are idiopathic.\textsuperscript{54}

Traditionally, Adam’s Forward Bend test (Adam’s test) has been used to visualize the structural effects of suspected scoliosis. The accuracy of Adam’s test improves as the Cobb angle increases, but at a 10 degree Cobb angle the Adam’s test yields a LR\textsuperscript{+} = 12.85 and a LR\textsuperscript{-} = 0.17.

In the past, Adam’s test was used to screen school-age children for this condition, but guidelines published by the U.S. Preventative Services Task Force now recommends against the routine screening of asymptomatic adolescents for idiopathic scoliosis (Grade D Recommendation).\textsuperscript{56}

The rationale for this recommendation follows a lack of evidence that routine scoliosis screening in asymptomatic individuals has not been shown to detect this condition earlier than detection without screening.

Thoracolumbar Junction Syndrome (Maigne’s Syndrome)

Thoracolumbar junction syndrome (also known as Maigne’s syndrome, posterior rami syndrome, or lumbar dorsal ramus syndrome) was proposed by the French physician Robert Maigne in the 1970s. Dr. Maigne proposed that dysfunctional thoracolumbar facets (T11-L3) may refer pain to the various regions supplied by the posterior rami and peripheral nerves originating at the dysfunctional thoracolumbar facets.\textsuperscript{57} The areas of pain referral were reported to include the sacroiliac region, groin/inguinal region, and lateral thigh in a non-dermatomal in distribution.\textsuperscript{58}

Clinicians should be aware that this condition is sparsely reported in the literature and uniform acknowledgement for the existence and legitimacy of this condition is lacking.

The diagnostic evaluation for thoracolumbar junction syndrome is accomplished by raising a fold of skin from the thoracolumbar region and “rolling” the skin between thumb and forefinger or via posterior-to-anterior pressure on the thoracolumbar facets.\textsuperscript{58} Reproduction of the patient’s distant pain complaint (e.g. sacroiliac, lateral thigh, groin) is considered a positive test result. We were unable to identify any tests evaluating the diagnostic procedure for thoracolumbar junction syndrome.
Is there anything happening to this person, as a whole, that may alter the patient’s pain experience?

Yellow flags are psychosocial factors which may result in perpetuation or amplification of a pain state. Such factors may predate or be sequelae of the patient’s pain condition. It may also be that these factors and persistent pain mutually maintain one another. Murphy includes 5 psychological factors and 4 contributing factors in his description of yellow flags; Table 12 for an overview of these yellow flags.

Table 12: Yellow Flags

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fear</td>
<td>A patient may experience a disproportionate amount of fear with regard to their condition. This can result in maladaptive behaviors including avoidance of activity for fear of worsening their condition or, less often, too much activity for fear of losing their ability to be active.</td>
</tr>
<tr>
<td>Catastrophizing</td>
<td>A tendency to assume that the worse possible outcome will occur. The patient may feel hopeless, convinced that their condition will never improve.</td>
</tr>
<tr>
<td>Passive coping</td>
<td>Passive coping is the practice of relying on external forces to provide healing, a cure, or relief. Strategies vary but examples include self-medication or frequently switching providers in search of a “fix”.</td>
</tr>
<tr>
<td>Low self-efficacy</td>
<td>Those with low self-efficacy have little confidence in their ability to manage their symptoms or improve their condition.</td>
</tr>
<tr>
<td>Depression</td>
<td>A persistently low mood and attendant feelings of hopelessness. Depression may or may not be related to the patient’s pain condition, but can profoundly impact their ability to recover.</td>
</tr>
<tr>
<td>Perceived injustice</td>
<td>This occurs when a patient perceives that someone or something is at fault for their condition. They feel as though they have been robbed of their pre-injury selves and this “perceived injustice” can affect the patient’s ability to recover.</td>
</tr>
<tr>
<td>Hypervigilance for symptoms</td>
<td>The patient is constantly taking inventory of internal and external threats. It is a preoccupation with one’s symptoms.</td>
</tr>
<tr>
<td>Anxiety</td>
<td>While fear was specific to the patient’s condition, anxiety is state of fear that may or may not be related to the patient’s condition. The psychological and</td>
</tr>
</tbody>
</table>
physiological changes that accompany an anxiety state may impact the patient’s ability to recover.

Cognitive fusion
This is a condition in which the patient fuses their assumptions, beliefs, and cognitions about pain with the experience of pain, resulting in an inaccurate assessment of danger.


Limitations
As this is a narrative review, selection bias may be introduced during the selection of relevant reference articles. Also, search results may be less reproducible than in a systematic review. While we attempted to select the highest quality reference materials, we did not formally grade all the articles used in this report.

Conclusion
The purpose of this article is to provide clinicians with an evidence-based overview of orthopedic tests for conditions of the head, neck, and thoracic region and also to point out when no such tests exist. Many of the traditional tests have demonstrated limited utility when used in isolation. For this reason, we recommend clinicians utilize clusters of tests when available. When quality orthopedic tests do not exist for a particular condition, clinicians should rely on their own clinical experience while remaining mindful of the patient’s values and preferences.

List of Abbreviations
+LR = positive likelihood ratio
-LR = negative likelihood ratio
∞ = infinity
CAD = cervical artery dysfunction
HNP = herniated nucleus pulposus
MJP = Manual joint palpation (MJP)
PST = Palpation for segmental tenderness
RA = rheumatoid arthritis
TOS = thoracic outlet syndrome

WAD = whiplash associated disorders

**Competing Interests**

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

**Author's Contributions**

CBR and CSO conceived this project, contributed to the literature review, and participated in the drafting and revisions of this work.

**Acknowledgements**

None. The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of Veterans Affairs or the US Government.

**References**


21. Volle E. Functional magnetic resonance imaging--video diagnosis of soft-tissue trauma to


49. Souza TA, Dean of Academic Affairs Palmer College of Chiropractic West Thomas Souza. Differential Diagnosis and Management for Chiropractors. Jones & Bartlett Publishers;


Chiropractic Management of Low Back Pain and Testicle Pain: A Case Report

Shawn M. Neff, DC, MAS, FACO1, Rebecca Warnecke3
1Staff Chiropractor Martinsburg VAMC
2Adjunct Clinical Faculty, Palmer College of Chiropractic
3Student, Palmer College of Chiropractic

Published: September 2017
Journal of the Academy of Chiropractic Orthopedists
September 2017, Volume 14, Issue 3

This is an Open Access article which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The article copyright belongs to the author and the Academy of Chiropractic Orthopedists and is available at: http://www.dcorthoacademy.com. © 2017 Neff/Warnecke and the Academy of Chiropractic Orthopedists.

Abstract

Introduction: This case report describes the chiropractic management of a patient with low back and testicular pain.

Case Presentation: A 68-year-old Caucasian male veteran was treated for low back pain and referred testicular pain with spinal manipulative therapy and a Sacro-Occipital Technique (SOT) ischemic muscle release.

Management and Outcome: The outcome measures used to measure the patient’s pain were the Quadruple Visual Analogue Scale (QVAS) and Back Bournemouth Questionnaire (BBQ). At each visit, a Numeric Rating Scale (NRS) was also used to assess daily pain levels. Lumbar spinal manipulation, initially with an adjusting instrument and later using a high-velocity-low-amplitude (HVLA) drop mechanism, was performed along with a muscle release technique to the right iliopsoas. Immediately after the initial visit, the patient reported resolution of testicular pain. After a total of five visits, the patient reported resolution of low back pain and continued absence of testicular pain. The patient returned to the clinic approximately four months after discharge with reoccurrence of the testicular pain. After one additional treatment, the pain was completely resolved.

Conclusion: This patient was treated with spinal manipulation and a Sacro-Occipital Technique (SOT) muscle release. The result was complete resolution of referred testicular and leg pain, as well as a significant reduction in low back pain. Due to the prevalence of chronic idiopathic testicular pain in male patients, further research in the form of case studies and especially
randomized control trials is warranted to provide appropriate alternative management for patients who have not found resolution elsewhere.

**Background**

Testicular pain is defined as discomfort felt in the testes or scrotum, which may be accompanied by genital tenderness, swelling, and redness. Testicular torsion is a condition that may cause acute testicular pain and swelling and is most commonly diagnosed in individuals under the age of twenty-five.\(^1\) If not treated quickly, it could lead to loss of the testicle. This must be ruled out prior to evaluation of other causes via a thorough patient history and physical exam.

Additional causes of testicular/groin pain include: sexually transmitted diseases, kidney stones, infection (epididymitis), testicular tumors, and an enlarged prostate.\(^2\) In 50% of cases, when all possibilities have been ruled out, the final diagnosis is idiopathic chronic testicular pain, which may remain unresolved for years.\(^2\) Testicular pain may also be referred from a lumbar strain.\(^2\) Little evidence exists regarding idiopathic chronic testicular pain; however, the process appears to be neurological in nature. Sensory fibers from the upper ureter and the testicles are transmitted through the T11 and T12 spinal cord segments and are hypothesized to lead to the sensation of referred pain caused by radiculitis of the respective nerve roots.\(^2\) Spinal pain, originating in the lumbar region may be transmitted through the genitofemoral and inguinal nerves as referred unilateral testicular or scrotal pain.\(^3\) The ramus genitalis of the genitofemoral nerve is derived from L1-L2 nerve roots of the lumbar plexus and travels through the inguinal canal to supply the scrotum.\(^4\) The ilioinguinal nerve arises from the lumbar plexus as well, specifically from the L1 nerve root to supply the skin above the inguinal ligament, medial thigh and mons pubis.\(^5\) Both the ilioinguinal and genitofemoral nerves (along with the hypogastric nerve) travel through the psoas muscle.\(^5\) Entrapment of the ilioinguinal and/or genitofemoral nerves can cause referred testicular and scrotal pain.\(^3\)

A substantial body of research exists regarding the chiropractic management of cervical and lumbar radiculopathy/radiculitis.\(^6\) Although the mechanisms of spinal pain, radiculopathy, and referred pain are similar, there are only two case studies having reported use of chiropractic care for referred testicular pain.\(^4,7\) These studies show the possible relationship between the lower thoracolumbar spine and surrounding musculature and referred testicular pain in patients with diagnosed idiopathic chronic testicular pain. This connection also provides a possible alternative treatment plan for this condition.

**Case Presentation**

A 68-year-old Caucasian male presented to the clinic with a chief complaint of low back pain beginning 10 weeks prior after tripping and falling onto his coffee table in November 2016. Following this accident, he developed constant low back pain. The patient then presented to an emergency department where a lumbar X-ray was ordered, revealing a compression fracture of L3 not present on an old computed tomography (CT) scan. The emergency department physician instructed the patient to follow up with his primary care provider who ordered an MRI to further
evaluate the L3 compression fracture. Dual Energy X-ray Absorptiometry (DEXA) was also accomplished and revealed decreased bone density with a T-score of -1.8 and a Z-score of -1 indicating an increased risk of fracture for his age. Prolonged standing at the sink or stove were described as provocative, while sitting combined with lateral bending relieved his low back pain. He described the pain as a constant ache and endorsed shooting pain into his right lateral thigh and right testicle two to three times per day. The back pain was constant at a severity of 6/10 on a Numeric Rating Scale (NRS). The score on the Quadruple Visual Analog Scale (QVAS) was 66.7/100 and the Back Bournemouth Questionnaire (BBQ) score was 32/70. The patient’s medical and surgical history were significant for a cholecystectomy and a bilateral inguinal hernia repair. He had hypertension, was prediabetic, and was prescribed and took calcium and vitamin D for his bone density. He had no known allergies and had never received chiropractic care. He smoked 25 cigarettes per day and drank two to three rum and cola beverages per day.

Review of systems was notable for night sweats, occasional left anterior costal angle chest pain, and depression. Vitals were within normal limits as follows: blood pressure 124/85 mmHg, height 68 inches, weight 165.6 pounds, pulse 76 beats per minute, and respiration 20 breaths per minute. Patellar deep tendon reflex was +2 bilaterally. Postural assessment revealed a left head tilt, an elevated left shoulder, and elevated right ilium with decreased sagittal curves. Thoracolumbar active range of motion was within normal limits in all directions but provocative on extension and right rotation. Kemp’s test was positive bilaterally for low back pain while the Straight Leg Raise test, Patrick’s, Ely’s, Nachlas’, Hibb’s, and Yeoman’s were negative bilaterally. Strength was rated 5 out of 5 for the following myotomes: knee extension (L3), ankle dorsiflexion (L4-5), ankle plantar flexion (S1), and knee flexion (S2). Severe pain was elicited upon palpation of both sacroiliac (SI) joints, the left being more severe. A right psoas contracture was noted upon arm check (Figure 1). There was decreased fluid motion of the left SI joint. Following the history and physical exam, the patient was diagnosed with: low back pain, osteopenia, testicular pain, and iliopsoas contracture.

Management and Outcome

Spinal manipulative therapy was performed using the Impulse thrust adjusting instrument (Neuromechanical Innovations, Chandler, AZ) to minimize force with consideration for osteopenia, and a right iliopsoas release was performed utilizing the Sacro-Occipital Technique (SOT). Following treatment, the patient reported reduced low back and testicular pain, rated 2/10 on an NRS. The patient was then scheduled for a trial of care at a frequency of one visit per week for a total of four weeks.

The patient returned 41 days later for his first of four follow up appointments. He denied radiating leg pain and right testicular pain since initial treatment. He had undergone a kyphoplasty of
L3 18 days earlier and rated his low back pain as a constant 5/10. Manipulation of bilateral SI joints was performed utilizing the Impulse thrust adjusting instrument, and the patient reported reduced low back pain rated at 3/10 on an NRS.

One week later, the patient returned for his second follow up. He rated the low back pain as a 5/10 on an NRS but stated that he was doing much better. His symptoms had improved following treatment but returned after lying in bed for an extended period. He also noticed radiation into his right thigh and testicle for the first time since beginning treatment, but this was transient and improved upon standing. Manipulation of bilateral SI joints was performed utilizing the Impulse thrust adjusting instrument, and the patient reported reduced low back pain rated at 3/10 on an NRS.

After another week, the patient returned for his third follow up and reported near complete resolution of low back pain which he rated at 3.5/10 on an NRS. He denied any testicular or radiating leg pain. The left SI joint was manipulated utilizing a drop piece mechanism with a manual thrust. After treatment, the patient reported complete resolution of pain.

The patient returned for re-evaluation one week later. He rated his pain at 2/10 on an NRS and stated that he felt he was getting better with every visit. There was no recurrence of radiating pain. His score on the QVAS was reduced to 23.3/100 (a 65% reduction). The score on the BBQ was reduced by 38% to a score of 20/70. There was no pain on palpation and no muscle spasms were noted on examination. The lumbar and SI joint fluid motion were found to be within normal limits upon palpation, and the patient was discharged from care.

The patient returned to the clinic approximately four months after discharge stating that his right testicular pain had recurred after 10 weeks, though his low back remained asymptomatic. Palpation revealed moderate hypertonicity of the middle lumbar paraspinals, predominantly right sided, without notable tenderness. There was decreased intersegmental flexion and extension at the L2-L3 motion unit. The right iliopectos was again identified as contracted utilizing the SOT arm check. The lumbar spine was manipulated at L2 utilizing an anterior manipulation technique, and the right iliopectos was treated utilizing an SOT iliopectos release. Immediately following treatment, the patient reported resolution of right testicular pain.

**Conclusion**

This case report details the successful treatment of low back and referred testicle pain with iliopectos ischemic muscle release and five treatments of spinal manipulation.

Chiropractors should be aware of common causes of testicular pain and how to identify them based on the patient’s history, presentation, and a detailed physical examination. This case report suggests that chiropractic care may improve the pain associated with idiopathic chronic testicular pain. Further research is warranted regarding the potential role of manual therapies in the treatment of patients experiencing idiopathic testicular pain.
Limitations

The results from this case report may not be generalized to all patients because of the uncontrolled nature of this case report. There are many uncontrolled variables in case studies and the treatment of one patient does not ensure equivalent results are to be expected in other patients. Spontaneous remission of the patient’s pain may also play a role in individual cases, as temporal associations do not translate to statements of efficacy.

Consent

Written consent for this publication was obtained from the patient.

Competing Interests

The authors declare that they have no competing interests.

Acknowledgements

Supported by the Department of Veteran Affairs. The contents do not represent the views of the Department of Veterans Affairs or the United States Government.

References


Editorial Review

**Malgaigne Fracture in Childhood**  
*A Case Report and Review of Literature*

Mustafa Kaya, MD, Can Yaldiz, MD, Davut Ceylan, MD

**Medicine – Volume 95, Number 4, January 2016 ISSN: 0025-7974**

**JACO Editorial Reviewer**: Jaroslaw P. Grod, D.C., FCCS(C)

Published: September 2017  
*Journal of the Academy of Chiropractic Orthopedists*  
September 2017, Volume 14, Issue 3

The original article copyright belongs to the original publisher. This review is available from: [http://www.dcorthoacademy.com](http://www.dcorthoacademy.com) ©2017 Grod and the Academy of Chiropractic Orthopedists. This is an Open Access article which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

**Authors’ Abstract:**

Sacrum fractures are rare pathologies seen after spinal trauma. The incidence of a sacral fracture after trauma is 0.6% in childhood. A Malgaigne fracture is composed of fractures and dislocations of the anterior and posterior regions of the pelvis. This is the first reported case of Malgaigne fracture during childhood.

A 12-year-old girl was admitted to our emergency room after having suffered a fall. Radiological tests revealed a zone 3 sacral fracture according to Denis scoring, a subtype 2 sacral fracture according to Roy-Camille classification, and a detachment in the symphysis pubis. Appropriate load distribution through a bilateral L6 – S1 – S2 transpedicular screw and a bilateral iliac with wing screw, as well as neural decompression were performed together with an S1 – S2 total laminectomy.

It is very difficult to make a generalization for treatment of sacral fractures and Malgaigne fractures in childhood due to the small number of patients. Each patient should be individualized and lumbosacroiliac instability should be treated.

*Medicine 95(4): e2521*

**JACO Editorial Summary:**

- This article was written by authors from the following institutions:  
  - Department of Neurosurgery, Karadeniz Eregli State Hospital, Zonguldak, Turkey (MK);  
  - Department of Neurosurgery, Sakarya Training and Research Hospital, Sakarya, Turkey (CY, DC)
A Malgaigne fracture is composed of fractures and dislocations of the anterior and posterior regions of the pelvis.

This appears to be the first reported case of Malgaigne fracture during childhood where a 12-year-old girl was admitted to the emergency room after having suffered a fall.

Sacral fractures are rare injuries in children with an incidence of 0.6%.

Even rarer is a transverse sacral fracture associated with an unstable pelvic ring.

This 12-year-old girl fell from a height of approximately 12 m on her left leg then hit her hip on the ground vertically.

She had severe thigh and left leg pain.

No neurological deficits or incontinence were noted.

Abdominal examination was normal.

Lumbar CT revealed a zone 3 sacral fracture according to the Denis classification, a sub type 2 fracture according to the Roy-Camille classification, an S1 – S2 listhesis and a right sacroiliac dysfunction.

The patient was placed prone on the operating table and was under general anesthesia. The paravertebral muscles between L4 and S3 were stripped subperiosteally.

S1 and S2 total laminectomy was performed and nerve decompression was provided.

Transpedicular screws were placed at the L5, S1 and S2 vertebrae bilaterally.

Pedicle screws were connected with a rod system.

Bilateral iliac wing screws were placed and both iliac wings were attached to the system through a connector.

No post-operative problems were seen.

Summary and Main Message

In Malgaigne fractures, the sacrospinous and sacrotuberous ligaments are also torn in addition to the posterior sacroiliac complex.

Comparative studies have shown that all current sacroiliac fixation methods have close stability with regard to biomechanical properties. Another result of these studies is that no methods can reach the stability of the intact pelvis.

Due to limited number of cases it is difficult to make treatment generalizations.

Although a Malgaigne fracture is not a common condition seen in a chiropractic practice, it is essentially useful to understand the mechanism of injury and the structures involved.
Editorial Review

Recurrent Piriformis Syndrome after Surgical Release

Philipp Kobbe MD, Boris A Zelle MD, Gary S Gruen MD

Published online February 9th 2008

The Association of Bone and Joint Surgeons 2008

JACO Editorial Previewer: J. Christopher Romney DC FACO

Published: September 2017

Journal of the Academy of Chiropractic Orthopedists
September 2017, Volume 14, Issue 3

The original article copyright belongs to the original publisher. This review is available from: http://www.dcorthoacademy.com © 2017 Romney and the Academy of Chiropractic Orthopedists. This is an Open Access article which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Authors’ Abstract:

Objective: To establish, in patients with subacromial impingement syndrome, the relationship between pain and shoulder function, as determined by the Constant score, and morphological findings, as determined by radiographs and magnetic resonance imaging (MRI) and the relationship between acromial shape and minimum acromiohumeral distance (AHD).

Design: Cross-sectional study.

Setting: Tertiary care center.

Patients: Forty-seven patients (33 males and 14 females; mean age, 51.7 years) with unilateral subacromial impingement syndrome who had failed to respond to conservative therapy for at least 6 months.

Interventions: The Constant score was determined preoperatively; acromial shape (type I, flat; type II, curved; and type III, hooked) was evaluated on preoperative outlet view radiographs and oblique sagittal T1-weighted MRIs; AHD was evaluated on preoperative anteroposterior radiographs and oblique coronal T1-weighted MRIs.

Main Outcome Measures: Correlation coefficients and the simple kappa statistic were calculated. Student t test and mean differences with 95% confidence limits were reported for group comparisons.

Results: The Constant score was fairly correlated with AHD ($r = 0.39, P < 0.01$) but not with acromial shape. Patients with an AHD 7 mm or less on MRI scored significantly lower than
those with an AHD more than 7 (mean difference, 18.5; P, 0.01). Acromial shape and AHD were not correlated on radiographs or MRI.

**Conclusions:** AHD seems to better reflect the clinical status of patients with subacromial impingement, but without rotator cuff tears, than acromial shape. Acromial shape is not a good descriptor of subacromial space narrowing.

**JACO Editorial Summary:**

- The article was written by authors from the Department of Radiology, Medical University of Vienna, Vienna, Austria; Institute of Radiology, Waldviertelklinikum Horn, Horn, Austria; Second Orthopedic Department, Orthopaedic Hospital Speising, Vienna, Austria; and Department of Orthopaedic Surgery, Great Ormond Street Hospital for Children, Institute of Child Health, University College London, London, UK.

- The purpose of this cross-sectional study was to evaluate the correlation between imaged shoulder morphology and shoulder function as measured by the Constant score.

- The Constant score is a validated assessment instrument that measures shoulder function across four domains that include pain, activities of daily living, shoulder ROM, and muscle strength. The instrument uses a 100 point scale with a higher score reflecting better function and lower pain.

- Forty seven patients with subacromial impingement syndrome received radiographs and MRI's to assess acromion morphology and acromiohumeral distance (AHD).

- Acromial morphology was assessed by imaging as Type 1, 2 or 3 as described by Bigliani, Epstien et al.

- Acromiohumeral distance was assessed by MRI and radiographic imaging. An AHD of 7 mm or less is considered abnormal.

- The Constant score correlated fairly with AHD but not with acromial shape.

- Patients with an AHD 7 mm or less on MRI had a significantly lower Constant score than those with an AHD greater than 7.

- Acromial shape and AHD were correlated, neither on radiographs nor on MRI.
Summary:

The results of this investigation suggest that assessment and reporting of acromiohumeral distance (AHD) is to be preferred to morphology assessment in that it correlates better with functional assessment of the shoulder.
Femoroacetabular Hip Impingement Syndrome

Alicia M. Yochum RN, DC, DACBR

Published: September 2017
Journal of the Academy of Chiropractic Orthopedists
September 2017, Volume 14, Issue 3

Femoral acetabular hip impingement (FAI) syndrome can be a source of anterior hip or groin pain usually and patients between the age of 20 to 40 years old. The prevalence of this diagnosis is approximately 10 to 15%. Clinical examination reveals anterior hip or groin pain exacerbated with full flexion and internal rotation of the hip. This is considered a positive anterior impingement sign (painful internal rotation is 90° of flexion). Pain can also be exacerbated in the sitting position or with sporting activity.

There are two types of bony deformity that can cause FAI. The first is the pincer deformity. This is also called acetabular over coverage as the contacting surface area of the femoral head on the acetabulum is larger. This can be seen on an AP radiograph with a crossover sign or an increased center edge angle (Figure 1 and 2). The normal measurement for the center edge angle should be less than 40°.

Figure 1 and 2: Pincer deformity with a center edge angle measuring approximately 52°.
The second type of osseous deformity is the CAM deformity. This is also called the pistol grip deformity due to the appearance of the femoral head neck junction similar to that of the handle of the pistol. The appearance of this CAM deformity is that of asphericity at the femoral head neck junction and has the appearance of an osseous bump. These are typically in the anterior lateral area of the femoral head neck junction. This is thought because by a variant of the epiphysis. Patients can also have a combination of both the pincer type and CAM type deformity.

![Figure 3 and 4: CAM deformity seen at the anterior lateral femoral head neck junction on both the AP and frog leg projection (arrows).](image)

Diagnosis is primarily clinical with the radiographic signs being supportive in nature.

Secondary radiographic signs of FAI include osteoarthritis, labral tears and labral ossification due to the abnormal stress placed on the hip joint with activity. A herniation pit, commonly seen within the femoral neck has been associated with FAI therefore clinical correlation for impingement should be performed when present. If there is concern for labral tearing an MRI arthrogram of the affected hip should be done with axial oblique images to evaluate and measure the CAM deformity.

**References:**

Ortho Quiz

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

1. Your patient has been told he has a L3/L4 prolapsed disc that was found on MRI. Which part of your patient’s dermatome evaluation will be most informative:
   a. Posterior thigh
   b. Dorsum of the foot
   c. Lateral aspect of the ankle
   d. Medial aspect of the ankle

2. Your patient has been told he has a L3/L4 prolapsed disc that was found on MRI. Which DTR when tested will be the most informative:
   a. Patella
   b. Achilles
   c. Lateral Hamstring
   d. Medial Hamstring

3. Your patient is a 50 year old male that has a history of 1st metatarsophalangeal joint pain with redness and swelling. He notes that this seems to occur after a night of going out with his friends and drinking beer. The best working diagnosis based on this really limited bit of history would be:
   a. Septic Arthritis of the 1st digit
   b. Osteoarthrosis
   c. Periodic Rheumatoid Arthritis Flare-ups
   d. Gouty Arthritis

4. Your patient is a 63 year old male with a history of 30 years of 2 pack a day smoking cigarettes. You observe the patient’s breathing and body posture and you notice that he has what appears to be a “barrel chest” and you also notice that he seems to be using accessory muscles to aide in his labored breathing. The best working diagnosis based on this really limited bit of history:
   a. Lung CA
   b. Pneumonia
   c. Emphysema
   d. Pulmonary edema

5. Your patient is a 63 year old male with a history of 30 years of 2 pack a day smoking cigarettes. You observe the patient’s breathing and body posture and you notice that he has what appears to be a “barrel chest” and you also notice that he seems to be using accessory muscles to aide in his labored breathing. Upon auscultation of his chest you would expect to find which percussion tone:
   A. Tympanic
   b. Hyperresonant
   c. Resonant
   d. Dullness
Current Events

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

Jerrold R Wildenauer DC, FACO
1859 Warrior Drive
Mendota Heights, MN 55118

TEL: 612-454-1472
FAX: 651-846-5590
E-mail: aco@dcorthoacademy.com

❖ Apply for the Lipe Scholarship

Details at http://www.accoweb.org/lipescholarship.html

❖ The full hours of the following conventions have been accepted by the Academy as qualifying for re-credentialing.

  o American College of Chiropractic Orthopedists 2018 Annual Convention
    19 Apr to 21 Apr 2018
    Hilton Garden Inn Carlsbad Beach, Carlsbad CA
    https://acoco.wildapricot.org/event-2436518

  o CFS 2017 Annual Fall Convention
    October 5-7, 2017
    Chicago Marriott Oak Brook
    1401 W 22nd Street | Oak Brook, IL 60523
    630.573.8555 www.marriott.com/chiob
    http://www.forensic-sciences.org/convention/
Answers to Ortho Quiz

1. d. *Medial aspect of the ankle*
   
   http://www.backpain-guide.com/Chapter_Fig_folders/Ch06_Path_Folder/4Radiculopathy.html

2. a. *Patella*
   
   https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4104583/

3. d. *Gouty Arthritis*

   https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4104583/

4. c. *Emphysema*


5. b. *Hyperresonant*

   http://www.rnceus.com/resp/respperc.html