

JACO

**Journal of the Academy of
Chiropractic Orthopedists**

2013



Volume 10

Issue 3

September, 2013



JACO

Journal of the Academy of Chiropractic Orthopedists

**The Open Access, Peer-Reviewed and Indexed
Publication of the Academy of Chiropractic Orthopedists**

September 2013 – Volume 10, Issue 3

Editorial Board

Editor-In-Chief

Bruce Gundersen, DC, FACO

Editor

Stanley N. Bacso, DC, FACO, FCCO(C)

Associate Editors

James Demetrious, DC, FACO

David Swensen, DC, FACO

Current Events Editor

James R. Brandt, DC, MPS, FACO

Editorial Advisory Board

James R. Brandt, DC, MPS, FACO

Ronald C Evans, DC, FACO

James Demetrious, DC, FACO

Michael Henrie, DO

Reed Phillips, DC, PhD

Robert Morrow, MD

Editorial Review Board

Scott D. Banks, DC, MS	Clark Labrum, DC, FACO
Ward Beecher, D.C., FACO	Gregory C. Priest, DC, FACO
Thomas F. Bergmann, DC	Joni Owen, DC, FACO
Gary Carver, DC, FACO	Deanna O'Dwyer, DC, FACO
Jeffrey R. Cates, DC, FACO	Joyce Miller, DC, FACO
Rick Corbett, DC, DACBR, FCCO(C)	Loren C. Miller DC, FACO
Anthony Vincent D'Antoni, MS, DC, PhD	Raymond S Nanko, DC, MD, DAAPM, FACO
Donald S. Corenman, MD, DC, FACO	J Chris Romney, DC, FACO
James Demetrious, DC, FACO	Roger Russel, DC, MS, FACO
Neil Erickson, DC, DABCO	Stephen M. Savoie, DC, FACO
Simon John Forster, DC, DABCO	David Swensen, DC, FACO
Jaroslav P. Grod, DC, FCCS(C)	Larry L. Swank, DC, FACO
Tony Hamm, DC, FACO	Cliff Tao, DC, DACBR
Jerry Hearn, DC, FACO	John M Ventura, DC, FACO
Dale Huntington, DC, FACO	Michelle A Wessely BSc, DC, DACBR
Keith Kamrath DC, FACO	Michael Wiles, DC, MEd, FCCS(C)
Charmaine Korporaal, M.Tech: Chiropractic,	James A. Wyllie, DC DABCO
CCFC, CCSP, ICSSD	Steve Yeomans, DC, FACO
Ralph Kruse, DC, FACO	Alicia Marie Yochum, R.N, D.C.

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 in any connotation.

Journal of the Academy of Chiropractic Orthopedists

September 2013 – Volume 10, Issue 3

Image and Art Gallery

- ❖ Multnomah Falls, Oregon - courtesy of columbiariverimages.com. JACO 2013, 10(3): 1.

Abstracts and Literature Review

- ❖ Dewan, A., et al: **MRI of the Elbow: Techniques and Spectrum of Disease.** *Reviewed by Tao, C.* JACO 2013, 10(3): 3-7.
- ❖ Bevelacqua, A. et al: **Posterior Interosseous Neuropathy: Electrodiagnostic Evaluation.** *Reviewed by Priest, G.* JACO 2013: 10(3): 9-12.
- ❖ Bronfort, G., et al: **Spinal Manipulation, Medication, or Home Exercise with Advice for Acute and Subacute Neck Pain.** *Reviewed by Labrum, I.* JACO 2013: 10(3): 14-19.

Announcements

- ❖ Announcements. JACO 2013, 10(3): 20-21.

Multnomah Falls, Oregon



Courtesy of columbiariverimages.com

Multnomah Falls, Oregon - at 620 feet - is the second highest year-round waterfall in the United States, the first being Yosemite Falls in California. Nearly two-million visitors a year come to see Multnomah Falls, making it Oregon's number one tourist place. The falls is fed by underground springs from Larch Mountain. Benson Bridge, built in 1914, crosses Multnomah Creek between the Upper and Lower Multnomah Falls. Multnomah Falls is one of many falls in the Columbia River Gorge which can be seen from the Historic Columbia River Highway. Downstream from Multnomah Falls are Wahkeena Falls and Bridal Veil Falls. Crown Point and Rooster Rock, other popular Oregon Gorge locations, are further downstream. Upstream are Oneonta Gorge and Horsetail Falls. Multnomah Falls is located at Columbia River Mile.

At Multnomah Falls the visitor can view six lava flows in the cliff face, with pillow flows being visible in the upper sequence near the lip of the Upper Falls. Five more flows of Grande Ronde basalt can be seen along Multnomah Creek along the trail above the falls. The cliff of Multnomah Falls was enhanced by the flood waters of the Missoula Floods thousands of years ago when the flood waters eroded away softer material, highlighting the spectacular cliff face.

CHIROPRACTIC FOCUSED ■ LEADER IN MALPRACTICE ■ EXPERT DEFENSE



NCMIC

We Take Care of Our Own®

NCMIC Stands Out Among the Rest

[Click here](#) to learn more
about NCMIC offerings.

Malpractice Insurance Plan is offered through NCMIC Insurance Company.
Policy terms may vary by state law.

www.ncmic.com/3120

Abstracts & Literature Review

MRI of the Elbow: Techniques and Spectrum of Disease

Ashvin K. Dewan, MD, A. Bobby Chhabra, MD, A. Jay Khanna, MD, MBA,
Mark W. Anderson, MD, and Lance M. Brunton, MD

J Bone Joint Surg Am. 2013;95: e99(1-13)

JACO Editorial Reviewer: Cliff Tao, DC, DACBR

Published:

Journal of the Academy of Chiropractic Orthopedists

September 2013, Volume 10, Issue 3

The original article copyright belongs to the original publisher. This review is available from: <http://www.dcorthoacademy.com>

© 2013 Tao 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:

Background: Magnetic resonance imaging (MRI) of the elbow allows for high-resolution evaluation of osseous and soft tissue structures, including ligaments, tendons, nerves, and muscles. Multiple imaging techniques and pulse sequences exist. The purpose of this article is to update orthopedic surgeons on current MRI techniques and illustrate the spectrum of elbow pathology detectable by MRI.

Methods: We searched MEDLINE with use of the keywords “MRI” and “elbow” for studies less than five years old evaluating MRI techniques. These papers, our experience, and textbooks reviewing elbow MRI provided the information for this article.

Results: We discuss the essentials and applications of the following techniques: (1) conventional, non-gadolinium enhanced MRI; (2) gadolinium-enhanced MRI; and (3) magnetic resonance arthrography. The classic MRI appearances of occult fractures, loose bodies, ulnar collateral ligament injuries, lateral collateral ligament complex injuries, biceps tendon injuries, triceps tendon injuries, lateral epicondylitis, medial epicondylitis, septic arthritis, osteomyelitis, osteochondritis dissecans, compression neuropathies, synovial

disorders, and various soft-tissue masses are reviewed.

Conclusions: MRI is a valuable, noninvasive method of elbow evaluation. This article updates orthopedic surgeons on the various available MRI techniques and facilitates recognition of the MRI appearances of the most commonly seen pathologic elbow conditions.

Background

Various technical advances in MRI have improved detection of abnormalities of the elbow. A review of imaging techniques and sequences specific to the elbow are presented, and examples of common pathology detected by MRI are noted.

Methods

The authors did a MEDLINE search using “MRI” and “elbow” for studies and used this data along with their clinical experience and unnamed textbooks in the generation of this paper.

Results

Imaging Sequences and Technique

Elbow MRI is usually performed with patient supine and arm at the side. T1-weighted images are used to show anatomic detail, and T2-weighted images are used to show alteration in water content. Short tau inversion recovery (STIR) and fat-suppressed T2-weighted images are best to show fluid and edema. Gradient-echo sequences highlight metallic and hemosiderin/blood products, and cartilage especially when used with fat-suppression. Intravenous (IV) contrast is used for evaluation of soft tissue masses and synovial disorders. MR arthrography is useful for intra- and/or peri-articular conditions.

Pathologic Conditions

Trauma: Persistent tenderness at a suspected injury site without x-ray abnormality may be an indication for MRI to detect occult fracture. The posterior fat pad sign on x-ray corresponds to occult fracture in >75% of patients. Fat-suppressed T2-weighted or STIR or sequences are best.

The anterolateral radial head lacks cartilage and a subchondral plate, predisposing it to fracture.

In children with x-ray showing effusion, MRI is used for physeal injury evaluation, such as Little Leaguer's elbow. This is best seen with coronal fat-suppressed gradient-echo sequences.

MRI has added benefit (over plain x-ray or CT) in the detection of loose bodies because it is better at showing non-ossified loose bodies. These are usually in the coronoid or olecranon fossa.

The ulnar collateral ligament (UCL or MCL), especially the functionally-important anterior bundle, is easily identified on coronal sequences with the forearm supinated. MRI detection of the full-thickness anterior UCL tears is excellent. However, for partial tears it is poor, unless used with intra-articular contrast.

The lateral UCL is the most important stabilizer of varus stress and is seen on one slice of the coronal

view just posterior to the radial head/neck. However, identification of tears of the LUCCL is difficult.

Biceps and triceps tendon injury is visualized on MRI, and like the anterior UCL, complete ruptures are easily seen and partial tears are not, but are identified as thickening and/or intrasubstance signal change. Occasionally, a complete rupture of the biceps can be mistaken for a partial tear if the bicipital aponeurosis (lacertus fibrosus) tethers the tendon, preventing retraction. Olecranon bursitis may be seen in cases of triceps injury.

Degenerative conditions: MRI is very good at detecting lateral epicondylitis (or epicondylitis) on coronal fat-suppressed T2-weighted or STIR sequences, with an abnormal extensor carpi radialis brevis tendon. MRI may help to differentiate between osteoarthritis, osteochondritis dissecans, radial tunnel syndrome, posterolateral rotator instability, occult fracture, and/or loose bodies. Medial epicondylitis is not imaged commonly; however MRI may be useful to rule out UCL injury or ulnar neuritis.

Infection: MRI can help to distinguish a joint effusion from superficial cellulitis or bursitis, but cannot differentiate between normal, hemarthrotic or purulent intra-articular fluid. Septic arthritis may show shaggy contrast enhanced rim. Intravenous contrast aids in localization of focal adjacent abscesses.

Osteomyelitis is well seen with MRI on almost all sequences. Clinical correlation is important since the findings may mimic neoplasm or osteonecrosis.

Other conditions: Osteochondritis dissecans is an idiopathic or repetitive trauma injury of articular cartilage affecting adolescents. Usually the capitellum is involved, and the possibility of a pseudo-defect should be considered. This anatomic variant is seen on coronal images at the junction of the lateral humeral condyle and posterior capitellum. The normal trochlear groove may also be mistaken for an osteochondral lesion. MRI is very useful in determining the viability and stability of an osteochondral fragment. Fluid or contrast tracking behind the fragment indicates instability,

and fragment enhancement post-contrast is suggestive of adequate blood supply and bone viability.

MRI can be used when conservative treatment of compression neuropathies has failed, or when neuropathy recurs post-surgery. This includes cubital tunnel, radial tunnel, posterior interosseous nerve, and pronator syndromes. Major peripheral nerves can usually be traced on sequential axial images.

Diagnosis of inflammatory arthritides, crystal deposition, pigmented villonodular synovitis (PVNS), and idiopathic synovial osteochondromatosis can be done with MRI. Rheumatoid arthritis is especially apparent with the avid enhancement of pannus post-IV contrast.

MRI is very helpful in cases of unknown soft tissue masses, including identifying enlarged lymph nodes, lipomas, ganglia, hemangiomas, neurofibromas, PVNS, and synovial osteochondromatosis.

Conclusions

MRI is a useful tool in the evaluation of a variety of elbow disorders. Knowledge of some of the specific technical details of MRI may help in the detection of some conditions.

Clinical Relevance

The chiropractor and chiropractic orthopedist will encounter patients with a variety of elbow disorders and this helps to categorize disorders that can be accurately (and some not so accurately) detected on MRI. Knowledge of these disorders and imaging techniques aids in the diagnosis, and hence management of these patients with these conditions.

JACO Editorial Summary:

- This is a concise non-systematic review of elbow MRI, written by orthopedists and radiologists
- The purpose of this review was to highlight the technical aspects of MRI relevant to the elbow and to demonstrate its effectiveness in the identification

of a variety of conditions including traumatic, degenerative and infectious conditions

- MRI is valuable tool in the non-invasive evaluation of a wide variety of elbow disorders

Summary

This concise review demonstrates the non-invasive ability of MRI to detect a variety of conditions and the technical aspects of sequence and anatomical slice selection as a helpful factor. Various elbow disorders are discussed in relation to MRI including traumatic, degenerative, infectious, and other conditions such as compression neuropathies and soft tissues masses.

Reviewer note: This article does not discuss the ability of MRI (or lack thereof) to detect various elbow conditions when the technical aspects are not optimal – open or low-field MRI, lack of dedicated surface coils, patient motion, poor positioning, inappropriate slice planning and pulse sequence selection, etc - the selection of a technically adequate imaging facility is a factor in the performance of MRI in the evaluation of elbow (and other) disorders that cannot be ignored.

References and Additional Readings

1. Brunton LM, Anderson MW, Chhabra AB. The elbow. In: Khanna AJ, editor. MRI for orthopaedic surgeons. New York: Thieme; 2010. p 118-28.
2. O'Dwyer H, O'Sullivan P, Fitzgerald D, Lee MJ, McGrath F, Logan PM. The fat pad sign following elbow trauma in adults: its usefulness and reliability in suspecting occult fracture. J Comput Assist Tomogr. 2004 Jul-Aug;28(4): 562-5.
3. Skaggs DL, Mirzayan R. The posterior fat pad sign in association with occult fracture of the elbow in children. J Bone Joint Surg Am. 1999 Oct;81(10): 1429-33.
4. Stein JM, Cook TS, Simonson S, Kim W. Normal and variant anatomy of the elbow on magnetic resonance imaging. Magn Reson Imaging Clin N Am. 2011 Aug;19(3): 609-19.
5. Griffith JF, Roebuck DJ, Cheng JCY, Chan YL, Rainer TH, Ng BKW, Metreweli C. Acute elbow trauma in children: spectrum of injury

- revealed by MR imaging not apparent on radiographs. *AJR Am J Roentgenol.* 2001 Jan;176(1):53-60.
6. Kaplan LJ, Potter HG. MR imaging of ligament injuries to the elbow. *Radiol Clin North Am.* 2006 Jul;44(4):583-94, ix.
7. JbaraM, PatnanaM, Kazmi F, Beltran J. MR imaging: arthropathies and infectious conditions of the elbow, wrist, and hand. *Magn Reson Imaging Clin N Am.* 2004 May;12(2): 361-79, vii.
8. Potter HG, Weiland AJ, Schatz JA, Paletta GA, Hotchkiss RN. Posterolateral rotatory instability of the elbow: usefulness of MR imaging in diagnosis. *Radiology.* 1997 Jul;204(1): 185-9.
9. Potter HG. Imaging of posttraumatic and soft tissue dysfunction of the elbow. *Clin Orthop Relat Res.* 2000 Jan;370:9-18.
10. Cain EL Jr, Dugas JR, Wolf RS, Andrews JR. Elbow injuries in throwing athletes: a current concepts review. *Am J Sports Med.* 2003 Jul-Aug;31(4):621-35.
11. Lynch JR, Waitayawinyu T, Hanel DP, Trumble TE. Medial collateral ligament injury in the overhand-throwing athlete. *J Hand Surg Am.* 2008 Mar;33(3):430-7.
12. Stevens KJ. Magnetic resonance imaging of the elbow. *J Magn Reson Imaging.* 2010 May;31(5): 1036-53.
13. Stevens KJ, McNally EG. Magnetic resonance imaging of the elbow in athletes. *Clin Sports Med.* 2010 Oct;29(4):521-53.
14. Fowler KAB, Chung CB. Normal MR imaging anatomy of the elbow. *Radiol Clin North Am.* 2006 Jul;44(4):553-67, viii.
15. Fritz RC, Steinbach LS. Magnetic resonance imaging of the musculoskeletal system: Part 3. The elbow. *Clin Orthop Relat Res.* 1996 Mar;324:321-39.
16. Hill NB Jr, Bucchieri JS, Shon F, Miller TT, Rosenwasser MP. Magnetic resonance imaging of injury to the medial collateral ligament of the elbow: a cadaver model. *J Shoulder Elbow Surg.* 2000 Sep-Oct;9(5): 418-22.
17. Schwartz ML, Al-Zahrani S, Morwessel RM, Andrews JR. Ulnar collateral ligament injury in the throwing athlete: evaluation with saline-enhanced MR arthrography. *Radiology.* 1995 Oct;197(1):297-9.
18. Timmerman LA, Schwartz ML, Andrews JR. Preoperative evaluation of the ulnar collateral ligament by magnetic resonance imaging and computed tomography arthrography. Evaluation in 25 baseball players with surgical confirmation. *Am J Sports Med.* 1994 Jan-Feb;22(1):26-31; discussion 32.
19. Fowler KAB, Chung CB. Normal MR imaging anatomy of the elbow. *Magn Reson Imaging Clin N Am.* 2004 May;12(2):191-206, v.
20. Sugimoto H, Ohsawa T. Ulnar collateral ligament in the growing elbow: MR imaging of normal development and throwing injuries. *Radiology.* 1994 Aug;192(2):417-22.
21. Munshi M, Pretterklieber ML, Chung CB, Haghighi P, Cho JH, Trudell DJ, Resnick D. Anterior bundle of ulnar collateral ligament: evaluation of anatomic relationships by using MR imaging, MR arthrography, and gross anatomic and histologic analysis. *Radiology.* 2004 Jun;231(3):797-803. Epub 2004 Apr 22.
22. O'Driscoll SW, Bell DF, Morrey BF. Posterolateral rotatory instability of the elbow. *J Bone Joint Surg Am.* 1991 Mar;73(3): 440-6.
23. Grafe MW, McAdams TR, Beaulieu CF, Ladd AL. Magnetic resonance imaging in diagnosis of chronic posterolateral rotatory instability of the elbow. *Am J Orthop (Belle Mead NJ).* 2003 Oct;32(10):501-3; discussion 504.
24. Terada N, Yamada H, Toyama Y. The appearance of the lateral ulnar collateral ligament on magnetic resonance imaging. *J Shoulder Elbow Surg.* 2004 Mar-Apr;13(2):214-6.
25. Melloni P, Valls R. The use of MRI scanning for investigating soft-tissue abnormalities in the elbow. *Eur J Radiol.* 2005 May;54(2):303-13.
26. Giuffrè BM, Moss MJ. Optimal positioning for MRI of the distal biceps brachii tendon: flexed abducted supinated view. *AJR Am J Roentgenol.* 2004 Apr;182(4):944-6.
27. Sampaio ML, Schweitzer ME. Elbow magnetic resonance imaging variants and pitfalls. *Magn Reson Imaging Clin N Am.* 2010 Nov;18(4):633-42. Epub 2010 Sep 01.
28. Williams BD, Schweitzer ME, Weishaupt D, Lerman J, Rubenstein DL, Miller LS, Rosenberg ZS. Partial tears of the distal biceps tendon: MR appearance and associated clinical

- findings. *Skeletal Radiol.* 2001 Oct;30(10):560-4.
29. Kraushaar BS, Nirschl RP. Tendinosis of the elbow (tennis elbow). Clinical features and findings of histological, immunohistochemical, and electron microscopy studies. *J Bone Joint Surg Am.* 1999 Feb;81(2):259-78.
30. Aoki M, Wada T, Isogai S, Kanaya K, Aiki H, Yamashita T. Magnetic resonance imaging findings of refractory tennis elbows and their relationship to surgical treatment. *J Shoulder Elbow Surg.* 2005 Mar-Apr;14(2):172-7.
31. Bredella MA, Tirman PFJ, Fritz RC, Feller JF, Wischer TK, Genant HK. MR imaging findings of lateral ulnar collateral ligament abnormalities in patients with lateral epicondylitis. *AJR Am J Roentgenol.* 1999 Nov;173(5):1379-82.
32. Miller TT, Shapiro MA, Schultz E, Kalish PE. Comparison of sonography and MRI for diagnosing epicondylitis. *J Clin Ultrasound.* 2002 May;30(4):193-202.
33. Schweitzer M, Morrison WB. Arthropathies and inflammatory conditions of the elbow. *Magn Reson Imaging Clin N Am.* 1997 Aug;5(3):603-17.
34. Berquist TH, Broderick DF. Musculoskeletal infection. In: Berquist TH, editor. *MRI of the Musculoskeletal System.* 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2006. pp. 916-47.
35. Boutin RD, Brossmann J, Sartoris DJ, Reilly D, Resnick D. Update on imaging of orthopedic infections. *Orthop Clin North Am.* 1998 Jan;29(1):41-66.
36. Simonson S, Lott K, Major NM. Magnetic resonance imaging of the elbow. *Semin Roentgenol.* 2010 Jul;45(3):180-93.
37. Kijowski R, De Smet AA. MRI findings of osteochondritis dissecans of the capitellum with surgical correlation. *AJR Am J Roentgenol.* 2005 Dec;185(6): 1453-9.
38. Rosenberg ZS, Bencardino J, Beltran J. MR features of nerve disorders at the elbow. *Magn Reson Imaging Clin N Am.* 1997 Aug;5(3):545-65.
39. Vucic S, Cordato DJ, Yiannikas C, Schwartz RS, Shnier RC. Utility of magnetic resonance imaging in diagnosing ulnar neuropathy at the elbow. *Clin Neurophysiol.* 2006 Mar;117(3):590-5. Epub 2006 Feb 14.
40. Kijowski R, Tuite M, Sanford M. Magnetic resonance imaging of the elbow. Part I: normal anatomy, imaging technique, and osseous abnormalities. *Skeletal Radiol.* 2004 Dec;33(12):685-97. Epub 2004 Oct 05.
41. Cheng XG, You YH, Liu W, Zhao T, Qu H. MRI features of pigmented villonodular synovitis (PVNS). *Clin Rheumatol.* 2004 Feb;23(1):31-4. Epub 2004 Jan 09.
42. Khanna AJ, Cosgarea AJ, Mont MA, Andres BM, Domb BG, Evans PJ, Bluemke DA, Frassica FJ. Magnetic resonance imaging of the knee. Current techniques and spectrum of disease. *J Bone Joint Surg Am.* 2001;83 (Suppl 2 Pt 2):128-41.
43. Frassica FJ, Khanna JA, McCarthy EF. The role of MR imaging in soft tissue tumor evaluation: perspective of the orthopedic oncologist and musculoskeletal pathologist. *Magn Reson Imaging Clin N Am.* 2000 Nov;8(4):915-27.
44. Gielen J, Wang XL, Vanhoenacker F, De Schepper H, De Beuckeleer L, Vandevenne J, De Schepper A. Lymphadenopathy at the medial epitrochlear region in cat-scratch disease. *Eur Radiol.* 2003 Jun;13(6):1363-9. Epub 2002 Oct 02.
45. Selby CD, Marcus HS, Toghill PJ. Enlarged epitrochlear lymph nodes: an old physical sign revisited. *J R Coll Physicians Lond.* 1992 Apr;26(2):159-61.



Cox[®] Seminars, Webinars, Workshops

share
evidence-based protocols and outcomes for spinal pain treatment

Cervical Spine—Thoracic Spine — Lumbar Spine

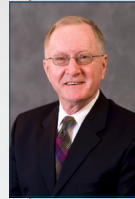
Research Outcomes

- Federally Funded HRSA Projects
 - Better for Radiculopathy Relief
 - Better for Chronic Moderate/Severe LBP
 - Better for Chronic Mild LBP
 - Better for Recurrent Mild LBP
 - Fewer Doctor Visits 1 year later
 - IVD Pressure Drop to **-39 to -192 mm Hg**
 - 28% increase in intervertebral foramen**
 - Better for LBP relief 1 year later
 - NEW! Cervical Spine IVD Pressure DROPS!**

"...taking the Cox courses over this year has really revived my enthusiasm for the profession and the practice, and opened me up to the power of what we can do. Having the **EVIDENCE** and the **PROTOCOL** for back and neck pain has made a huge difference for me."

Keith Olding, DC

Get ACO Recertification
Credits with Cox[®]
Courses!



Designed by Dr. James Cox, founder of Cox[®] Technic Flexion-Distraction and Decompression, Cox[®] Certification Courses offer **evidence-based application and support** to chiropractic physicians who invite the tough cases — **the disc herniation and stenosis cases** — as enthusiastically as other more common spine pain patients.

Hands-on practice at Part I is introductory and at Part II is more intense and available...**with an objective transducer to measure your pressure application.**

Cervical Spine Cox[®] Technic is introduced at Part I and built on with more hands-on at Part II.

Dr. Cox makes Clinical Practice Reality come to life at Part III which is open to everyone to see **how Cox[®] Technic affects patients and clinical practice!**

www.coxtechnic.com/events.aspx

1-800-441-5571

LIVE WEBINARS

January 16, 2014—12:30pm EST
Diagnostic Imaging: Beyond the Disc Pathology

February 20, 2014—12:30pm EST
Short Leg & Scoliosis; Diagnosis, Foot Examination, Orthotics

RECORDED WEBINARS

On Demand—On Your Time—
29 topics and growing—**CE Credits**
available in certain states.

HANDS-ON WORKSHOPS

February 15, 2014—**Minster, OH**
February 22, 2014—**Wildomar, CA** (CE for CA)
March 15, 2014—**Mayetta, NJ**
April 5, 2014—**Vancouver, Canada** (CE)
May 3, 2014—**Atlanta, GA**
May 16, 2014—**Chicago, IL**
June 7, 2014—**Wildomar, CA** (CE for CA)
TBA—**Herndon, VA**
TBA—**Halifax, Canada** (CE)

More dates/locations on the website.

SEMINARS

January 25-26, 2014
San Francisco—Part I with Dr. Greenwood
March 22-23, 2014
Orlando, FL—Part III with Dr. Cox
April 24-27, 2014
July 17-20, 2014
November 6-9, 2014
Fort Wayne, IN—Parts I/II with Cox[®] Team
October 11-12, 2014
Baltimore, MD—Part III with Dr. Cox

32 hours CE

Abstracts & Literature Review

Posterior Interosseous Neuropathy: Electrodiagnostic Evaluation

Anna-Christina Bevelacqua, MD, Catherine L. Hayter, MBBS, Joseph H. Feinberg, MD, Scott A. Rodeo, MD

HSSJ (2012) 8:184–189/Published online: 24 January 2012

* Hospital for Special Surgery 2012

JACO Editorial Reviewer: Gregory C. Priest, DC, FACO

Published:

Journal of the Academy of Chiropractic Orthopedists

September 2013, Volume 10, Issue 3

The original article copyright belongs to the original publisher. This review is available from: <http://www.dcorthoacademy.com>

© 2013 Priest 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

Electrodiagnostic studies are used to anatomically localize nerve injuries. These tests help differentiate between cervical radiculopathies, brachial plexopathies, and peripheral nerve injuries. They also help to identify or rule out other underlying neurological diseases and disorders. In this case report, a 22-year-old male swimmer presented with left finger extensor weakness following pull-up exercises. Left wrist extension remained intact.

Electrodiagnostic testing revealed a severe but incomplete posterior interosseous neuropathy. Magnetic resonance imaging (MRI) confirmed inflammation of the nerve in the forearm. Posterior interosseous neuropathy is an uncommon but well-studied condition. Typically, this condition presents with weakness in finger and thumb extension with preserved wrist extension as the extensor carpi radialis longus is innervated proximal to the site of nerve compression in most cases. It is important to understand the anatomic course and distribution of the radial nerve in order to make an accurate diagnosis. Once the anatomy is understood, electrodiagnostic testing may be used to identify the location of nerve injury and exclude other disorders.

Keywords

Posterior interosseous nerve, nerve injury, electromyography (EMG), electrodiagnostics, finger extension weakness.

Background

Posterior interosseous neuropathy (PIN) is an entrapment neuropathy of the deep branch of the radial nerve in the forearm. The deep branch of the radial nerve is primarily a motor nerve, and patients suffering from PIN may present with finger and thumb extension weakness without sensory abnormalities. The symptomatology associated with PIN makes it difficult to clinically differentiate from lateral epicondylitis, radial nerve injury, radial tunnel syndrome, cervical radiculopathy, and brachial plexopathy.

Familiarity with the anatomy of the course that the radial nerve follows in the forearm is important when considering the diagnosis of PIN. Judicious use of electrodiagnostic studies can aid the clinician in localizing the injury to the posterior interosseous nerve, as well as excluding other similar disorders and determining the severity and prognosis of the injury to the posterior interosseous nerve.

Methods

This is a case report of a 22-year-old left-handed male that presented with weakness of the fingers of

the left hand. Three months prior, the patient had been doing pull-ups when he became aware of tightness and discomfort at the lateral aspect of his left elbow. The following day, he found that he could not extend his left arm due to pain and tightness. Over the next few days his pain improved but he found that he had weakness upon extension of the fingers of his left hand. This was not associated with any other radicular symptomatology.

When he presented for examination three months after the initial episode he was found to have subtle atrophy of the muscles in his left forearm and weakness of the second, third, fourth and fifth fingers at the metacarpophalangeal joints of the left hand as well as left thumb extension. The remainder of upper extremity motor, sensory and reflex function was entirely intact. No other salient physical examination findings were noted.

Results

Six months after the initial episode, electrodiagnostic studies including electromyography and nerve conduction studies were performed, as were radiographs and MRI of the left elbow. The radiographs of the left elbow did not reveal any acute abnormalities of the bony structures. The MRI of the left elbow demonstrated hyperintensity of signal within the posterior interosseous nerve. The results of his electrodiagnostic testing included slowed left radial motor conduction velocity across the elbow, prolonged distal latency, and reduced amplitude at the forearm and the spiral groove when compared to the right side.

Electromyographic needle examination revealed severely abnormal spontaneous activity, discrete recruitment pattern, and decreased recruitment interval in posterior interosseous innervated muscles. The radially innervated brachioradialis was found to be normal. The authors found these findings to be consistent with a diagnosis of severe but incomplete left posterior interosseous neuropathy. The patient subsequently underwent two months of physical therapy and at one year follow-up he was found to have full range of motion

of the left wrist and fingers, as well as 85% improvement of finger strength.

Conclusions

Patients with PIN syndrome typically present with loss of motor function without sensory loss. In contrast, patients with radial tunnel syndrome (RTS) typically present with lateral proximal forearm pain rather than weakness. Posterior interosseous neuropathy syndrome is a result of compression of the PIN outside of the radial tunnel. Radial tunnel syndrome can be difficult to distinguish from lateral epicondylitis, and electrodiagnostic testing in RTS is often not helpful, whereas EMG/NCS are diagnostic in PIN syndrome.

In this case, electrodiagnostic testing was effective in localization of the level of the nerve injury. Brachial neuritis is also included in the differential diagnosis but was excluded in this case due to a lack of presentation of classic symptomatology seen in brachial neuritis such as cold or flu-like symptoms, history of prior surgery, or severe pain followed by weakness although this patient did have short-lived pain.

Clinical Relevance

The clinical diagnosis of PIN syndrome can be difficult, but electrodiagnostic testing and MRI are of great value in arriving at a correct diagnostic conclusion. Posterior interosseous neuropathy (PIN) syndrome can occur following trauma to the elbow (most often Monteggia fractures where the proximal ulna is fractured and the radial head dislocates posteriorly), following surgical release of the common extensor tendon for treatment of lateral epicondylitis, following prolonged compression by a forearm orthosis, or spontaneously.

JACO Editorial Summary:

- Posterior interosseous neuropathy is a rare but well-described syndrome.
- Brachial neuritis may also be included in the differential diagnosis, but in this case was

excluded due to a lack of concomitant symptomatology suggestive of brachial neuritis.

- Electrodiagnostic testing is of great value in the diagnosis of PIN syndrome, and in the differentiation from other disorders that may present similarly.
- PIN syndrome is primarily a motor disorder, vis-à-vis RTS which includes pain in the lateral proximal elbow which typically worsens with activity.
- MRI is helpful to exclude mass effect with compression of the nerve, as well as identifying hyperintensity of signal within the posterior interosseous nerve.
- MRI may demonstrate fatty atrophy in the chronic phase.
- PIN syndrome is typically treated conservatively with activity modification, splinting, physical therapy, anti-inflammatory medication, and/or corticosteroid injections when no identifiable cause is found on imaging studies.
- If the patient does not demonstrate satisfactory improvement within six months, spontaneous improvement is unlikely and surgical consultation becomes necessary.
- An understanding of the anatomic course and distribution of the radial nerve is necessary in order to make an accurate diagnosis of PIN syndrome.

References and Additional Readings

1. Akuthota V., Herring SA. Nerve and vascular injuries in sports medicine. Springer, New York. 2009: 79–81.
2. Bayramoglu M. Entrapment neuropathies of the upper extremity. *Neuroanatomy*. 2004, 3: 18–24.
3. Braddom, RL. Physical medicine and rehabilitation. Elsevier Science, Saunders, 3rd Edition, Philadelphia. 2007: 211–212.
4. Brown, WF, Bolton CF, Aminoff MJ. Neuromuscular function and Disease. Basic, clinical, and electrodiagnostic aspects. Volume 1. Elsevier Science, Saunders, Philadelphia. 2002: 924–926.
5. Cho CH, Lee KJ, Min BW. Tardy posterior interosseous nerve palsy resulting from residual dislocation of the radial head in a Monteggia fracture: a case report. *Journal of Medical Case Reports*. 2009; 3:9300.
6. Cho TK, Kim JM, Bak KH, Kim CH. Posterior interosseous nerve (PIN) syndrome caused by anomalous vascular leash. *J Korean Neurosurgery*. 2005; 37:293–295.
7. Dang AC, Rodner CM. Unusual compression neuropathies of the forearm, part II: median nerve. *J Hand Surg*. 2009;34A:1915–1920.
8. Dhall U, Kanta S. Variations in the nerve supply to extensor carpi radialis brevis. *J Ant Soc India*. 2001; 50(2). 134–136.
9. Dickerman R.D, Stevens Q.E.J., Cohen A.J., Jaikumar S. Radial tunnel syndrome in an elite power athlete: a case of direct compressive neuropathy. *Journal of the Peripheral Nervous System*. 2002; 4: 229–232.
10. Hazani R, Engineer N J, Mowlavi A, Neumeister M, Lee A, Wilhelmi BJ. Anatomic Landmarks for the Radial Tunnel. *Eplasty*. 2004; 8: 377–382.
11. Kirichi Y., Irmak M.K. Investigation of two possible compression sites of the deep branch of the radial nerve and the nerve supply of the extensor carpi radialis brevis muscle. *Neurol Med Chir (Tokyo)* 2004; 44: 14–19.
12. Kromberg A.J., Pestronk A. Chronic motor neuropathies: diagnosis, therapy, and pathogenesis. *Annals of Neurology*. 1995; 37(1): 43–50.
13. Latinovic R, Gulliford MC, Hughes RAC. Incidence of common compressive neuropathies in primary care. *J Neurol Neurosurg Psychiatry*. 2006; 77:263–265.
14. Loh YC, Lam WL, Stanley JK, Soames RW. A new clinical test for radial tunnel syndrome: the rule of nine test: a cadaveric study. *J Orthop Surg (Hong Kong)* 2004; 12(1): 83–86.
15. McCarty E.C, Tsairis P., Warten R.F. Brachial neuritis. *Clinical Orthopedics and Related Research*. 1999; 368: 37–42.
16. Miclan A, Ozge A, Sahin G, Saracoglu M, Kuyurtar F. The role of electrophysiologic tests in the early diagnosis of posterior interosseous neuropathy in patients thought to have lateral epicondylitis. *Acta Orthop Traumatol Turc* 2004; 38(5): 326–329.
17. Molina A.E.P, Bout C., Oberline C., Nzeuseu A., Vanwijk R. The posterior interosseous nerve

- and the radial tunnel syndrome: an anatomical study. *International Orthopaedics*. 1998; 22: 102–106.
18. Monteiro E., Moura A., Barros F., Carvalho P. Lipoma causing a posterior interosseous nerve syndrome. *European Journal Plastic Surgery*. 2002; 25: 35–37.
 19. Mulholland R.C. Non-traumatic progressive paralysis of the posterior interosseous nerve. *Journal of Bone and Joint Surgery*. 1966; 48B, No. 4: 781–785.
 20. Planchier KD, Peterson RK, Steichen JB. Compressive neuropathies and tendinopathies in the athletic elbow and wrist. *Clin Sports Med* 1996;15(2):331–71.
 21. Prasarthitha T., Prasert L., Rohanakit A., A study of the posterior interosseous nerve (PIN) and the radial tunnel in 30 Thai cadavers. *The Journal of Hand Surgery*. 1993; 18A:107–12.
 22. Ragoonwansi R., Kirkpatrick NW, Moss ALH. Posterior interosseous nerve palsy after intravenous cannulation of the forearm. *Journal of the Royal Society of Medicine*. 1999; 92: 411.
 23. Roles NC, Maudsley RH: Radial tunnel syndrome: resistant tennis elbow as a nerve entrapment, *Journal of Bone and Joint Surgery*. 1972; 54B(3): 499–508.
 24. Rosenbaum R. Disputed radial tunnel syndrome. *Muscle and Nerve*. 1999; 22: 960–967.
 25. Russel SM. (2006) Examination of peripheral nerve injuries: An anatomical approach. Thieme Medical Publishers, New York. 2006: 62–64.
 26. Siegel IM. Dorsal interosseous nerve compression syndrome from the use of a Canadian crutch. *Muscle Nerve*. 1988. 11 (12):1273–1274.
 27. Spinner M. The arcade of Frohse and its relationship to posterior interosseous nerve paralysis. *The Journal of Bone and Joint Surgery*. 1968; 50B: 809–812.
 28. Sunderamoorthy D, Chaudhury M. An uncommon peripheral nerve injury after penetrating injury to the forearm: the importance of clinical examination. *Emerg Med Journal*. 2003; 20: 565–566.
 29. Werner CO, Haeffner F., Rosen I. Direct recording of local pressure in the radial tunnel during passive stretch and active contraction of the supinator muscle. *Archives of Orthopaedic and Traumatic Surgery*. 1980; 96: 299–301.
 30. Werner CO. Paralysis of the posterior interosseous nerve caused by tumour: brief report. *The Journal of Bone and Joint Surgery*. 1987; 69 B(4): 670–671.
 31. White SH, Goodfellow JW, Mowat A. Posterior interosseous nerve palsy in rheumatoid arthritis. *J Bone Joint Surg Br*. 1988. 70B (3): 468–471.
 32. Vreiling C., Robinson P.H., Geertzen, J.H.B. Posterior interosseous nerve syndrome: literature review and report of 14 cases. *Eur J Plast Surg*. 1998; 21: 196–202.



Inside:

Spenco® TOTALSUPPORT™
Insoles when you wear shoes.



1-800-877-3626
www.spenco.com



We Make the Internet User-Friendly

*Your Web site is important.
And so is your time.*

Let ResidentTECH manage
your site, so you can manage
your business.

Contact us for your **FREE**
Web site evaluation!
Toll Free: **866.993.2228**
www.residenttech.com

To order the newly designed

Academy of Chiropractic Orthopedists'

Patient Education Brochure, purchase is now available at:

<http://www.dcorthoacademy.com/store-pamphlet.php>



Abstracts & Literature Review

Spinal Manipulation, Medication, or Home Exercise with Advice for Acute and Subacute Neck Pain

Gert Bronfort, DC, PhD; Ron Evans, DC, MS; Alfred V. Anderson, DC, MD; Kenneth H. Svendsen, MS;
Yiscah Bracha, MS; and Richard H. Grimm, MD, MPH, PhD

Annals of Internal Medicine; Vol 156 Number 1; 3 Jan 2012

JACO Editorial Reviewer: I. Clark Labrum, DC, FACO

Published:

Journal of the Academy of Chiropractic Orthopedists
September 2013, Volume 10, Issue 3

The original article copyright belongs to the original publisher. This review is available from: <http://www.dcorthoacademy.com>

© 2013 Labrum 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: The Goal of the study was to test the hypothesis that spinal manipulation therapy (SMT) is more effective than medication or home exercise with advice (HEA) for acute and sub-acute neck pain.

Study Design: Randomized, controlled trial.

Objective: To determine the relative efficacy of spinal manipulation therapy (SMT), medication and home exercise with advice (HEA) for acute and sub-acute neck pain in both the short and long term.

Summary of Background Data: Mechanical neck pain is a common condition that affects an estimated 70% of persons at some point in their lives. Little research exists to guide the choice of therapy for acute and sub-acute neck pain.

Methods: Two-hundred and seventy-two (272) persons aged 18 to 65 who had non-specific neck pain for 2 to 12 weeks were included in the study. The primary outcome was participant-rated pain, measured at 2, 4, 8, 12, 26, and 52 weeks after randomization. Secondary measures were self-reported disability, global improvement, medication use, satisfaction, general health status, and adverse events. Blinded evaluation of neck

motion was performed at 4 and 12 weeks. Objective measures of cervical spine motion were measured at 4 and 12 weeks by 7 trained examiners using a CA6000 Spine Motion Analyzer.

Results: For pain, SMT had a statistically significant advantage over medication after 8, 12, 26 and 52 weeks, and HEA was superior to medication at 26 weeks. No important differences in pain were found between SMT and HEA at any time point.

Conclusion: For participants with acute and sub-acute neck pain, SMT was more effective than medication in both the short and long term. However, a few instructional sessions of HEA resulted in similar outcomes at most time points.

Background

Neck pain is a prevalent condition that nearly three quarters of persons experience at some point in their lives. One of the most commonly reported symptoms in primary care settings, neck pain results in millions of ambulatory health care visits each year and increasing health care costs. Although it is not life-threatening, neck pain can have a negative effect on productivity and overall quality of life.

Methods

The trial was conducted from 2001 to 2007 in Minneapolis, Minnesota. Five-hundred and four (504) persons were evaluated for eligibility, of which 272 were randomly assigned to one of the 3 groups: 90 to the medication group, 91 to the SMT group, and 91 to the HEA group:

SMT Group

- 6 chiropractors with a minimum of 5 years experience served as the primary providers.
- Visits lasted 5-20 minutes, included a brief history and examination of the cervical and thoracic spine.
- Treatment focused on areas of spinal hypomobility using diversified technique of low amplitude high velocity, but also including some low amplitude spinal adjustments.
- The specific spinal level and the number of treatment sessions were left to the discretion of the provider over the 12 weeks.
- Adjunct therapy common to clinical practice included limited light soft tissue massage, assisted stretching, hot and cold packs.
- Advice on activity levels was recommended as needed.

Medication Group

- A licensed MD provided care with the focus of treatment on prescription medication.
- Visits lasted 15-20 minutes including a brief history and examination.
- The first line of therapy was non-steroidal anti-inflammatory drugs, acetaminophen, or both.
- If non-responsive, second line of therapy was narcotic medications.
- Muscle relaxants were also used
- Activity level was modified as needed.

HEA Group

- Home exercise with advice was provided in two 1-hour sessions, 1-2 weeks apart.
- 6 therapists provided instruction with focus on simple self-mobilization exercise of the neck and shoulder joints.

- The delivery method was 1 on 1, individualized to the patient's abilities.
- Participants were instructed to do 5 to 10 repetitions of each exercise, 6-8 times a day.
- Printed material of each exercise was provided as well as basic information about anatomy and postural instructions and demonstrations on how to lift were given.

Conclusions

Spinal Manipulation Therapy (SMT) was more effective than medication in both the short and long term. However, a few instructional sessions of HEA resulted in similar outcomes at most time points. Group differences in most secondary outcomes were similar to those of the primary outcomes. Spinal Manipulation Therapy was superior to medication at the end of treatment and during follow-up in terms of global improvement and participant satisfaction. Home exercise with advice (HEA) was superior to medication in both the short and long term for satisfaction with care and for long-term medication use.

Clinical Relevance

Health care practitioners who treat patients with musculoskeletal complaints should take note and may need to alter their approach to the care of neck pain. The doctor of chiropractic should take extra note as he/she may be in the best position to offer the best care by combining their skills of SMT with education as to how the patient can continue their treatment at home. Providing appropriate exercises and postural management as well as education in-office plus take home materials should aid in overall patient education and positive outcome.

JACO Editorial Summary:

- SMT was more effective for acute and sub-acute neck pain than medication.
- However, a few instructional sessions of HEA resulted in similar outcomes at most time points
- Participants were excluded who had any of the following conditions: cervical spine instability, fracture, referred pain, neurologic deficits, existing cardiac disease, blood clotting

disorders, DISH, infectious disease, substance abuse, pregnancy, previous cervical spine surgery or involved in litigation.

- Overall, the greatest changes in cervical spine motion were observed in the HEA group.
- Participant satisfaction was greatest in the SMT group and lowest in the medication group.
- No serious adverse events were reported in the study. Expected, non-serious adverse events that are typical to these treatments did occur and were all transient in nature.
- This study was intended to be pragmatic in nature and to answer clinical questions regarding commonly used treatment approaches by approximating how they are delivered in practice.

Summary

In light of the current legislation regarding national health care, health care providers who treat neck pain should pay attention to this study and take note as to how they can best position their practice to not only provide consistent and beneficial outcomes but also at a reasonable cost. The doctor of chiropractic is in a unique position to do this. Failure to do so, may not only result in their exclusion from participation at a personal/local level but as a profession as a whole.

References and Additional Readings

1. Cote P, Cassidy JD, Carroll L. The Saskatchewan health and back pain survey. The prevalence of neck pain and related disability in Saskatchewan adults. *Spine (Phila Pa 1976)*. 1998;23:1689-98.
2. Fejer R, Kyvik KO, Hartvigsen J. The prevalence of neck pain in the world population: a systematic critical review of the literature. *Eur Spine J*. 2006;15: 834-48.
3. Hogg-Johnson S, van der Velde G, Carroll LJ, Holm LW, Cassidy JD, Guzman J, et al; Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders. The burden and determinants of neck pain in the general population: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. *Spine (Phila Pa 1976)*. 2008;33:S39-51.
4. Guzman J, Haldeman S, Carroll LJ, Carragee EJ, Hurwitz EL, Peloso P, et al; Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. Clinical practice implications of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders: from concepts and findings to recommendations. *Spine (Phila Pa 1976)*. 2008;33:S199-213.
5. Riddle DL, Schappert SM. Volume and characteristics of inpatient and ambulatory medical care for neck pain in the United States: data from three national surveys. *Spine (Phila Pa 1976)*. 2007;32:132-40.
6. Barnes PM, Powell-Griner E, McFann K, Nahin RL. Complementary and alternative medicine use among adults: United States, 2002. *Adv Data*. 2004;1-19.
7. Coulter ID, Hurwitz EL, Adams AH, Genovese BJ, Hays R, Shekelle PG. Patients using chiropractors in North America: who are they, and why are they in chiropractic care? *Spine (Phila Pa 1976)*. 2002;27:291-6.
8. Martin BI, Deyo RA, Mirza SK, Turner JA, Comstock BA, Hollingworth W, et al. Expenditures and health status among adults with back and neck problems. *JAMA*. 2008;299:656-64.
9. Cote P, van der Velde G, Cassidy JD, Carroll LJ, Hogg-Johnson S, Holm LW, et al; Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. The burden and determinants of neck pain in workers: results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. *Spine (Phila Pa 1976)*. 2008;33:S60-74.
10. Cote P, Kristman V, Vidmar M, Van Eerd D, Hogg-Johnson S, Beaton D, et al. The prevalence and incidence of work absenteeism involving neck pain: a cohort of Ontario lost-time claimants. *Spine (Phila Pa 1976)*. 2008;33:S192-8.
11. Linton SJ, Hellsing AL, Hallden K. A population-based study of spinal pain among 35-45-year-old individuals. Prevalence, sick leave, and health care use. *Spine (Phila Pa 1976)*. 1998;23:1457-63.

12. Gross AR, Hoving JL, Haines TA, Goldsmith CH, Kay T, Aker P, et al; Cervical overview group. Manipulation and mobilisation for mechanical neck disorders. *Cochrane Database Syst Rev*. 2004;CD004249.
13. Kay TM, Gross A, Goldsmith C, Santaguida PL, Hoving J, Bronfort G; Cervical Overview Group. Exercises for mechanical neck disorders. *Cochrane Database Syst Rev*. 2005;CD004250.
14. Peloso P, Gross A, Haines T, Trinh K, Goldsmith CH, Burnie S; Cervical Overview Group. Medicinal and injection therapies for mechanical neck disorders. *Cochrane Database Syst Rev*. 2007;CD000319.
15. Gross A, Miller J, D'Sylva J, Burnie SJ, Goldsmith CH, Graham N, et al. Manipulation or mobilisation for neck pain. *Cochrane Database Syst Rev*. 2010; CD004249.
16. Spitzer WO, Skovron ML, Salmi LR, Cassidy JD, Duranceau J, Suissa S, et al. Scientific monograph of the Quebec Task Force on Whiplash-Associated Disorders: redefining "whiplash" and its management. *Spine (Phila Pa 1976)*. 1995;20:1S-73S.
17. Guzman J, Hurwitz EL, Carroll LJ, Haldeman S, Co'te' P, Carragee EJ, et al; Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. A new conceptual model of neck pain: linking onset, course, and care: the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. *Spine (Phila Pa 1976)*. 2008;33:S14-23.
18. Pocock SJ. *Clinical Trials. A Practical Approach*. Chichester, United Kingdom: J Wiley; 1986.
19. Evans R, Bronfort G, Bittell S, Anderson AV. A pilot study for a randomized clinical trial assessing chiropractic care, medical care, and self-care education for acute and subacute neck pain patients. *J Manipulative Physiol Ther*. 2003;26: 403-11.
20. Bergmann TF, Peterson DH. *Chiropractic Technique: Principles and Procedures*. 3rd ed. St. Louis: Mosby; 2011.
21. Seffinger MA, Najm WI, Mishra SI, Adams A, Dickerson VM, Murphy LS, et al. Reliability of spinal palpation for diagnosis of back and neck pain: a systematic review of the literature. *Spine (Phila Pa 1976)*. 2004;29:E413-25.
22. Tierney LM, McPhee SJ, Papadakis MA. *Current Medical Diagnosis and Treatment*. 36th ed. Stamford, CT: Appleton & Lange; 1997.
23. Scholten-Peeters GG, Bekkering GE, Verhagen AP, van Der Windt DA, Lanser K, Hendriks EJ, et al. Clinical practice guideline for the physiotherapy of patients with whiplash-associated disorders. *Spine (Phila Pa 1976)*. 2002;27:412-22.
24. McKenzie R. *Treat Your Own Neck*. 3rd ed. Waikanae, New Zealand: Spinal Publications; 2002.
25. Bronfort G, Evans R, Nelson B, Aker PD, Goldsmith CH, Vernon H. A randomized clinical trial of exercise and spinal manipulation for patients with chronic neck pain. *Spine (Phila Pa 1976)*. 2001;26:788-97.
26. Jaeschke R, Singer J, Guyatt GH. A comparison of seven-point and visual analogue scales. Data from a randomized trial. *Control Clin Trials*. 1990;11:43-51.
27. Jensen MP, Karoly P, Braver S. The measurement of clinical pain intensity: a comparison of six methods. *Pain*. 1986;27:117-26.
28. Huskisson EC. Measurement of pain. *Lancet*. 1974;2:1127-31.
29. Carlsson AM. Assessment of chronic pain. I. Aspects of the reliability and validity of the visual analogue scale. *Pain*. 1983;16:87-101.
30. Vernon H, Mior S. The neck disability index: a study of reliability and validity. *J Manipulative Physiol Ther*. 1991;14:409-15.
31. Koes BW, Bouter LM, van Mameren H, Essers AH, Verstegen GM, Hofhuizen DM, et al. A blinded randomized clinical trial of manual therapy and physiotherapy for chronic back and neck complaints: physical outcome measures. *J Manipulative Physiol Ther*. 1992;15:16-23.
32. Deyo RA, Walsh NE, Martin DC, Schoenfeld LS, Ramamurthy S. A controlled trial of transcutaneous electrical nerve stimulation (TENS) and exercise for chronic low back pain. *N Engl J Med*. 1990;322:1627-34.
33. Hansen FR, Bendix T, Skov P, Jensen CV, Kristensen JH, Krohn L, et al. Intensive, dynamic back-muscle exercises, conventional physiotherapy, or placebo-control treatment of low-back pain. A randomized, observer-blind trial. *Spine (Phila Pa 1976)*. 1993;18:98-108.

34. Bronfort G, Goldsmith CH, Nelson CF, Boline PD, Anderson AV. Trunk exercise combined with spinal manipulative or NSAID therapy for chronic low back pain: a randomized, observer-blinded clinical trial. *J Manipulative Physiol Ther.* 1996;19:570-82.
35. Daffner SD, Hilibrand AS, Hanscom BS, Brislin BT, Vaccaro AR, Albert TJ. Impact of neck and arm pain on overall health status. *Spine (Phila Pa 1976).* 2003;28:2030-5.
36. Dvorak J, Antinnes JA, Panjabi M, Loustalot D, Bonomo M. Age and gender related normal motion of the cervical spine. *Spine (Phila Pa 1976).* 1992; 17:S393-8.
37. Petersen CM, Johnson RD, Schuit D. Reliability of cervical range of motion using the OSI CA 6000 spine motion analyser on asymptomatic and symptomatic subjects. *Man Ther.* 2000;5:82-8.
38. Evans R, Bronfort G, Nelson B, Goldsmith CH. Two-year follow-up of a randomized clinical trial of spinal manipulation and two types of exercise for patients with chronic neck pain. *Spine (Phila Pa 1976).* 2002;27:2383-9.
39. Littell RC, Milliken GA, Stroup WW, Wolfinger RD. *SAS System for Mixed Models.* Cary, NC: SAS Publications; 1996.
40. Verbeke G, Molenberghs G, eds. *Linear Mixed Models in Practice: A SAS Oriented Approach.* New York: Springer; 1997.
41. Brown H, Prescott R. *Applied Mixed Models in Medicine.* New York: J Wiley; 1999.
42. Jennrich RI, Schluchter MD. Unbalanced repeated-measures models with structured covariance matrices. *Biometrics.* 1986;42:805-20.
43. Pocock SJ, Assmann SE, Enos LE, Kasten LE. Subgroup analysis, covariate adjustment and baseline comparisons in clinical trial reporting: current practice and problems. *Stat Med.* 2002;21:2917-30.
44. Yu LM, Chan AW, Hopewell S, Deeks JJ, Altman DG. Reporting on covariate adjustment in randomised controlled trials before and after revision of the 2001 CONSORT statement: a literature review. *Trials.* 2010;11:59.
45. Sherman KJ, Cherkin DC, Erro J, Miglioretti DL, Deyo RA. Comparing yoga, exercise, and a self-care book for chronic low back pain: a randomized, controlled trial. *Ann Intern Med.* 2005;143:849-56.
46. Levin J, Serlin R, Seaman M. A controlled, powerful multiple-comparison strategy for several situations. *Psychol Bull.* 1994;115:153-9.
47. Little RJ, Rubin DB. *Statistical Analysis with Missing Data.* 2nd ed. New York: J Wiley; 2002.
48. Rubin DB. Inference and missing data. *Biometrika* 1976;63:581-92.
49. Ostelo RW, de Vet HC. Clinically important outcomes in low back pain. *Best Pract Res Clin Rheumatol.* 2005;19:593-607.
50. Pool JJ, Ostelo RW, Hoving JL, Bouter LM, de Vet HC. Minimal clinical important change of the Neck Disability Index and the Numerical Rating Scale for patients with neck pain. *Spine (Phila Pa 1976).* 2007;32:3047-51.
51. Sherman KJ, Cherkin DC, Hawkes RJ, Miglioretti DL, Deyo RA. Randomized trial of therapeutic massage for chronic neck pain. *Clin J Pain.* 2009; 25:233-8.
52. Fritz JM, Hebert J, Koppenhaver S, Parent E. Beyond minimally important change: defining a successful outcome of physical therapy for patients with low back pain. *Spine (Phila Pa 1976).* 2009;34:2803-9.
53. Bendtsen L, Bigal ME, Cerbo R, Diener HC, Holroyd K, Lampl C, et al; International Headache Society Clinical Trials Subcommittee. Guidelines for controlled trials of drugs in tension-type headache: second edition. *Cephalalgia.* 2010;30:1-16.
54. Ostelo RW, Deyo RA, Stratford P, Waddell G, Croft P, Von Korf M, et al. Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change. *Spine (Phila Pa 1976).* 2008;33:90-4.
55. Guyatt GH, Juniper EF, Walter SD, Griffith LE, Goldstein RS. Interpreting treatment effects in randomised trials. *BMJ.* 1998;316:690-3.
56. Dworkin RH, Turk DC, McDermott MP, Peirce-Sandner S, Burke LB, Cowan P, et al. Interpreting the clinical importance of group differences in chronic pain clinical trials: IMMPACT recommendations. *Pain.* 2009;146:238- 44.\

57. Hill J, Lewis M, Papageorgiou AC, Dziedzic K, Croft P. Predicting persistent neck pain: a one-year follow-up of a population cohort. *Spine (Phila Pa 1976)*. 2004;29:1648-54.
58. Hoving JL, Koes BW, de Vet HC, van der Windt DA, Assendelft WJ, van Mameren H, et al. Manual therapy, physical therapy, or continued care by a general practitioner for patients with neck pain. A randomized, controlled trial. *Ann Intern Med*. 2002;136:713-22.
59. Hoving JL, de Vet HC, Koes BW, Mameren H, Deville WL, van der Windt DA, et al. Manual therapy, physical therapy, or continued care by the general practitioner for patients with neck pain: long-term results from a pragmatic randomized clinical trial. *Clin J Pain*. 2006;22:370-7.
60. Pool JJ, Ostelo RW, Ko"ke AJ, Bouter LM, de Vet HC. Comparison of the effectiveness of a behavioural graded activity program and manual therapy in patients with sub-acute neck pain: design of a randomized clinical trial. *Man Ther*. 2006;11:297-305.
61. Cleland JA, Glynn P, Whitman JM, Eberhart SL, MacDonald C, Childs JD. Short-term effects of thrust versus nonthrust mobilization/manipulation directed at the thoracic spine in patients with neck pain: a randomized clinical trial. *Phys Ther*. 2007;87:431-40.



The Journal of the Academy of Chiropractic Orthopedists welcomes your comments on these and any other issues you wish to provide feedback on.

Please address your comments or concerns to the Editors at:
ACO@dcorthoacademy.com

Editor-In-Chief

Bruce Gundersen, DC, FACO

Editor

Stanley N. Bacso, DC, FACO, FCCO(C)

Associate Editor

James Demetrious, DC, FACO

Associate Editor

David Swensen, DC, FACO

Announcements

Announcements

The University of Bridgeport's orthopedic Diplomate with a sub-specialty in neuromusculoskeletal medicine will begin in Fort Lauderdale, FL on December 7 and 8, 2013.

Please contact Dr. James Lehman at jlehman@bridgeport.edu for further information.

Future Orthopedic Diplomate Examination:

Date: Fall 2014

Location: Northwestern Health Sciences University
8400 Penn Avenue South
Bloomington, MN 55431

Watch this website for the exact date