

Magnetic resonance imaging of subjects with acute unilateral neck pain and restricted motion: a feasibility study



8th ICAOR, Milan, Italy, April, 2010

Gary Fryer, Ph.D., B.Sc.(Osteopathy),^{1,2} James Adams, D.O.³

Still Research Institute
A.T. STILL UNIVERSITY OF HEALTH SCIENCES

VICTORIA UNIVERSITY

A NEW SCHOOL OF THOUGHT

¹A.T. Still Research Institute, A.T. Still University, Kirksville, MO, USA

²School of Biomedical & Health Sciences, Victoria University, Melbourne, Australia

³Kirksville College of Osteopathic Medicine, Kirksville, MO, USA

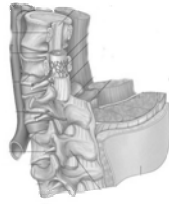
Introduction

- Palpation of soft tissue texture and subtle joint motion are considered important for the assessment of somatic dysfunction
- Clinical indicators of dysfunction are said to be
 - Tissue texture change
 - Asymmetry
 - Range of motion disturbance
 - Tenderness

Greenman PE. *Principles of Manual Medicine*. 3rd ed. Philadelphia: Lippincott William & Wilkins; 2003
DiGiovanna EL, Schiowitz S, Dowling DJ. *An Osteopathic Approach to Diagnosis & Treatment*. 3rd ed. Philadelphia: Lippincott William & Wilkins; 2005

Etiology and pathophysiology of somatic dysfunction are speculative

- Proposed that segmental dysfunction is not a single clinical entity
 - potentially a number of distinct pathologies and functional disturbances
 - related by a natural history of strain and degeneration
- When acute, palpable signs may be related to tissue inflammation, and range of motion disturbance to zygapophysial synovitis & effusion



Fryer G. Intervertebral dysfunction: a discussion of the manipulable spinal lesion. *J Osteopath Med*. 2003;6(2):64-73.
Fryer G, Fossum C. Therapeutic mechanisms underlying muscle energy approaches. In: Fernández-de-las-Peñas C, Arendt-Nielsen L, Gerwin RD, eds. *Tension-type and Cervicogenic Headache: Pathophysiology, Diagnosis, and Management*. Sudbury, MA: Jones and Bartlett Publishers; 2009:221-225.

Few studies have examined volunteers with spinal pain & dysfunction for signs of inflammation in deep spinal structures

- Nazarian *et al.* used diagnostic ultrasound to detect signs of cervical and lumbar zygapophysial joint inflammation in patients with neck and LBP
 - Did not demonstrate abnormal echogenicity in or adjacent to these joints
 - Did not report the duration of symptoms, and it is likely the subjects were suffering from sub-acute or chronic pain

Possible that zygapophysial joint effusion may only be evident in the very acute stage of joint injury

Rhodes DW, Bishop PA. A review of diagnostic ultrasound of the spine and soft tissue. *J Manip Physiol Ther*. 1997;20:267-273
Nazarian LN, Zegel HG, Gilbert KR, Edell SL, Bakst BL, Goldberg BB. Paraspinous ultrasonography: lack of accuracy in evaluating patients with cervical or lumbar back pain. *J Ultrasound Med*. 1998;17:117-122

MRI in arthritides

- Established as a sensitive and specific tool to detect sacroiliitis
- Used to detect periarticular inflammation in the lumbar and thoracic spines of people with ankylosing spondylitis

Therefore, MRI may be useful in the detection of spinal inflammation in acute nontraumatic spinal pain

Lukas C, Braun J, van der Heijde D, Hermann KG, Rudwaleit M, Ostergaard M, et al.: Scoring inflammatory activity of the spine by magnetic resonance imaging in ankylosing spondylitis: a multireader experiment. *J Rheumatol* 2007, 34:862-870.
Hermann K-GA, Althoff CE, Schneider U, Zühlsdorf S, Lembcke A, Hamm B, et al.: Spinal Changes in Patients with Spondyloarthritis: Comparison of MR Imaging and Radiographic Appearances. *Radiographics* 2005, 25:559-569.

Acute 'crick in the neck' pain

- Acute neck pain with marked restricted motion (typically of rotation & sidebending to side of pain)
- Benign self-limiting condition that affects adults
- Typically involves trivial or no trauma
- Clinical signs of acute somatic dysfunction (TART)



May be an ideal condition to explore deep spinal structures for signs of inflammation

Aims of study

1. Examine the feasibility of recruiting subjects with acute neck pain of less than 48 hours duration
2. Investigate the cervical spine with MRI for inflammation and joint effusion in subjects with acute neck pain
3. Correlate abnormal MRI findings with palpatory findings

Methods

- Recruitment
 - Posters displayed at ATSU and Truman State at participating medical clinics
 - E-mails circulated to student & employees
 - ATSU IRB Ethics approval
- Was necessary to create awareness of study so that individuals contact the researchers on the day of onset of pain



Participant eligibility

- **Inclusion criteria**
 - Acute unilateral neck pain of less than 48 hours duration
 - Physical examination confirms
 - focal tenderness in cervical region
 - painful limitation of full movement in cervical extension, sidebending, and/or rotation to the side of pain
- **Exclusion criteria:**
 - Recent history of major trauma (e.g. whiplash)
 - Radiation of pain or neurological signs
 - Previous diagnosis of cervical disc prolapsed
 - Use of anti-inflammatory medication in the previous six hours
 - Contraindications for MRI examination such as cardiac pacemakers & metal implants

Procedure

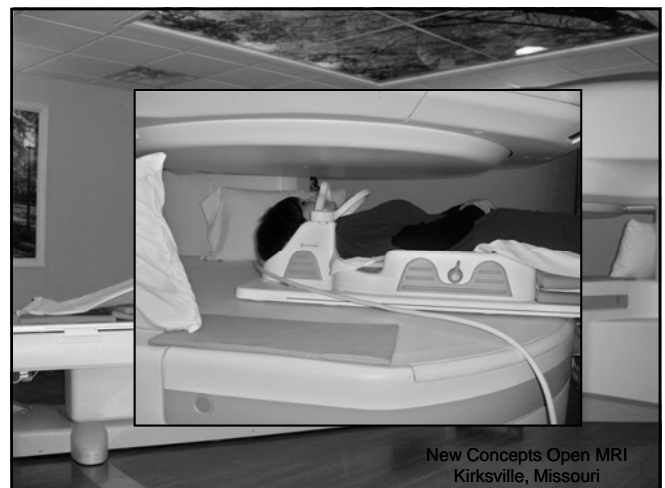
- Posters and e-mails
 - Necessary to create awareness of study so that individuals contact the researchers on the day of onset of pain
- Physical examination
 - Pain severity, current & worst (0-10 scale)
 - Active range of motion (ranked on 0-3 scale)
 - Side and spinal level of tenderness
 - Segmental motion restriction (ranked on 0-2 scale)
- Blinded MRI examination
 - Same day
 - Repeat in 2 weeks if positive findings

MRI examination

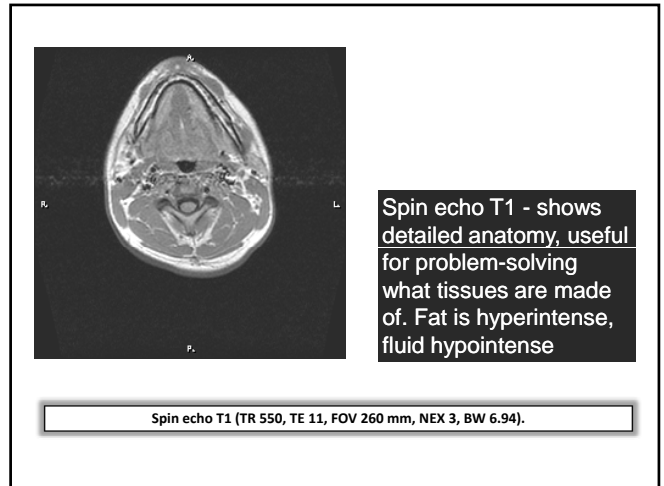
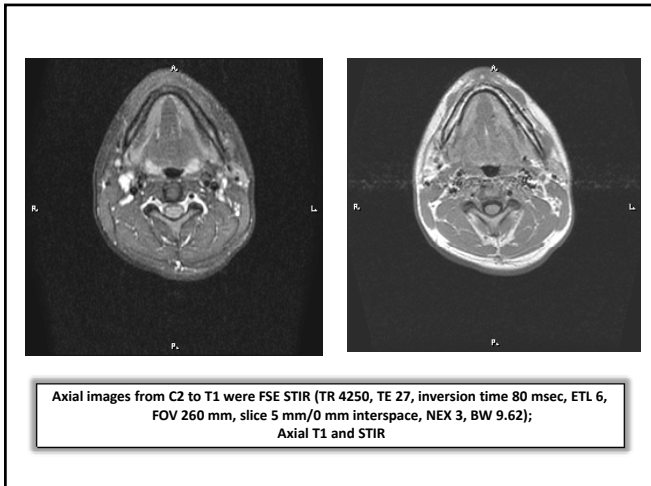
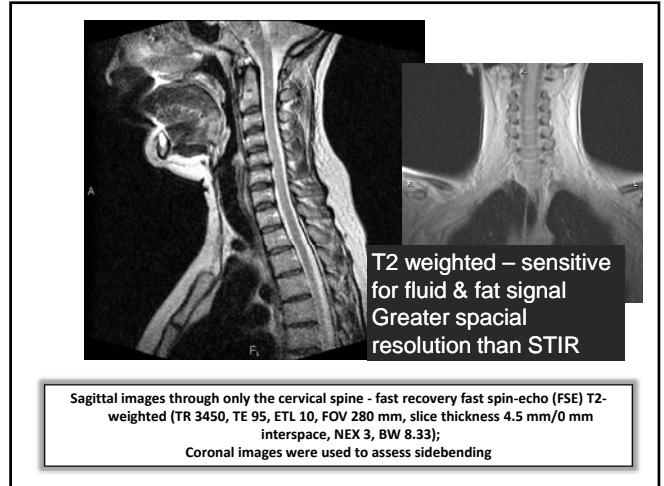
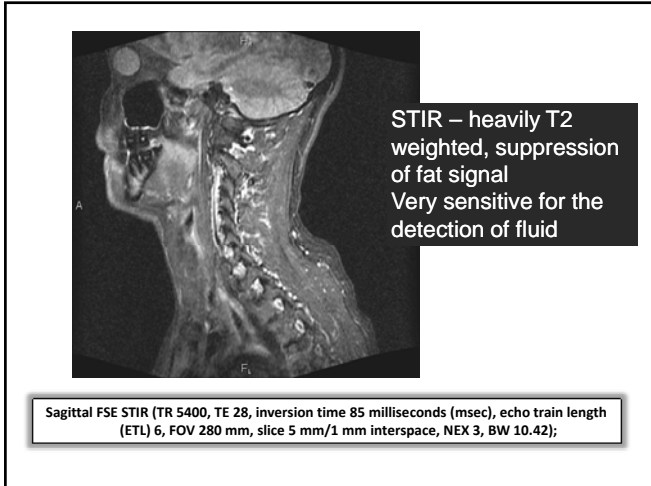
- MRI imaging was performed with a 0.35-T MRI system (Signa Ovation: GE Medical Systems, Milwaukee, WI) using a dedicated phased-array C-T-L spine surface coil
- Dedicated radiology PACS workstation (eFilm Workstation 3.0, Merge Healthcare, Milwaukee, Wis)
- Board-certified diagnostic radiologist with added qualification and fellowship training in body imaging/ cross sectional (JA) with 13 years experience

MRI PROTOCOL

1. **Sagittal images through entire neck** – Fast spin-echo (FSE) STIR, repetition time (TR) 5400 milliseconds, echo time (TE) 28 milliseconds, inversion time 85 milliseconds, echo train length (ETL) 6, field of view (FOV) 280 millimeters, slice 5 mm/1 mm interspace, number of excitations (NEX) 3, and bandwidth 10.42 kHz.
2. **Sagittal images through only the cervical spine** – Fast Recovery FSE T2-weighted, TR 3450, TE 95, ETL 10, FOV 280, slice thickness 4.5 mm/0 mm interspace, NEX 3, and bandwidth 8.33.
3. **Axial images from C2 to T1** – Series one: FSE STIR, TR 4250, TE 27, inversion time 80, ETL 6, FOV 260, slice 5 mm/0 mm interspace, NEX 3, and bandwidth 9.62. Series two: SE T1, TR 550, TE 11, FOV 260, slice 5 mm/0 mm interspace, NEX 3, and bandwidth 6.94



New Concepts Open MRI
Kirksville, Missouri



MRI analysis

- Evidence of capsule or periarticular oedema and joint space T2 increase was recorded
- signs were to be ranked on a Berlin scoring system
- Additionally, other signs recorded:
 - muscle oedema
 - alignment (lordosis, side bending)
 - disc disease
 - facet arthritic change
 - spinal stenosis

MRI findings were correlated with

- Symptoms (side of pain, level)
- Palpatory findings (side of pain, level, restriction)

Results

Subjects

- Five subjects were recruited over a 3-month period
- 3 females, 2 males, Mean age 31.6 years (SD 12.4)

Subject	Side of Pain	Level of Pain	Current Pain	Worst Pain
1	Left	All	3	7
2	Left	Upper	6	8
3	Right	Upper	7	7
4	Right	Lower	4	6
5	Left	Lower	4	7
Mean (SD)			4.8 (1.6)	7.0 (0.7)

- Symptoms
 - Mean current pain = 4.8 (SD 1.6, visual analogue scale 0-10)
 - Worst pain since onset = 7.0 (SD 0.7)
 - Mean duration of symptoms = 12.4 hours (SD 14.1)

Results

Limited active motion

- Rotation to the painful side
- followed by side bending to the painful side and extension

Subject	Side Bending		Rotation		Flexion	Extension
	Ipsilateral	Opposite	Ipsilateral	Opposite		
1	1	0	0	1	1	0
2	2	0	2	0	1	0
3	3	1	2	0	1	3
4	1	1	2	1	3	2
5	2	2	2	2	3	2
Mean	1.8	0.8	1.6	0.8	1.8	1.4
SD	0.8	0.8	0.9	0.8	1.1	1.3

0-3 point scale: 0 = no restriction, 1 = mild restriction, 2 = moderate restriction, and 3 = marked restriction

Results

Palpation

- Most symptomatic segment varied from subject to subject
- Perceived degree of restriction at that segment varied from mild to markedly restricted

Subject	Side	Spinal Level	Restriction
1	Left	C4	1
2	Left	C2	2
3	Right	C2	2
4	Right	C6	1
5	Left	C7	2
Mean (SD)			1.6 (0.6)

Segmental motion restriction ranked on a 0-2 scale, where 0 = no restriction, 1 = mild restriction, and 2 = moderate restriction

MRI findings

- No findings on MRI examination demonstrated clear evidence of either synovial effusion or inflammation around the joints of the cervical spine

MRI findings

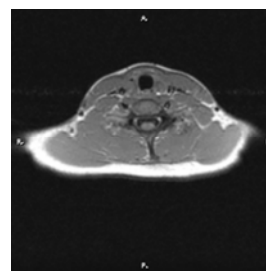
- No findings on MRI examination demonstrated clear evidence of either synovial effusion or inflammation around the joints of the cervical spine
- In some individuals, signs of muscle oedema, altered alignment, disc and facet arthrosis, and spinal stenosis were noted

MRI findings

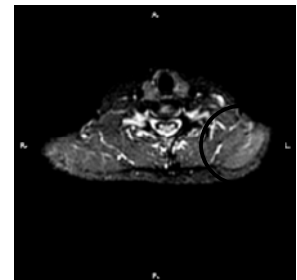
Subject	Muscle edema (signal increase)	Alignment Lordosis	Alignment Side Bending	Disc Degeneration	Facet Arthrosis	Spinal Stenosis
1	Subtle increase right inferior paraspinals	Straightened mid cervical	Left, minimal	C5/6, mild bilateral	No	C5/6, mild central canal
2	Subtle increase left trapezius and lower cervical region	Near straightened	Right, mild	C5/6, mild, worse right; C6/7, mild	No	C5/6 and C6/7, mild central canal
3	Subtle increase left trapezius and lower cervical region	Kyphotic mid cervical	Left, mild	No	No	No
4	Subtle increase left paraspinal region and mid neck	Kyphotic mid cervical	No	No	Mild unciniate arthrosis C6/7	No
5	Subtle increase right paraspinal and mid-upper cervical	Kyphotic mild lower cervical	No	C5/6, mild; C6/7, minimal	No	C5/6, mild central canal

These did not appear to be related to the symptomatic segmental level or side of pain

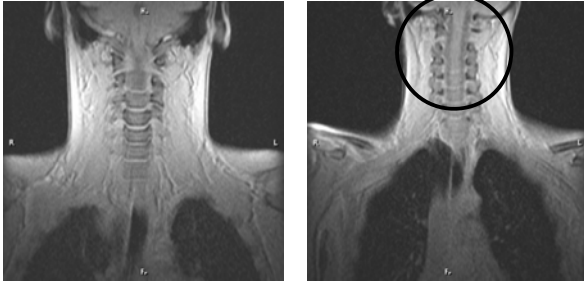
T1



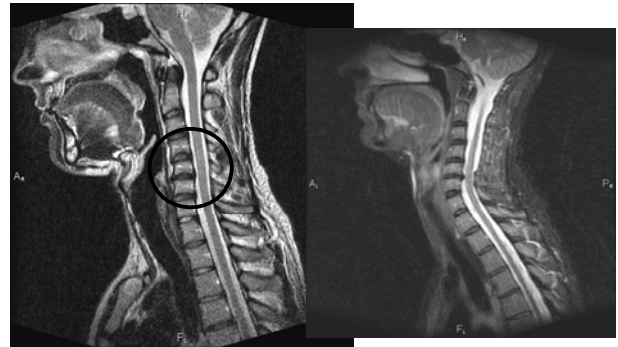
STIR



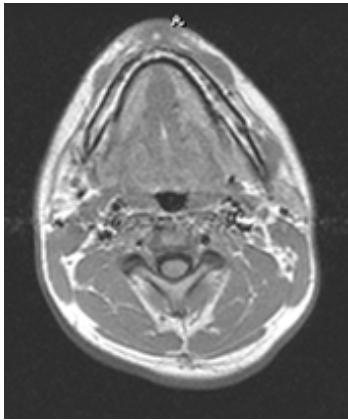
Subtle left trapezius muscle oedema



Assessment of sidebending from initial localizer images



Disc degeneration, with posterior disc bulging greater at C5-6 than at C4-5. C5-6 has a right-central herniation



No signs of facet degeneration

Discussion

- Very few researchers have attempted to investigate the deep structures of the spine in patients with pain for signs of inflammation
- No study examined patients with acute pain

- This feasibility study established that subjects with acute neck pain (less than 48 hours) could be recruited, albeit with difficulty and over a substantial period
- Failed to find any indication of inflammation in the deep spinal structures using MRI

Zygapophysial joint has been implicated as a major pain generator in chronic cervical and LBP

- Underlying etiology has not been determined
 - Capsule sprain and tears demonstrated
 - Association with acute or chronic neck or back pain unknown

- Although sample size was small, no relevant signs of inflammation were found in any of the five subjects
- Suggests that inflammation is not likely detectable using these methods even in a larger cohort
- Consistent with findings of Nazarian et al.
 - Ultrasonography less sensitive, subjects not acute

Cavanaugh JM, Lu Y, Chen C, Kallakuri S. Pain generation in lumbar and cervical facet joints. *J Bone Joint Surg Am.* Apr 2006;88
Bogduk N. *Clinical Anatomy of the Lumbar Spine and Sacrum.* 4th ed. New York: Churchill Livingstone; 2005
Nazarian LN, Zegel HG, Gilbert KR, Edell SL, Bakst BL, Goldberg BB. Paraspinal ultrasonography: lack of accuracy in evaluating patients with cervical or lumbar back pain. *Journal of Ultrasound Medicine.* 1998;17:117-122

Minor pathologies were detected in all subjects

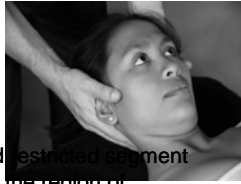
- No obvious relation to side and level of pain
- Likely these pathologies were incidental and unrelated to the current presentation of pain or the findings on palpation

Consistent with evidence that

- Degree of cervical lordosis/ kyphosis cannot accurately identify 'cervical muscle spasm'
- Degenerative changes observed in MRI are common in asymptomatic subjects and are not well correlated with neck pain

Nordin M, Carragee EJ, Hogg-Johnson S, et al. Assessment of Neck Pain and Its Associated Disorders: Results of the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and Its Associated Disorders. *Spine.* 2008;33(4S):S101-S122

Palpation



- Palpation of the most sensitive and restricted segment coincided with the side of pain and the region of symptoms in all subjects
- Identified segment appeared markedly restricted with motion palpation in all cases
- Lends support for the validity of palpation

**Researcher was not blinded to the clinical picture of subjects
Concordance alone is therefore not convincing evidence of the
reliability and validity of palpation**

Feasibility of recruitment



- Feasible, but difficult
 - Within 48 hours of onset of pain
- In order to achieve a larger sample:
 - Create awareness of the study in a community
 - Longer recruitment period
 - Newspaper and radio advertising

Limitations & recommendations

- Small sample size
- Does not rule out inflammatory changes associated with acute neck pain
 - Low grade sprains of much larger joints can be occult to MRI and other imaging
- Imaging with higher field strength systems may possibly detect very subtle inflammation
 - Tailored techniques at 3 Tesla (or even the ultra-high 7 tesla)
 - Gadolinium IV-enhancement

Conclusion

- Recruitment of subjects with acute 'crick in the neck' pain is difficult but feasible over a long data collection period
- No evidence of cervical joint inflammation was detected
 - a variety of degenerative features were identified which appeared incidental to the presenting complaint
- If inflammatory changes exist in or around the cervical joints in subjects with acute neck pain, more sensitive imaging methods are required to detect it

Questions?

