Understanding the Chronically Painful Neck

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Catherine is a 45-year-old lawyer and mother of two young children. She has suffered fairly constant neck pain and muscular tightness for the past 10 years, which began gradually in the absence of any obvious injury. Balancing the demands of work and young children has meant less in the way of general physical activity and exercise over that time. Six months ago she recalls jolting her neck during a rough boat ride whilst on holiday in Fiji. Her pain subsequently worsened and she recalls feeling very dizzy for the following week.

Catherine also developed aching pain in the right scapula and upper arm a short time later and has been feeling diffuse tingling sensations in her right arm at night in bed. She saw her GP after returning home, who obtained an MRI of the cervical spine. This demonstrated mild disc degenerative changes at C5-6 and C6-7, but without any signs of disc protrusion or neural compression. It was explained to Catherine that the weakened disc structure was the most likely cause of her pain and she was referred for physiotherapy.

Catherine was prescribed chin retraction exercises, along with isometric neck flexion exercises for strengthening, although she discontinued these after a short time because of increased pain. She then saw a chiropractor, who found her neck to be quite stiff on palpation and attributed her pain primarily to facet joint restriction and associated muscle spasm. Manual adjustments to her C1-2 segment were applied over 2-3 treatment sessions, however, this made her feel worse and she discontinued treatment.

Catherine's work has been very stressful over the past 4 months and she has been surviving with regular paracetamol and ibuprofen. She still suffers motion disturbances, periodic dizzy feelings when at work, occasional blurry vision and chronic pain and stiffness in her neck and shoulders. Her level of anxiety is increasing and she has felt periods of depression lately, as she struggles to keep up with her work and home activities.

Desperate to find relief for the tightness in her neck, Catherine tried massage a few weeks ago, which provided small and only transient benefit. She consulted her GP again last week, who felt that she seemed to be running out of options and suggested undergoing facet joint blocks.

Q1. What do you think are the major pain generators in Cathryn's neck?

Q2. How would you explain her feeling of stiffness even though her gross range of motion is normal?

Q3. Offer an explanation as to why previous treatment approaches may not have been successful?

Q4. Outline the functional deficits that are known to be associated with chronic neck pain and which ones do you recognise with Cathryn?

Q5. Explain a management strategy that would aim to address both the peripheral and central mechanisms of pain and dysfunction with Cathryn?

CENTRAL THEME

BEIGHTON SCALE

Joint Finding	Negative	Unilateral	Bilateral
Passive dorsiflexion of 5th finger >90 degrees	0	1	2
Passive dorsiflexion of thumbs to the forearm	0	1	2
Hyperextension of the elbows beyond 10 degrees	0	1	2
Hyperextension of the knees beyond 10 degrees	0	1	2
Forward flexion of the trunk with knees fully extended and palms resting on the floor	0	Present = 1	

BEIGHTON SCALE

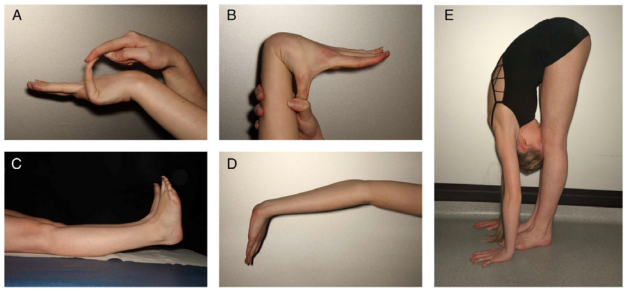

Figure 1 Components of the Beighton score.[11] A maximum of two points are scored for each of the manoeuvres demonstrated (on each side of the body) involving (A) little fingers, (B) thumbs, (C) knees and (D) elbows. One point is scored for spinal flexion (E) when able to place the palms of the hands flat on the floor with knees straight.

PAIN MECHANISMS

Input mechanisms
Nociceptive pain and peripheral neurogenic pain

Processing mechanisms
Central sensitisation and cognitive/affective mechanisms

Output mechanisms
Impaired motor control, autonomic, neuroendocrine and immune

INPUT MECHANISMS

Zygapophysial joint pain
55%

Intervertebral disc pain
16%

Lateral atlantoaxial pain
9%

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Prevalence of annular tears and disc herniations on MR images of the cervical spine in symptom free volunteers

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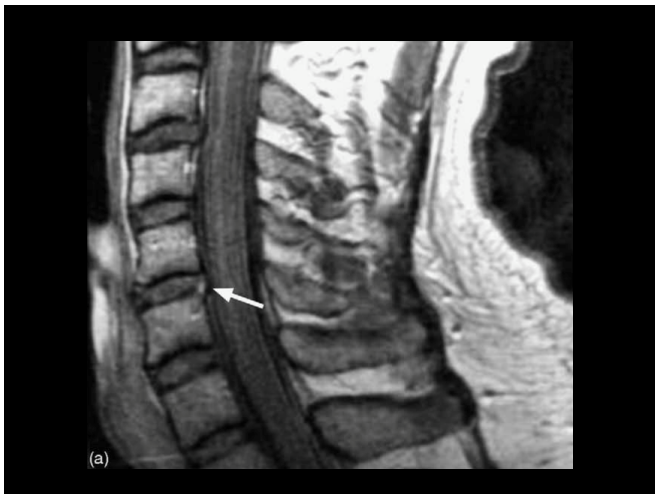
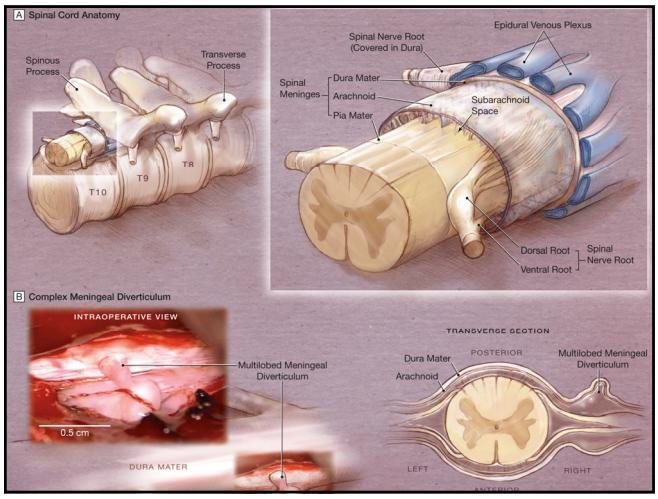
Abstract

Study design: Prospective MR analysis of the cervical spine of 30 asymptomatic volunteers.
Objectives: To evaluate the prevalence of annular tears, bulging discs, disc herniations and medullary compression on T2-weighted and gadolinium-enhanced T1-weighted magnetic resonance (MR) images of the cervical spine in symptom free volunteers.
Summary of background data: Few studies have reported the prevalence of cervical disc herniations in asymptomatic people, none have reported the prevalence of cervical annular tears on MR images of symptom free volunteers.
Materials and methods: Thirty symptom-free volunteers (no history or symptoms related to the cervical spine) were examined using sagittal T2-weighted fast spin-echo (SE), sagittal gadolinium-enhanced T1-weighted SE imaging and axial T2*-weighted gradient echo (GRE). The prevalence of bulging discs, focal protrusions, extrusions, nonenhancing or enhancing annular tears and medullary compression were assessed.
Results: The prevalence of bulging disk and focal disk protrusions was 73% (22 volunteers) and 50% (15 volunteers), respectively. There was one extrusion (3%).

Eleven volunteers had annular tears at one or more levels (37%) and 94% of the annular tears enhanced after contrast injection. Asymptomatic medullary compression was found in four patients (13%).
Conclusion: Annular tears and focal disk protrusions are frequently found on MR imaging of the cervical spine, with or without contrast enhancement, in asymptomatic population. The extruded disk herniation and medullary compression are unusual findings in a symptom-free population.





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Cervical Roots as Origin of Pain in the Neck or Scapular Regions

Yasuhisa Tanaka, MD, Shoichi Kokubun, MD, Tetsuro Sato, MD, and Hiroshi Ozawa, MD

Study Design. A prospective observational study.
Objectives. To determine whether the pain in the neck or scapular regions in patients with cervical radiculopathy originates from the compressed root and whether the site of pain is useful for diagnosing the level.
Summary of Background Data. The pain has been thought to be caused not by root compression but by instability caused by disc degeneration or zygapophysial joint osteoarthritis because it usually precedes radicular symptoms in the arm/fingers.
Methods. The subjects were 50 consecutive patients with pain as well as arm/finger symptoms, who underwent single-root decompression alone. The involved roots were C5 in 9 patients, C6 in 14, C7 in 14, and C8 in 13.
Results. The pain preceded the arm/fingers symptoms in 35 patients (70%). Although the pain had lasted for more than 7 months on average before surgery, it was relieved early after surgery in 46 patients (92%). When the painful site was suprascapular, C5 or C6 radiculopathy was frequent ($P < 0.01$). When it was interscapular, C7 or C8 radiculopathy was frequent ($P < 0.001$). When it was scapular, C8 radiculopathy was frequent ($P < 0.01$).
Conclusions. Pain in the suprascapular, interscapular, or scapular regions can originate directly in the compressed root. The site of the pain is valuable for determining localization of the involved root.
Key words: cervical radiculopathy, neck pain, scapular pain, cervical nerve root, diagnosis, surgery. **Spine 2006; 31:E568–E573**

When the pain originates from an intervertebral disc or joint, it will not be relieved with surgery that simply decompresses the root without fusion. On the other hand, when the pain originates from a compressed nerve root, it may be perceived at a site referable to the root. This study was prospectively conducted to determine whether the neck and scapular pain in patients with radiculopathy originates from the nerve root and whether the perceived site of the pain is useful for diagnosing the level of the involved nerve root.

■ Materials and Methods

Patients. The subjects of this study were 50 consecutive patients (42 males and 8 females) with radiculopathy who complained of neck or scapular pain as well as symptoms in an arm or fingers, and underwent single-nerve root decompression through posterior open foraminotomy[7] between January 1998 and December 2002. Surgeries were indicated after ineffective conservative treatment for at least 4 months, except for the patients with the inability to elevate the shoulder or extend the fingers, in which cases surgery was indicated earlier. Informed consent was obtained from all the patients before surgery. The age of the patients at surgery ranged from 30 to 80 years (average 52). The duration of symptoms in the arm or fingers before surgery ranged from 2 months to 3 years (average 7 months). The involved nerve roots were C5 in 9 patients, C6 in 14, C7 in 14, and C8 in 13.

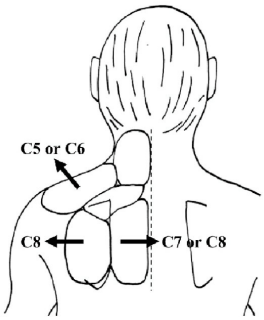

Figure 5. Site of the neck or scapular pain and the indicated level of the involved nerve root.

3 TYPES OF NEURAL INSULT

ISCHAEMIC
Vascular compromise

INFLAMMATORY
Chemical irritation

MECHANICAL
Physical compression or traction

Manual Therapy (2001) **6(2),** 106–115

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Clinical commentry

Acute low cervical nerve root conditions: symptom presentations and pathobiological reasoning

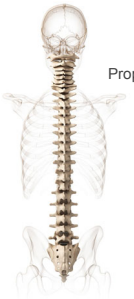
L. Gifford

SUMMARY. **Acute low cervical nerve root conditions may be easily misdiagnosed. The perspective presented is that their symptom presentation is not as straightforward as the classic descriptions of brachialgia would have us believe. This clinical commentary presents a series of observations and reasoning models that are relevant to patient symptom presentations believed to be of cervical nerve root origin. Clinicians are urged to consider low cervical nerve root assessment in the light of our current understanding of neural sensitivity, pain science, nerve root biomechanics and the presence and effect of degenerative changes. This particularly relates to thoughts about cervical movements and postures being able to bring forces to bear on nerve roots via compressive as well as elongation forces.** © **2001 Harcourt Publishers Ltd.**

INPUT MECHANISMS

With pain comes guarding and reduced movement, altered axes of joint rotation

Reduced joint position sense in the neck is strongly associated with chronic neck pain



Proprioception

INPUT MECHANISMS

Hand 1st lumbrical
16 spindles/gm

Trapezius
2 spindles/gm

Obliquus capitis inferior
242 spindles/gm

CENTRAL PROCESSING MECHANISMS

Central sensitisation
The altered responsiveness of central pain pathways and processing areas

Scrutiny
Constant sampling of the neck tissues and how the input is interpreted by the pain neuromatrix

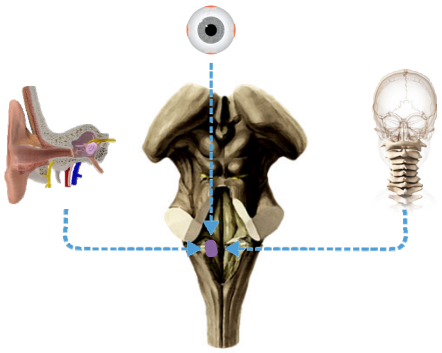
Impaired sensorimotor control
The neck is a uniquely important joint system in that it's also essentially an organ of balance, postural control and spatial orientation

SENSORIMOTOR CONTROL

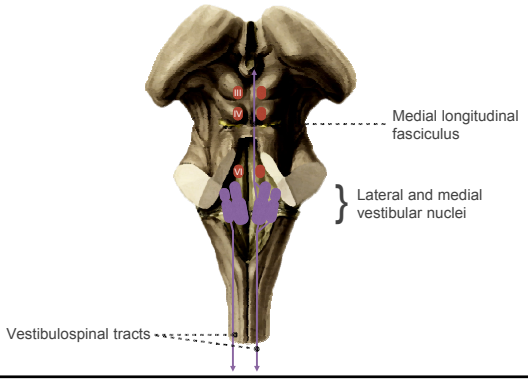
The way in which sensory input drives motor output

Includes all the afferent, efferent and central connections involved in maintaining stability in the postural system

MIDLINE MOTOR CONTROL



THE VESTIBULAR NUCLEI



Exp Brain Res (2002) 147:89–97
DOI 10.1007/s00221-002-1218-2

RESEARCH ARTICLE

Georg Schweigart · Rey-Djin Chien · Thomas Mergner

Neck proprioception compensates for age-related deterioration of vestibular self-motion perception

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Abstract Vestibular functions are known to show some deterioration with age. Vestibular deterioration is often thought to be compensated for by an increase in neck proprioceptive gain. We studied this presumed compensatory mechanism by measuring psychophysical responses to vestibular (horizontal canal), neck and combined stimuli in 50 healthy human subjects as a function of age (range 15–76 years). After passive horizontal rotations of head and/or trunk (torso) in complete darkness (dominant frequencies 0.05, 0.1, and 0.4 Hz), subjects readjusted a visual target to its remembered prerotational location in space. (1) *Vestibular-only stimulus* (whole-body rotation); subjects' responses were shifted towards postrotatory

It is internally shaped to always match the vestibular signal, so that these two signals cancel each other out when summed during head rotation on stationary trunk. Because of this matching, perceived trunk stationariness during head rotation on the stationary trunk is independent of vestibular deterioration (related to stimulus frequency, age, ototoxic medication, etc.). The other neck proprioceptive signal, coding head-on-trunk rotation, is superimposed on the estimate of trunk-in-space rotation, thereby yielding a notion of head-in-space. This neck signal remains essentially unchanged with vestibular deterioration. Generally, we hold that the transformation of the vestibular signal from the head down to the trunk

- Delayed onset of deep neck flexors
- Increased activation of superficial neck flexors
- Decreased flexor muscle endurance
- Decreased cervical muscle strength
- Multifidus muscle atrophy
- Lower movement velocity
- Jerky movement patterns
- Reduced trajectory movement control
- Irregular and stiffer movement patterns
- Increased postural sway
- Functional balance disturbances and dizziness
- Reduced cervical joint position sense
- Breakdown in eye movement control

The key finding was that neck pain patients show an overall more rigid neck motor control pattern compared to healthy controls - indicated by lower neck flexibility, slow movement velocity, increased head steadiness and a more rigid trajectory. Neck flexibility was the parameter that showed the significant association with clinical features in neck pain patients.

Neck pain patients may still have a full gross range of motion in a certain direction, but the conjunct movements were much more limited. There is a marked limitation in the richness of small movements.

SPINAL STIFFNESS

Stiffen muscles to reduce movement variability in order to protect 'weak' and de-conditioned tissues

The central representation of the neck is disorganised, distorted, smudged and smaller

Sensory conflict with vestibular inputs and vision will produce abnormal postural control reflexes in the spine and eyes

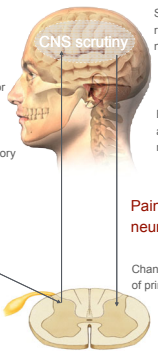
A lack of alternative motor strategies creates a neck that is inherently unstable, but stiff

De-conditioning, injury and stress

Life impact, meaning of injury and pain - resulting beliefs

TCC - genetic tendency for sensitivity and inhibitory function

VN and cerebellum - sensory conflict with other balance inputs



Shrinkage of cortical representation of the neck

Balance disturbance and anxiety, abnormal neck/eye motor control

Pain output from neuromatrix

Change in response pattern of primary afferents

Tissue pathology - peripheral pain generators, disturbed proprioceptive reporting

Altered movement behaviour and muscle recruitment (stiffening of motor pattern), change in receptor properties, further de-conditioning, underuse, atrophy

MANAGEMENT CONSIDERATIONS

Input mechanisms
Nociceptive pain and peripheral neurogenic pain

Processing mechanisms
Central sensitisation and cognitive/affective mechanisms

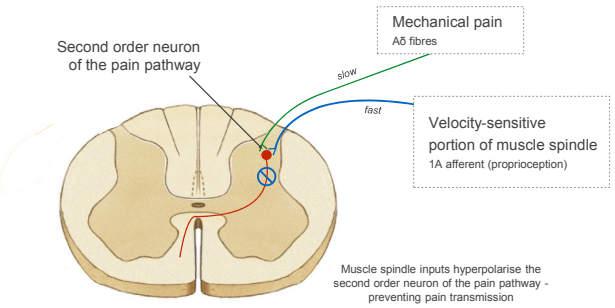
Output mechanisms
Impaired motor control, autonomic, neuroendocrine and immune

MANAGEMENT CONSIDERATIONS

- What does the adjustment do in terms of an input?
- What is unique about HVLA?
- The role of the muscle spindle apparatus
- What is a 'novel stimulus'?
- Tissue stretch versus proprioceptive activation
- Sensory discrimination re-training
- Reversing a form of sensory neglect

autonomic, neuroendocrine and immune

NOVEL SENSORY STIMULUS



Muscle spindle inputs hyperpolarise the second order neuron of the pain pathway - preventing pain transmission

MANAGEMENT CONSIDERATIONS

Input mechanisms
Nociceptive pain and peripher
neurogenic pain

Processing mechanisms
Central sensitisation and
cognitive/affective mecha

Output mechanisms
Impaired motor control,
autonomic, neuroendocrine and
immune

MANAGEMENT CONSIDERATIONS

RE-FRAME RE-MAP RE-LEARN