Headaches: Pain Science View

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Prevalence of C-spine disorders

Neck pain in Hong Kong: a telephone survey on prevalence, consequences, and risk groups.


In Spinal Pain (especially LBP) a model emerged...

Followed by another...

- If a 100 people attended PT with LBP, surely some must get better when we manipulate them.
- Some must get better if we teach them stabilization exercises
- Some need medical attention
- Etc.

Wouldn't it be great to know ahead of time who they are?

The “New” Model

New Neck Pain Model

Ipsistate.com
Prevalence

Headaches are common
- 47% point prevalence
- 68% Lifetime prevalence

- Cervicogenic headache:
  - 2.5 - 13.8% of the population
- Tension-type Headache:
  - 40-74% of population - almost 80% of all headache diagnoses

Impact of Headaches

- One of the 5 most disabling disorders in women
- More functional limitation than chronic diabetes, HT, OA and LBP
- Socio-economic impact
- Impact on individual headache sufferer


Perceived Impact of Chronic HA [Diener 2001]

- 70 – 90% gradually change from episodic to almost continuous headache syndromes within an average time period of 10.7 years
- Prevalence of Chronic Daily Headache = 3 - 5 % of the population
Clinically: The STORY...

1. Tension-Type
2. Cervicogenic
3. Migraine

TCN: Headaches

The TCN is a relay center
- Afferent fibers from the upper three cervical nerve roots
- Trigeminal nerve

The spinal nucleus of the trigeminal nerve extends caudally to the dorsal horn of the upper three cervical spinal segments

TCN: Filling the Cauldron*


*Concept from Dr. Ina Diener
1. Tension-Type Headache

Severity = Frequency!

Finally, depending on the frequency of the headaches, patients can be diagnosed as:

a. Infrequent episodic TTH: at least 10 episodes occurring on <1 day per month on average (<12 days per year)

b. Frequent episodic TTH: at least 10 episodes occurring >1 but <15 days per month for at least 3 months (>12 but <100 days per year)

c. Chronic tension-type headache: Headache occurring on >15 days per month on average for >3 months (>150 days per year)

Notes: *History and physical and neurological examination do not suggest any of the disorders listed in groups 5-12, or history and/or physical examination suggest a headache but it is ruled out by appropriate investigations, or such diagnosis is uncertain*. Further diagnosis can be sought for a time in a controlled environment to the disease.


1. TTH: Central Sensitization...

- Increased sensitivity due to HA
- Headache causes central sensitization and not the other way around


**TTH End Result?**

**Trigger Points**
- Tender spot in a taut band
- Positive twitch response
- Referred pain

**Inflammatory Changes**
- Increased N-Sensitivity

**Increased Sensitivity**

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**TTH: Trigger Points**

1. Tender spot in a taut band
2. Positive twitch response
3. Referred pain

---

**TTH End Result?**

Trigger points = major cause of TTH
- 100% of TTH patients have trigger points in the sub-occipital muscles
- 70% of the trigger points represent the exact same symptoms as the TTH

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**TTH End Result?**

- 70% of the trigger points represent the exact same symptoms as the TTH
- Active trigger points refer and produce HA
- TP: increased intensity and frequency of HA
- Associated with TP and NOT tender points
C-Spine: Large, extra sensitive nerves


Stimulation of the Cervical Spine Facet Joints


Nerve Innervation

- Medial branch
- Dorsal ramus


Injection Studies


Cevicogenic Headache


The upper cervical dura:
A small tendon from rectus capitis posterior minor inserts into the posterior dura to keep the dura tight when the neck is extended.

Neurodynamics and Cervicogenic Headaches


Dural Ligaments and Headaches


Kids, Growth Spurts and Headaches


WAD: Forward Head

Rectus capitis posterior minor
Dura mater

Sub-Occipital Clinical Presentation


Hypermobility linked to headaches

- Eleven of the 12 headache patients were found to have cervical spine joint hypermobility.
- Ten of the 12 NDPH patients had evidence of widespread joint hypermobility with the Beighton score.
- We suggest that joint hypermobility, specifically of the cervical spine, may be a predisposing factor for the development of headaches.


WAD Capsular Avulsions

3. Migraines


3. Migraines with Aura


3. Migraines

The most noticeable difference between TTH, CG and migraines is the presence of:

- Photophobia
- Vomiting
- Nausea
- Throbbing
- Pounding


Table 2: International Classification of Migraine Without Aura (ICHS Second Edition, 2004)*

<table>
<thead>
<tr>
<th>Diagnostic criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. At least five attacks fulfilling criteria B-D</td>
</tr>
<tr>
<td>B. Headache attacks lasting 4-72 hours (ambrosoled or unsensitively treated)</td>
</tr>
<tr>
<td>C. Headaches at least 2 of the following pain characteristics:</td>
</tr>
<tr>
<td>1. Unilateral location</td>
</tr>
<tr>
<td>2. Provoked by or occurring in association with routine physical activity such as walking or climbing stairs</td>
</tr>
<tr>
<td>D. During headache at least one of the following:</td>
</tr>
<tr>
<td>1. Nausea and/or vomiting</td>
</tr>
<tr>
<td>2. Photophobia and phonophobia</td>
</tr>
</tbody>
</table>

*Not defined for other disorders

Note: *myopЋ and vascular headache have been reclassified under the new International Classification of Headache Disorders (ICHD-3), which may lead to differences in the number of attacks per month.
3. Migraine

Migraine without Aura


3. Migraine: Allodynia


3. Migraines

Only headache category associated with genetics


Other Headaches (? Migraines)

Exercise-related Headaches
- Exertional headache
- Valsalva-type maneuvers
  - Wrestling
  - Weight-lifting
- Not vascular, but has a vascular base
  - ?blood pressure
- Exclude subarachnoid hemorrhage

Effort headache
- Most common type of HA in athletes
- Maximal or submaximal aerobic activity
- ?Fluid imbalance
- Migraine-like treatment e.g. medicine
- Goggle headache
- Diver’s headache
- Altitude headache

Post-traumatic Headaches

Concussion
- Blow to the head
- With or without loss of consciousness
- Headache
- Disorientation
- Confusion
- Dizziness
- Amnesia
- Etc.

Headache Continuum

- With persistent input there is increased CNS sensitivity and development of allodynia
- Migraine sufferers also suffer from TTH and that TTH patients (especially chronic TTH) suffer from migraines

Migraine: Increased Sensitization

Infrequent TTH  Frequent TTH  Chronic TTH  Migraines

TTH  Time  Migraine

Headache Summary

<table>
<thead>
<tr>
<th>Clinical Trait</th>
<th>CGH</th>
<th>TTH</th>
<th>Migraine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unilaterality %</td>
<td>100</td>
<td>8</td>
<td>52</td>
</tr>
<tr>
<td>Mechanical precipitation</td>
<td>100</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Prior onset, attacks%</td>
<td>97</td>
<td>30</td>
<td>22</td>
</tr>
<tr>
<td>Diffuse Arm discomfort%</td>
<td>100</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Restriction, ROM %</td>
<td>93</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td>Photophobia %</td>
<td>19</td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

The Subjective Examination

The subjective evaluation is the cornerstone in establishing an effective treatment plan


SINS

- “Severity” — Debilitating; High intensity
- “Irritability” — Small movement causes a lot of pain and take a while to subside
- “Nature” — Deep, burning...type of pathology, i.e., nerve root
- “Stage” — Prognosis/stage of the disorder

Gathered subjectively and objectively to help aid diagnosis, prognosis, caution and vigor of tests and treatments
The Categories

1. Kind of disorder
2. History
3. Site of Symptoms
4. Behavior of Symptoms
5. Special Questions

1. Kind of Disorder

- The main problem – from the patient’s perspective
- Typically:
  - Pain (headache)
  - Limited movement
  - Limited range of motion
  - Decreased Function
  - Facial symptoms: Paresthesia, etc.
  - Photophobia
  - Phonophobia
  - Etc.

Why we use “History” first...

- By focusing on pain and the word “pain” we increase the pain experience
- Immediately jumping to “site” maybe over-emphasizes pain?
- Building a relationship/trust with a patient is strongly correlated to success

Interview Skills...

- Verbal and non-verbal
- Open ended questions
- Receptive
- Control the interview where needed
- Speak slowly
- Be deliberate in questions
- Ask one question at a time
- Never assume anything
- Use the patient's words

“SINS”

- SINSS
  - Severity
  - Irritability
  - Nature
  - Stage
  - STABILITY

- SPINS
  - Severity
  - PAIN MECHANISM
  - Irritability
  - Nature
  - Stage

2. History

• **Onset of the disorder**
  - How and when did this start?
  - What kind of symptoms was present when it started?
  - Did any of the symptoms spread anywhere else?
  - How long did it take for the symptoms to come on?
  - What were you doing around the time of the onset?
  - What do you think happened?
  - Why do you think you hurt?

• **Diagnosis, treatment and it's effect**
  - Self
  - Pharmaceutical
  - Surgical
  - Specialists
  - Conservative/non-pharmaceutical
    • Manual therapy?
    • Effect?

• **Progression of the disorder**
  - Is it getting better, worse or the same?
  - If (better, worse or the same), in which way?
  - Musculoskeletal issues get better (by itself) over time:
    Cervicogenic headaches

• **Previous history**
  - Similar episodes
    • How often does it happen?
    • How long does it last?
  - Any cervical spine episodes
    • Motor vehicle collisions
  - Other orthopedic issues
  - Other medical issues

3. Site of Symptoms

• **Area/s**
• **Depth**
• **Nature**
• **Correlation**

• **Prioritize the symptoms**
  - P1
  - P2
  - P3
  - Etc.
3. Site of Symptoms

- **Nature**
  - Constant vs. Intermittent
    - Constant:
      - Variable
      - Non-variable
    - “Dull, Ache, Sharp, Stabbing, Burning”

- **Correlation between symptoms:**
  - “When P1 gets bad, then P2 starts”


Areas

- Does this help?
- We need more...

Nature

- Adding more detail
- Patient information

Correlation

If you can only aim at one (P1, P2 or P3), which one would you and why?

3. Site of Symptoms

- Need a working knowledge of dermatomes...

Chronic Widespread Pain

Headaches and Facial Pain

- Face Recognition in Patients with Migraine: Yetkin-Ozden, Ekizoglu & Baykan Pain Practice 2014
  - Migraineurs had poorer performance in both face recognition and visuospatial perception
- Recognition of emotional facial expressions and alexithymia in patients with chronic facial pain: von Piekartz et al 2013
  - Recognition of facially expressed emotions, and the ability to identify and describe one’s own feelings are restricted in chronic facial pain sufferers

Emerging Research: Headaches and Facial Pain


4. Behavior of Symptoms

- What increases symptoms?
- What decreases symptoms?
- SINS (SINSS/SPINS)
- Latency
- Daily Pattern
4. Behavior of Symptoms

• **Increases**
  - Activity
  - Positions
  - Mechanical loading
  - Duration
  - Frequency

• **Decreases**
  - Unloading
  - Rest (short)
  - Rest (long)
  - Sleep
  - Self-treatments
  - Medications

- **SINS**
  - Latency
    - “I will pay for it later today or tomorrow”
  - Inflammation
  - Sensitized nervous system


4. Behavior of Symptoms

• **Daily pattern**
  - AM – still in bed awake
  - AM – immediately out of bed
  - 30 minutes later after moving
  - Middle of the day
  - Afternoon
  - Evening
  - At night

5. Special Questions

Red Flag Screening

Common:
- Unaffected by spinal movement
- Associated symptoms, i.e., heartburn
- Past medical history
- Insidious onset of symptoms
- Risk increases significantly with:
  - Age (under 20; over 50)
  - Family history
  - Past personal history
  - Sudden, unexpected weight loss/gain


Review of Systems

Biggest Predictors of Cancer

- Risk increases significantly with:
  - Past personal history of cancer
  - Failure to improve within 1 month of treatment
  - Age: Under 20 or over 50
  - Family history of cancer (genetic)
  - Sudden unexplained weight loss/gain

Where is NIGHT PAIN? So What?

Neuropathic pain is synonymous with night pain

Where is NIGHT PAIN?

- The 1994 US Agency for Health Care Policy and Research guidelines suggest nighttime pain should be used as a "red flag."
- Although it is a significant and disruptive symptom for patients, these results challenge the specificity of the presence of night pain per se as a useful diagnostic indicator for serious spinal pathology in a back pain triage clinic.
- Night pain typically only shows up at the end-stages of cancer...

Contraindications and Precautions

What's the difference?
- Contraindication – wouldn't/shouldn't use a physical test or technique under any circumstances
- Precaution

Contraindications and Precautions

Precaution
- Depending upon the skill, experience and training of the practitioner, the type of test or technique selected, the amount of leverage and force used, and the age, general health and physical condition of the patient, it may not be the wisest choice

5. Special Questions

Vertebrobasilar Insufficiency

5 D’s And 3 N’s
- Dizziness
- Ataxia
- Diplopia
- Nystagmus
- Dysphagia
- Numbness
- Drop attacks
- Vomiting
- Nausea
- Dysarthria

Medication: 5 Key ones for spinal pain

1. Pain medication
2. Anti-inflammatories
3. Muscle Relaxers
4. Anti-depressants
5. Anti-seizure

Various Outcome Measures

NDI (Neck Disability Index) validated for HA and WAD

Planning the Physical Examination

90% of the “diagnosis” comes from the subjective examination...

Why do a Physical Examination?

- To confirm your subjective hypothesis/diagnosis
- To find “comparative signs” to use to assess the effect of treatment techniques and overall progress
- To choose techniques and plan the treatment
- To determine the patient’s movement limits
- To determine the patient’s willingness to move
- Patient want it

Planning the Physical Examination

Sources of the symptoms
- Possible structures at fault
  - Both for local and referred pain
- Highlight (*) the structures which must be examined on DAY 1
- Do the symptoms appear to fit those commonly associated with a particular syndrome or disorder?


Planning the Physical Examination

At which point will you limit your physical evaluation?
- To the point of onset - short of pain
- Partial reproduction
- Total reproduction
- Production of referred symptoms
- Would you perform a neurological evaluation?
- Do you expect a comparative sign(s) easy/hard to find?

Planning the Physical Examination

• Not all tests are needed
• Triage
  - Based on the working hypothesis (diagnosis), if I could only do 1 test to confirm/negate the hypothesis, which one would it be?
  - If I could do one more test, which one would it be?
  - Etc.

Planning your Examination

C-Facet Joints
AO and AA Joints
Dura Mater
Skin
Sub-occipital Muscles

Cervicogenic (Traditional C-Spine Screen)

• Posture
  - Head positions
• Active C-ROM
• Passive C-ROM
  - Combined
  - Repeated
  - Sustained
• Compression
• Distraction
• Passive C-ROM
• Joint Palpation
  - Accessory
  - Physiological

(Most of this is well known and well described)
Cervicogenic (Traditional C-Spine Screen)

- Neurodynamics
  - Upper Limb Neurodynamic Tests
  - Straight leg raise
  - Slump
  - Slump longsit

(Not well known or well described)

Spinal Stabilization

- Stabilization
- Senorimotor

(Not well known or well described)

Changes in strength and endurance

More important finding appears to be loss of craniocervical and cervical flexor endurance at lower contraction levels (25% and 20% MVC)

Low intensity contractile deficit detrimental to stability of the C spine

Alterations in cervical motor control

- Emerging body of research evidence
- Shows changes in:
  - Amplitude
  - Timing
  of cervical muscle activation associated with neck pain
**Assessment of Cervical Muscle Function**

1. Craniocervical flexion test (CCFT)
2. Cervical joint position sense
3. Standing balance
4. Oculomotor assessment

**Craniocervical flexion test (CCFT)**

**Pressure biofeedback device**
- Placed behind neck so it abuts the occiput to monitor change in shape of curve as it flattens with the contraction of deep cervical flexors
- Pressure inflated to 20 mmHg
- Instruct patient to perform a head-nodding action (as if saying “yes”)
- Target sequentially five 2-mmHg progressive increases from baseline of 20 to max of 30 mmHg as well as hold

**Formal test procedure - Two stages**

1. Testing of isometric capacity of deep neck flexors at test stages that the patient is able to achieve with correct craniocervical flexion action

**Craniocervical flexion test (CCFT)**

**Supine crook lying**

- Neck in neutral position (no pillow)
- Line of face horizontal
- Line bisecting neck longitudinally is horizontal to testing surface
- Use layers of towels under head to achieve neutral position
- Keep upper cervical region free for positioning pressure biofeedback device

**Craniocervical flexion test (CCFT)**

**Craniocervical flexion test (CCFT)**

**Craniocervical flexion test (CCFT)**
Without the Pressure Biofeedback

• Similar CCFT position
• Maximal contraction/nod (100%)
• Then ½ of that (50%)
• Then ½ of that (25%)
• Hold 25% - lift head off the towel and hold...

CCFT Normative Data

Neck Flexor Muscle Endurance Test

Pain free individuals:
• Men: 38 seconds
• Women: 29 seconds

Cervical joint position sense

Measure ability to relocate the natural head posture with eyes closed

Joint position error (JPE) is angular difference between starting postural position and that assumed after a neck movement


2. Cervical joint position sense

• Use of laser pointer
  • Patient sits 90 cm away from wall
  • Starting position projected by laser onto wall and marked
  • Patient closes eyes and moves into extension (or rotation L/R) then ‘relocates’ to start position
  • Second mark placed on wall
  • Measure difference between two marked points in centimeters as negative or positive value (undershoot/overshoot)

Cervical Joint Position Sense


- Errors of >4.5° (for this target, beyond the yellow circle) are likely to be significant.
- Distance from center of the target to a 4.5-degree error depends the distance the patient is from the target. This target is calibrated for a patient who is 90 cm away.
- If the patient (center of axis of rotation to the target, thus, the crown of the head) is 90 cm from the target, then a 7 cm error from the center of the target translates to a 4.5 degree error.


Images and information from Rob Landel PT, DPT, OCS

Cut-off Scores

- ≤ 4.5 degrees (horizontal) denotes "normal" cervical proprioception. (Sensitivity 86%, Specificity 93%)
- > 4.5 degrees (horizontal) indicates abnormal cervical proprioception.


Planning your Examination

1. Sub-occipital

2. Temporalis


3. Sternocleidomastoid

4. Upper Trapezius

Fernandez-de-Las-Penas C, Arendt-Nielsen L, Cerne K. Tension-Type and Cervicogenic Headache: Pathology, Diagnosis, and Management. Sudbury: Jones and Bartlett; 2010.

Planning your Examination

Central Sensitization

Primary lesion or dysfunction is located in the spinal cord, brainstem and cerebral hemispheres


Central Sensitization

• Symptom and sign cluster (486 times) for CS
  – Disproportionate pain
  – Disproportionate aggravating and easing factors
  – Diffuse palpation tenderness
  – Psychosocial issues

Fear-Avoidance

Presence of avoidance behavior is associated with increased risk of prolonged disability and work loss.

• FABQ-Work sub-scale scores >34
• FABQ-Physical Activities sub-scale scores >14

Pain Catastrophization Scale

Previous studies utilizing the PCS have shown a median score of 18 for healthy individuals and in patients with pain, the PCS is generally higher.

Testing a Sensitive Nervous System


Overview of the clinical examination of patients with suspected central sensitization:

- Assessment of pressure pain thresholds at sites remote from the symptomatic site
- Assessment of sensitivity to touch during manual palpation at sites remote from the symptomatic site
- Assessment of sensitivity to vibration at sites remote from the symptomatic site
- Assessment of sensitivity to heat at sites remote from the symptomatic site
- Assessment of sensitivity to cold at sites remote from the symptomatic site
- Assessment of pressure pain thresholds during and following exercise
- Brachial plexus provocation test

Nerve Palpation: With/without pressure algometry...

Away from the "hot spot"


Vibration Sensitization

Dysfunction of A-beta fibers and Pacini corpuscles have shown increased sensitivity in neuropathic pain


Heat and Cold...

Neurodynamic tests...
Treating Headaches

Medical Management for HA

Medicine and Tension Type Headaches

Amitriptylin – commonly used in TTH
• 11% improvement when compared to placebo

Ibuprofen – commonly used for TTH
• Little efficacy in treating TTH

Tricyclic antidepressants
• Have also shown major efficacy in treating TTH

Planning your Treatment

Cervicogenic Headache

Tension Type Headache

TTH accounts for 80% of headaches

Migraine

Vascular
Too Much
Too Little

Soft Tissue
Spinal Mobilization
Spinal Manipulation
Neurodynamics
Aerobic Exercise
ROM Exercises
Relaxation
Meditation
Sleep Hygiene
Etc.

Pain Neuroscience Education for Headaches


Today’s Question:

- Mobilization and manipulation
- Soft tissue massage
- Muscle and neural mobilization
- Trunk stabilization
- Circuit based aerobic exercise
- Movement exercises
- Pacing of ADLs
- Graded exposure with ADLs
- Neck stabilization exercises
- Aquatic exercise program

PNE+

- Mobilization and manipulation
- Soft tissue massage
- Muscle and neural mobilization
- Trunk stabilization
- Circuit based aerobic exercise
- Movement exercises
- Pacing of ADLs
- Graded exposure with ADLs
- Neck stabilization exercises
- Aquatic exercise program

Movement is the biggest pain killer on the planet

A six mile run stimulates endorphin release that is equivalent to 10mg of morphine


There are thresholds for both the intensity (>50% Vo2max) and duration (>10 min) of exercise required to elicit exercise analgesia


There are thresholds for both the intensity (>50% Vo2max) and duration (>10 min) of exercise required to elicit exercise analgesia


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**Goal Setting**

Most patients:
- No goals
- Poorly defined goals

You have to have a reason to get out of bed

**Clinical Case Example**

**Manual Therapy PLUS PNE**

- Teach people about pain
- Exercise
- Modalities
- Manual therapy
- Relaxation/Meditation
- Breathing
- Sleep hygiene
- Safe, healing environment
- Coping skills
- Pacing and graded exposure
- Goal setting
- More...

**Patient Case**

- Sandy is a 56 year-old lady
- Insidious onset of right forearm and elbow 2 years ago
- Worked as a legal aide and possible increase work and stress around the time
- Pain spread:
  - Right wrist
  - Right upper arm
  - Right neck
  - Headaches
Patient Case

- Multiple treatments/consultations
  - 3 different physical therapists
  - 2 different chiropractors
  - Several physicians
    - Rheumatologist
    - Neurologist
    - Pain management
- Epidurals
  - No relief
- MRI
  - Mild DJD
- EMG
  - Mild “nerve issues”
- PT
  - Sub-occipital muscles soft tissue treatment
    - Severe increase in her headaches

Patient Case: Current

- Right neck pain and constant headaches – right > left from the occiput to the eyebrow
- Significant sleep disturbance
- Changed work due to pain
  - NDI 25 (severe disability)
  - UE functional scale 58/80
- Headache increases with
  - Direct pressure to the neck/scalp
  - Sitting “still” more than 30 minutes
- Most relief:
  - Keep moving; heat; Advil (ibuprofen)

Patient Case: Physical

- Pleasant; no visible distress
- Extreme tenderness to palpation around the neck and scalp per pressure algometry
- Positive Tinel tests:
  - Bilateral cubital tunnels
  - Bilateral posterior tarsal tunnels
  - Bilateral posterior knee
- Shoulder AROM WFL Left = Right
- Cervical Spine AROM
  - Flexion and extension 90%
  - Rotation left/right 75%
  - Side flexion left/right 50%
- Slump: Positive LE/Neck symptoms with structural differentiation
- Positive ULNT’s: Median, Radial and Ulnar left and right
- Intact:
  - Neurological, Babinski, Klonus, Grip strength, TPD, Cranial nerves
- PAIVMs, PPIVMs: Unable to assess due to pain

Clinical Impression

- Peripheral Sensitization
- Central Sensitization
- Cervicogenic Headache
- Hyperalgesia
- Allodynia

Problem
Solution...?

Treatment (initial)

• PNE
  – Sensitive Nerves
  – Nosy Neighbors
  – Calming Sensitive Nerves
  – Pain Comes from the Brain
  – Lions and Stress

End-Result?

Results

Even with mobilization and manipulation...

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Key to headaches

Trigeminal Cervical Nucleus (TCN)

Supraorbital N. Occipital N.

Trigeminal Nucleus Caudalis

C1 Spinal N. C2 Spinal N. C3 Spinal N.