# Headache

**Biomechanics & Recent Research**

SW Regional – Florida Chiropractic Association

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## Structure *determines* Function

## Function *determines* Outcome

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## Cervical Biomechanics Study

**Intro**

- Headaches (HAs) associated with Forward Head Posture (FHP) at 13.8%
  - Poorly understood
  - Multifactorial
- Compression of greater occipital nerve, suboccipital nerve, or C2 nerve root?

**Methods**

- Cadaveric simulations
  - 13 fresh-frozen cervical spine
  - 21-67 years (9M:4F)
  - Dissected to bone, discs, ligaments
- CT scans
  - Specimen-specific 3D computer models
    - Add muscles for simulation

Kalmanson et al. 2019

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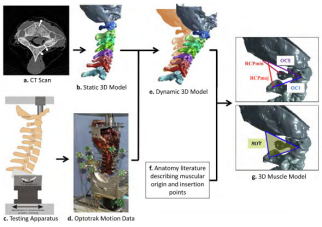
## Cervical Biomechanics




- Neutral was determined by 'no translational load' on the inferior load cell
- Simulated FHP translation to 3 Nm (2.2 ft-lbs)
- Greatest ↑ in sagittal vertical alignment was 26 mm **(~1 in)**

Kalmanson et al. 2019

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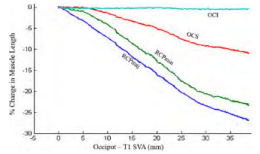
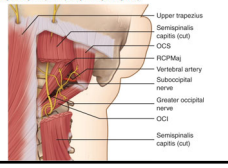
## Results

- Suboccipital Triangle (RCPmaj, OCS, and OCI)
  - ↓ **18.7±6.4%**
- Model shows *continuous shortening* of RCPmaj / RCPmin / OCS with ↑ FHP
- No change in OCI




**Graph 1.** The muscle length results of a single representative specimen demonstrating continuous shortening of the RCPmaj, RCPmin, and OCS as FHP increased. *RCPmaj (Rectus Capitis Posterior Major); RCPmin (Rectus Capitis Posterior Minor); OCS (Obliquus Capitis Superior); OCI (Obliquus Capitis Inferior).*




Kalmanson et al. 2019

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## Results

Dimensions of the suboccipital triangle measured in neutral and Forward Head Posture.

| Measurement | Value at Neutral posture | Change at 26 mm increase in FHP | P Values |
|---|---|---|---|
| C0-C1 Segmental Angle | 7.3 ± 5.0 deg. | −10.7 ± 4.6 deg. | <0.001 |
| C1-C2 Segmental Angle | −28.6 ± 9.2 deg. | −4.6 ± 4.3 deg. | 0.004 |
| C0-C2 Segmental Angle | −20.3 ± 12.2 deg. | −15.3 ± 2.3 deg. | <0.001 |
| RCPmin muscle length | 35 ± 7 mm | −15.0 ± 7.6% | <0.001 |
| RCPmaj muscle length | 48 ± 8 mm | −20.0 ± 4.6% | <0.001 |
| OCI muscle length | 49 ± 4 mm | 0.5 ± 0.8% | 0.066 |
| OCS muscle length | 52 ± 5 mm | −6.6 ± 3.3% | <0.001 |
| SOT Area | 10.4 ± 1.9 cm² | −18.7 ± 6.4% | <0.001 |
| C2 nerve root gap | 7.6 ± 1.8 mm | −1.0 ± 1.3 mm | 0.013 |
| CON gap | 8.5 ± 2.0 mm | −0.2 ± 0.18 mm | 0.004 |

Kalmanson et al. 2019

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## Cervical Biomechanics

- Concluded that statistical ↓ of SOT is not *clinically significant*
- Disagree? What about…
  - Compression / restriction w/ fascia, connective tissue, muscle
  - Inflammation
  - Increased bulk of muscle with chronic overload
  - Fatigue causing muscle recruitment
  - 26 mm (1 in.) translation?!?
- Studied 'healthy spines'
  - Cannot comment:
    - Other degenerative conditions
    - Cervical kyphosis
    - Vertebral subluxation

Kalmanson et al. 2019

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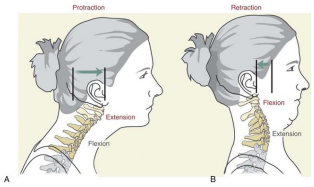
## Cervical Protraction

- Difficult to find data on this!
- Mean sagittal mobility (protraction minus retraction)
  - 9.1 (1.9) cm
    3.6 (0.8) in.
  - Range 4.4 – 14.0 cm
    1.7 – 5.5 in.




Severinsson et al. 2012

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## Headache Basics

- HA one of more common complaints in outpatient care and emergency room
- Released in January 2018, *International Headache Society* (IHS) lists **>200** different varieties of HA
  - Differentiated by *history* and *physical examination* alone
- Worldwide, HA common adult experience
- Recurring HAs negatively impact family life, social activity, work capacity
- *World Health Organization*: Migraines 19th among years lived with disability

Bryans et al. 2011; Whalen et al. 2018

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**How many types of headaches?**

**> 200**

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## More HA Basics

- Migraines
  - $36B / year
  - 113M lost workdays
  - 1 in 5 Americans

- More pronounced FHP typical feature in patients with migraine, cluster, cervicogenic, and tension HA
- Daily computer- or laptop-use > 3h associated with ↑ prevalence of MSK complaints, especially HA and neck
- Maladaptive head posture during sitting recognized as possible intrinsic etiological factor for HA, but ***few studies*** compare posture with HA

Mingels et al. 2016; Verma et al. 2021

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## Two Divisions of HA

- **Primary HA**
  - Not caused by another disease (HA *is* the disease)
  - Physical and neurological examinations are normal
  - IHS classifies primary headaches into 4 types:
    1. Migraine
    2. Tension headache
    3. Trigeminal autonomic cephalalgias (cluster headache most prominent)
    4. Other primary headache disorders
- **Secondary HA**
  - Not the disease, but a symptom
  - Can be emergent!
- If patient suffering from none of four types of primary HA, problem must be secondary HA, potentially reflecting a dangerous underlying disease

May 2018

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## Elderly (≥ 65 years),

- Although less prevalent than younger individuals, HA in elderly can present a diagnostic challenge
  - Increase in potentially fatal diseases within this population
- Secondary causes:
  - Temporal or giant cell arteritis
  - Subdural hematomas
  - CNS tumors
  - Strokes
  - CNS infections
- Forming an appropriate treatment plan requires careful assessment of HA characteristics, known medical conditions, and current medication use

Sharma et al. 2018

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## What should prompt immediate referral?

- Initial manifestation of atypical HA
- Atypical clinical course
- Increasing severity of pain
- Changing character of pain in patient with known HA syndrome
- Simultaneous appearance of neurological symptoms or deficits

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## Good News!

- Most HAs can be effectively treated
- Treatment of HAs rewarding activity for physicians of all specialties

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## Cervicogenic HA

- Secondary HA
- 2.2-2.5% of adult population
  - 15-20% of chronic / recurrent HA
- Females 4x ↑ than males
- Cervicogenic HA includes symptoms of:
  - Dizziness
  - Nausea
  - Lightheadedness
  - Inability to concentrate
  - Retro-ocular pain
  - Visual disturbances

Racicki et al. 2013

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## Manipulative Therapy (MT)

- MT of cranium and drainage of glymphatic system has ability to help individuals with HA
  - Theorized to help individuals with Alzheimer's disease
- More data needed to determine if MT increases efficacy compared to conventional HA treatments
  - Most current research articles are *case studies*
  - Future research needs to:
    - Pin-point cause of HAs
    - Improve our understanding
    - Demonstrate efficacy of treatment
- MT increases efficacy of other conventional HA treatments

Whalen et al. 2018

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## Cervicogenic HA w/ conservative therapy

- **Systematic Review:**
  - Of 2,350 hits, only 6 articles fit criteria for inclusion!
    - *Criteria*:
      - RCT
      - Conservative therapy
    - *Exclusions*:
      - Unsuitable study design
      - Not available
      - Not in English
      - Lack of outcome measures
- Most common methodological weakness of studies?
  - Failure to 'blind' therapist administering therapy
- MT w/ exercise most effective for ↓ intensity, frequency, and neck pain
- MT also excellent for pediatrics (RCT 7-14 years)
  - 2x ↑ response vs sham

Racicki et al. 2013; Lynge et al. 2021

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## Clinical Pearls

**Ergonomic Advice**

- Patients need postural training
  - Postural awareness
  - Dynamic postural training
- Chiro ideal for this arena!!

**Prophylaxis**

- Patients who regularly suffer from unusually long migraine attacks, or from more than three attacks per month, stand to benefit from prophylactic treatment
- Goal is to ↓ frequency, severity, and duration of migraine attacks and prevent drug-induced continuous headache

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## Take Homes

- HAs are common complaints, but **not** 'one size fits all'
- Advance your practice with current research / mHealth
- **Research in the chiropractic field is needed!** As a profession, we are already 'behind the 8-ball'…

- **Be involved!**
  - Encourage young chiros / students to pursue careers in clinical research
    - DC/PhD or DC w/ research experience
  - Find & share high-quality research
    - Develop critical thinking
  - Use research to support your treatments / practice
  - Contribute financially to foundations that support high-quality research (i.e. FCA, FCF, NCMIC, NBCE, etc.)

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