DC, DCCJP, FCCJP, BSc(kin), PgCPain

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Conflict of Interest

I have no financial interest in the subject matter or materials discussed in this presentation.
Least Potential Energy position

Do we stand on our bones?
Tensegrity
Contiguous tension with isolated zones of compression

How a human stands

Least Potential Energy position
Shear is the enemy!

http://www1.ttcn.ne.jp/a-nishi/tensegrity/z_tensegrity.html
Do you care about Posture? How do you measure it?

Static vs Dynamic

Dynamic is the rule
sway speed, deviation considerations

Static is never truly static – so how can you measure
Clinical Research
Your gait and balance solution

Mobility Lab

now being used in pharmaceutical clinical trials

LEARN MORE
Kalman Filter-Based Noise Reduction Framework for Posture Estimation Using Depth Sensor

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In Eq. 7, \( M \) is the polynomial order, and \( a_k \) is the set of coefficients of the polynomial that must be approximated. Therefore, the overall objective is to minimize Eq. 8 as described in paper [30].

\[
\xi_i = \sum_{i=-N}^{N} (p(n) - y_i)^2
\]

\[
= \sum_{i=-N}^{N} \left( \sum_{k=0}^{M} a_k n^k - y_i \right)^2
\]

where, \( N \) is the width of the approximation interval and \( N \) is less than or equal to \( 2M \).

D. Posture correction algorithm

Although smoothing filters alone significantly reduced the amount of random noise present in the motion capture data, there were still inconsistencies in the estimation of the skeleton.

Fig. 2: Conversion of a skeleton model into an undirected acyclic graph.
Increased Moments of Force

Average weight of the human head 12 lbs (8-16 lbs)

FHP
Increased Moments of Force

Increased lordosis in cervical spine as a function of T1 anteroflexion (thoracic kyphosis)

Increased lordosis in lumbar spine as a function of sacral base angle
Moving away costs more...
Material will deform

Collagen will stretch
Soft tissue deformation - Creep, Hysteresis

• Creep – soft tissue elongation over time under load
• Hysteresis – the amount of elongation the tissue will maintain

• A muscle held under slight tension for 20-40 minutes will take 24-48 hours to return to its previous length

• Elastic vs contractile elements of muscle
Whiplash

Compression, Tension, Sheer all within 50-120 milliseconds.
“A 10 mile/hour collision is equivalent to catching a 200 lb bag of cement dropped from a second story window.”

Dr Scott Rosa
Protect Yourself With These Easy Steps:

- The centre of the headrest should be slightly above the top of the ear.
- The top of the headrest should be at least as high as the top of the head.
- Ideally, the distance between the headrest and the back of the head should be less than 6 centimetres.
70% of people injured in collisions each year report a soft tissue injury such as whiplash.

Are you protected?

Pay it Ahead Rest

Pay it forward with us and spread the word to your family and friends.
Whiplash Considerations

Ligaments

The ability, under physiologic loads, to limit patterns of displacement so as not to damage or irritate the spinal cord or nerve roots.

Newton’s of resistance
INJURY CLASSIFICATIONS

1/3 or less of membrane missing
1/3 to 2/3 of membrane missing
2/3 or more of membrane missing

GRADE 1
GRADE 2
GRADE 3
MEMBRANE
DURA MATER
Abnormal tectorial membrane from the literature (upper left image depicted by a single white arrow).
Beighton’s score

Joint Hypermobility

9-point scale

The joints assessed are:

1. Knuckle of the little/fifth/pinky finger
2. Base of the thumb
3. Elbow
4. Knee
5. Spine

Connective Tissue Disorder
Whiplash Considerations

Radiologists tend to opine on pathological processes where as we consider biomechanical aberrancies

Coupled motion disturbances
Coupled motion

Motion about multiple axes that reduce stress in each other

Lack of appropriately coupled motion is difficult to adapt to both biomechanically and neurologically.
Osteoarthritis is inherently caused by biomechanical dysfunction in joints caused by ligamentous insufficiency induced disruption of the instantaneous axis of rotation (IAR-motion) for each position.

David Harshfield
The Crowbar

Shut down muscles to minimize stress

Fascia

Muscles

Less
(Compression)

More
(Compression)

Slide credit David Harshfield
Muscle 20%  
Fascia 80%

For a 200 kg lift

Slide credit David Harshfield
People with LBP have a significant increase in muscle activity.

Moves like a LBP subject.

Immature fascia.

Muscle.
Coordination spine/pelvis

Trunk flexion

Moment
L4/5

Fascia
Muscle

0 15 30 45 60

0 15 30 45 60
Changes – resting length, tone, NM control

• What influences levels of muscle tone?
  • Active (isotonic concentric)
  • Habitual (isotonic eccentric)
  • Reflexive (isometric)
Muscular Reactivation

4 layers
• Deepest layer contains multifidus (rotator(s) brevis, longus, & semispinalis)

3 K
• 25-100 per day

L,T,C regions
• Language – Capital T, second toe, fifth toe
• Practice
Normal Position of the Cerebellar Tonsils

Basion

Basion-Opisthion line (B-OL)

Opisthion

Normal position of cerebellar tonsils: 2 mm above the Basion-Opisthion line
Grade III Trauma of the Cranio-Vertebral Junction

- Tear of the tectorial membrane
- Tear of the cruciform ligament:
  - Superior band
  - Right transverse band
- Cranial dura
- Tear of the posterior atlanto-occipital membrane
- Tear of the myodural bridge (from rectus capitis posterior minor muscle)
- Tear of the posterior atlantoaxial ligament
- Tear of the right alar ligament
- Tear of the apical ligament
Injuries to the Cervico-Occipital Junction

High grade (class III) tear of the Tectorial Membrane

Asymmetry of the Alar Ligaments and the transverse bands of the Cruciform Ligament

Tears in the Capsular Ligaments

High grade (class III) tear of the Posterior Dura Mater/Atlanto-Occipital Membrane and disruption of the Myodural Bridge

Tears of the Anterior and the Posterior Longitudinal Ligaments

Loss of the normal collagenous architecture of the Posterior Atlanto-Axial Ligament

Hyperextension of C1 on C2
Normal Position of the Cerebellar Tonsils

Basion

Basion-Opisthion line (B-OL)

Opisthion

Normal position of cerebellar tonsils: 2 mm above the Basion-Opisthion line

C1 C2 C3
Cerebellar Tonsular Ectopia

Increased pressure on the Brain & Spinal Cord collapses the Central Canal and disrupts normal CSF circulation.

Cerebellar Tonsils displaced downward into the Spinal Canal & press against the Spinal Cord.

Basion-Opisthion line (B-OL)

Normal position of Cerebellar Tonsils

CRANIAL VAULT

SPINAL CANAL
Grade III Trauma of the Cranio-Vertebral Junction

- Tear of the tectorial membrane
- Superior band of the cruciform ligament
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- Tear of the posterior atlantodental ligament
- Tear of the right alar ligament
- Tear of the apical ligament
Dural Venous Sinus Review

Confluence of Sinus’ (located at Internal Occipital Protuberance)

Created by:
1. Superior
2. Transverse
3. Straight
4. Occipital

6 paired
1. Sigmoid
2. Transverse
3. Superior Petrosal
4. Inferior Petrosal
5. Cavernous
6. Sphenoparietal

4 unpaired
1. Superior
2. Inferior
3. Straight
4. Occipital
Normal craniocervical junction in flexion. The neuraxis stretches by approximately **10%** of its total length with flexion of the craniocervical junction

A clivo-axial angle of less than 130° was associated with delay or failure to recover after foramen magnum decompression.

Ligamentum Nuchae
Lateral Aperature
Median Aperature
Cerebellomedullary Cistern Cisterna Magna
Cerebral Aquaduct
Neurological Involvement

Midbrain
Periaqueductal Gray

Pain signal transmission to the cortex
Crucial in descending pain modulation
Fourth Ventricle
Neurological Involvement

**Locus Coeruleus** – stress, panic, pain
(rhomboid fossa, reticular activating system)
Located in the **Pons**
Major relay center for pain
Neurological Involvement

**Spinal Cord** – relay centers from DRG – **Spinothalamic tract**

The brain sites known to be part of the pain transmission system in the thalamus and cortex were fully activated only when both stimulus intensity and high pain cues were given together

**what happens and what we expect**
Spinothalamic

i. Pain Temperature
ii. Light touch

Enters cord – synapses
Crosses at or close to cord level where it enters
Travels through cord and brainstem to the Thalamus
Spinal Trigeminal Tract

Mesencephalic – proprioception
Pons/Medulla – Light Touch
Cervical – Pain/Temperature
Note: V1, V2, V3 distribution
Note: Falx Cerebri & Tentorium Cerebelli
Note: innervation below Tentorium

Classification/Diagnosis

Ascending/Descending

Ocular, Occlusal, Pedorthic
Welcome to the Upper Cervical Monograph

The National Upper Cervical Chiropractic Association (NUCCA) and the Upper Cervical Research Foundation (UCRF) are dedicated to the research, education and sustainability of a unique and profoundly influential form of healthcare. This website is dedicated to bridging the understanding of research and clinical practice to offer best of outcome measures, the safest interventions and the greatest enhancement in quality-of-life.

Please explore the information here and look for updates as we continue to discover new possibilities for a healthier future.
November 1st through November 30, 2019

Welcome to the 11th annual UCRF Small Steps to Success Campaign.
Thank you

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