There is no such thing as non-specific LBP from bench to bedside: The Science – Part 1

Edward D J Cambridge, BKin, DC, PhD

The Influencers…

Gen Z (ref. Betsy Butterick)

- "digital natives"
- "shorter attention spans"
- 52% cite honesty as the most important quality in leadership
- Data driven and accustomed to instant, expert feedback

Mastery (ref. Andres Ericsson)

- Defined "Deliberate Practice" as the means to Mastery in any area
  - Consistent high level of effort and focused on areas that need improvement
  - Often not fun – but hard work with several years of many hours of ***time on task***
  - Immediate, Expert feedback

Mastery is not a function of genius or talent. It is a function of time and intense focus applied to a particular field of knowledge.

— Robert Greene —

AZ QUOTES

We Need More Doctors Who Are Scientists

It's in everyone's benefit if physicians participate in research.

Sept. 23, 2019

Physician-scientists have often changed the history of medicine by identifying a problem in the clinic and taking to the lab to address it. Runstudio/The Image Bank, via Getty Images Plus

Clinical Practice Needs

More Science

And

Science Needs More

Clinical Practice!

There is no such this as non-specific low back pain: The Science

- Outline for part 1
  - Introduction
  - Case Presentation 1
  - The Science
    - MOI
    - Injury cascade
  - Case Presentation 2
  - The Science
    - MOI
    - Injury Cascade
  - Summary and Conclusions

Case Presentation

Case 1

Case 1: Mother of 2, 34 yoa, LBP and Leg pain

- Children are (1) 3 years and (2) 8 months old
- Bending and lifting injury – crib pick-up
- Poor sleep – the 8-month-old is teething
- Athletic history – national team rower – starboard side sweep
  - Recalls back trouble on and off as a rowing but never impeding her
- Current job – marketing and digital advertising

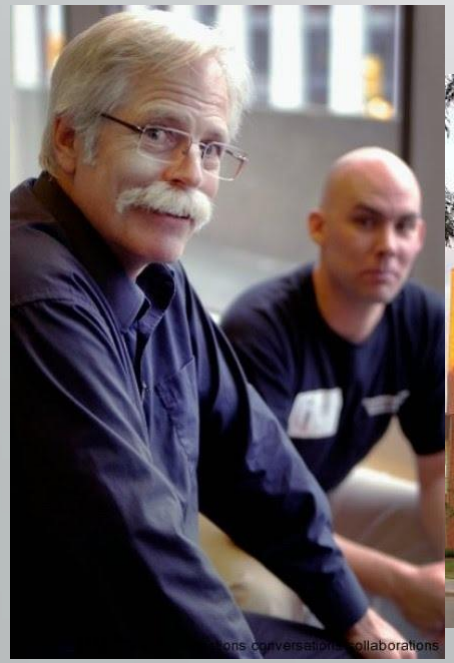
Evidence gathering is critical!

Case 1: Mother of 2, 34 yoa, LBP and Leg pain

- Current episode
  - Pain started picking up 8-month-old in a crib at 4am
  - Initial back pain
    - Ice and rest
  - Next bend injury – taking out the stroller from the car
    - Back and leg pain down the right side
      - Initially just in the glut, then hamstring then calf and top of foot over the last 2 moths

University of Waterloo

Spine Biomechanics Laboratory

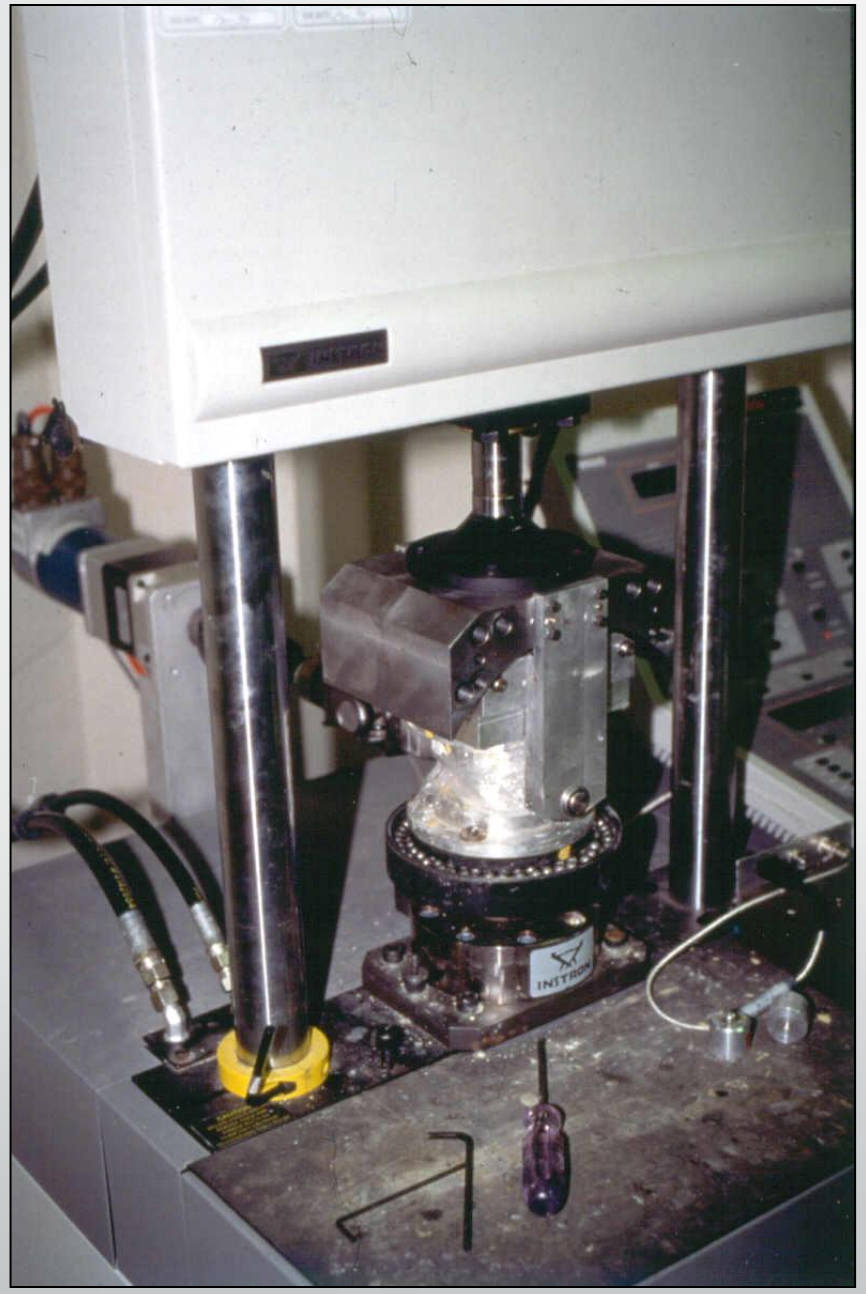


Spine Mechanics

Anatomy and Normal Mechanics

Injury Occurs When:

Applied Load > Tissue Tolerance



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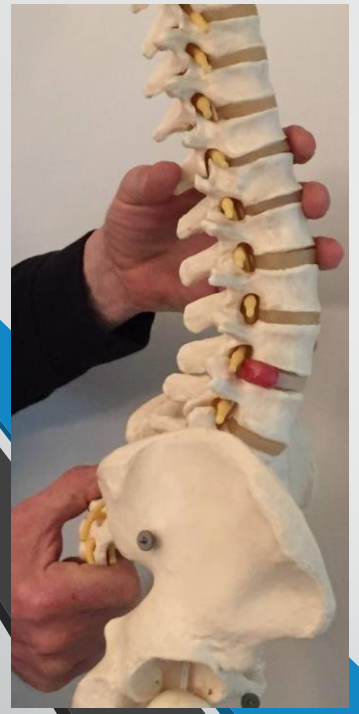

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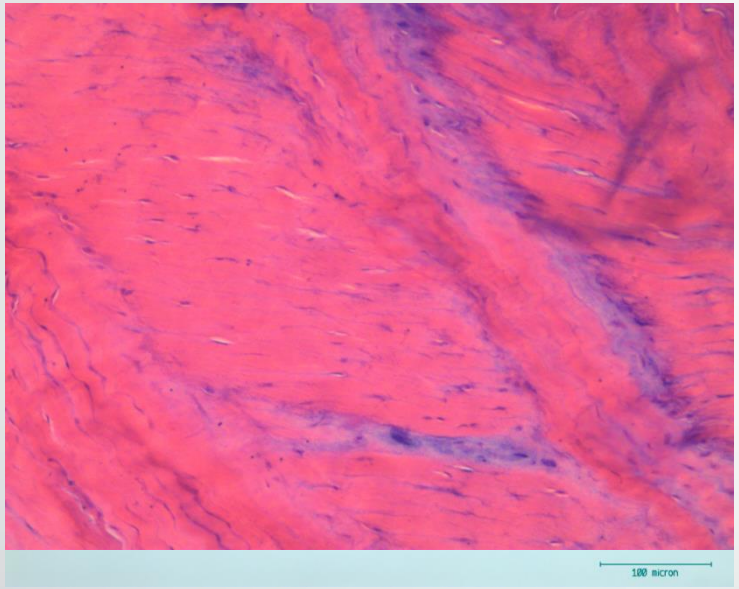
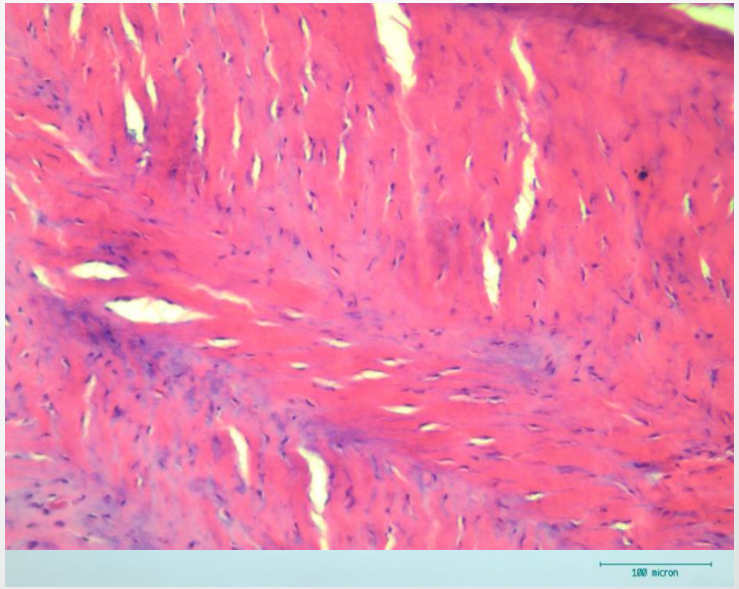
Micro Damages after 3600 Cycles



Post static loading (one hour) at 1500 N



Post flexion-extension cyclic loading protocol (1Hz cyclic loading at 1500 N for one hour)

H&E staining of control (left) and flexion-extension cyclic (FEC) loading protocol (left) specimens. Posterior region of annulus fibrosus was dissected following each protocol and immediately fixed in the OCT (optimal cutting temperature). The fixed annulus was cut horizontally (along the layers of lamellae) into 10µm slices using a cycrotome. Following the H&E staining procedure, above images were taken using a PixeLINK PL-B623CU microscope camera (B700; magnification x100; PixeLINK, Ottawa, ON). Specimens that underwent FEC loading protocol showed multiple clefts (in white) along the orientation of fibres (stained in pink), whereas the control group showed minimal gap between fibres.

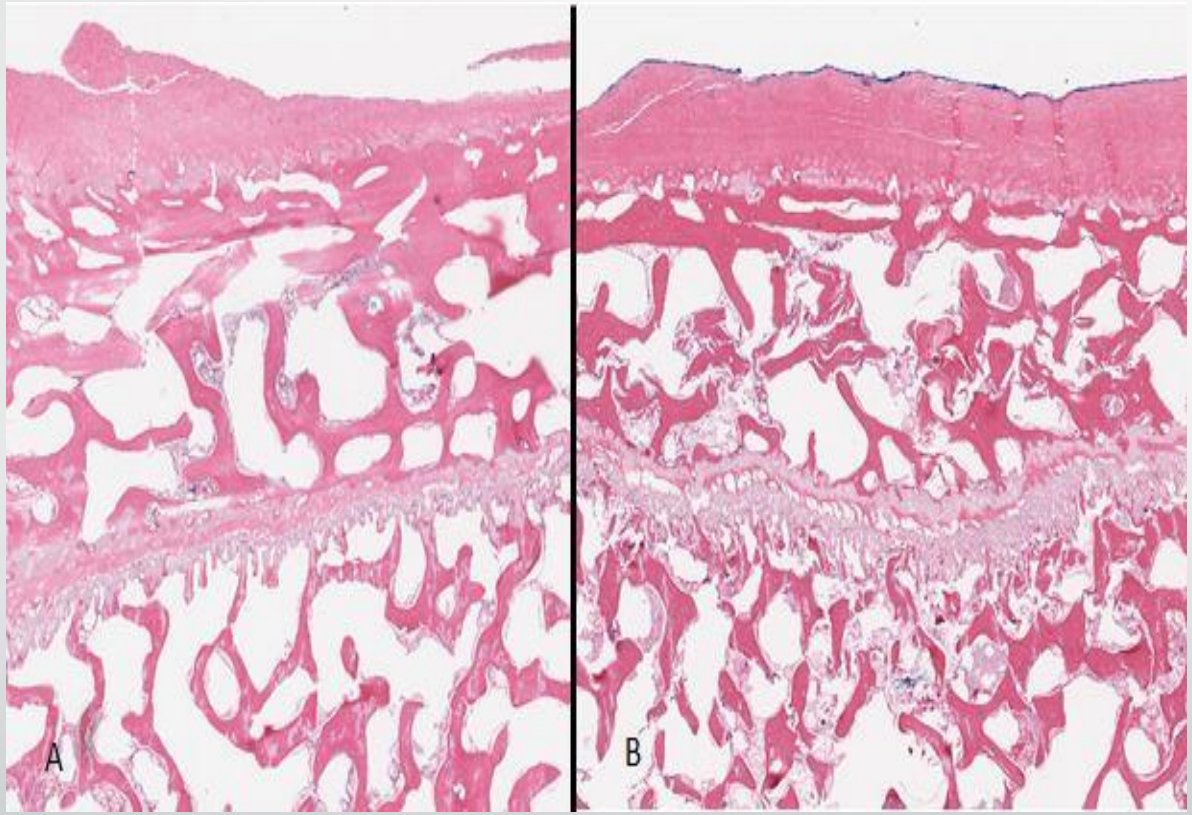
Noguchi & Callaghan (2014)

Deadlifting Damage long before pain

- Spine:
- 15 October 2014 - Volume 39 - Issue 22 - p 1881–1886
- **Early Intervertebral Disc Degeneration Changes in Asymptomatic Weightlifters Assessed by T1ρ-Magnetic Resonance Imaging**
- **Vadalà, Gianluca MD, PhD*; Russo, Fabrizio MD*; Battisti, Sofia MD†; Stellato, Luigi MD†; Martina, Francesca MD†; Del Vescovo, Riccardo MD†; Giacalone, Antonino MD*; Borthakur, Arijitt PhD‡; Zobel, Bruno Beomonte MD†; Denaro, Vincenzo MD***

Not just the disc!

Before load



After

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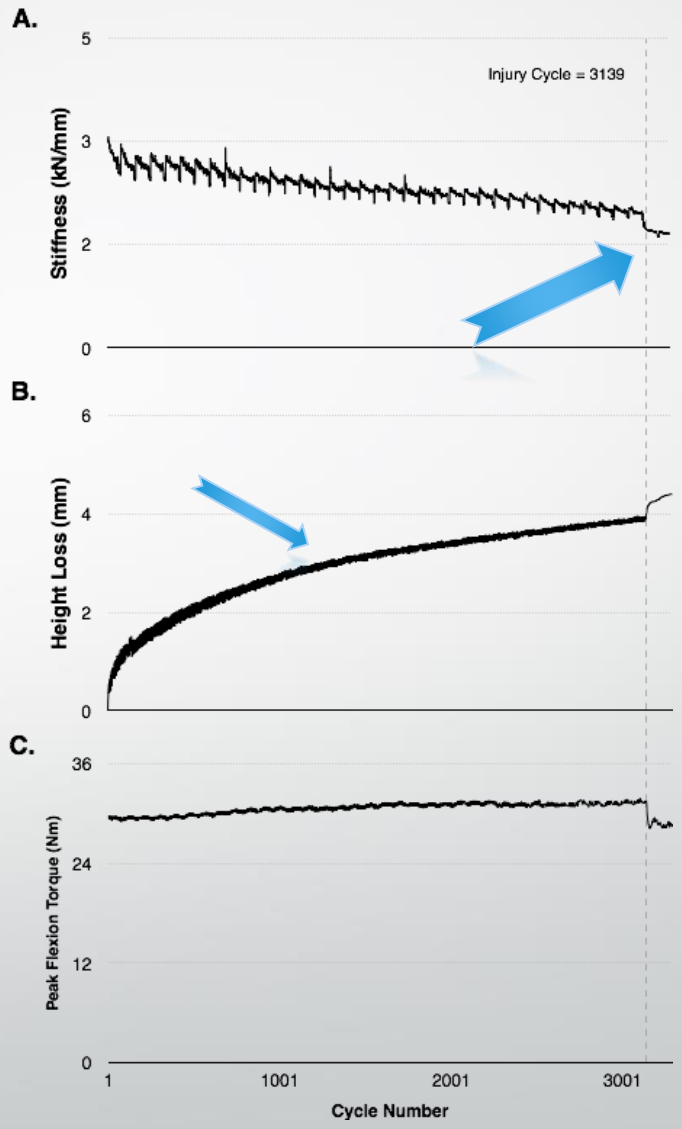
Herniation Process

The endplate and underlaying trabecular bone also appears damaged

When did the injury occur?



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Disc Herniation:

- Cause: Modest compression with cyclic flexion motion (torque)
- Comp (N) with 61Nm:
  - 260 No herniation up to 86,400 cycles
  - 867 Herniation at 22-28 K-cycles
  - 1472 Herniation at 5-9.5 K-cycles

Repeated flexion with compression

- **<30 % of comp tolerance = herniation**
- **>30 % of comp tolerance = End plate damage**

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Flexion and Lateral Bend Influence Herniation

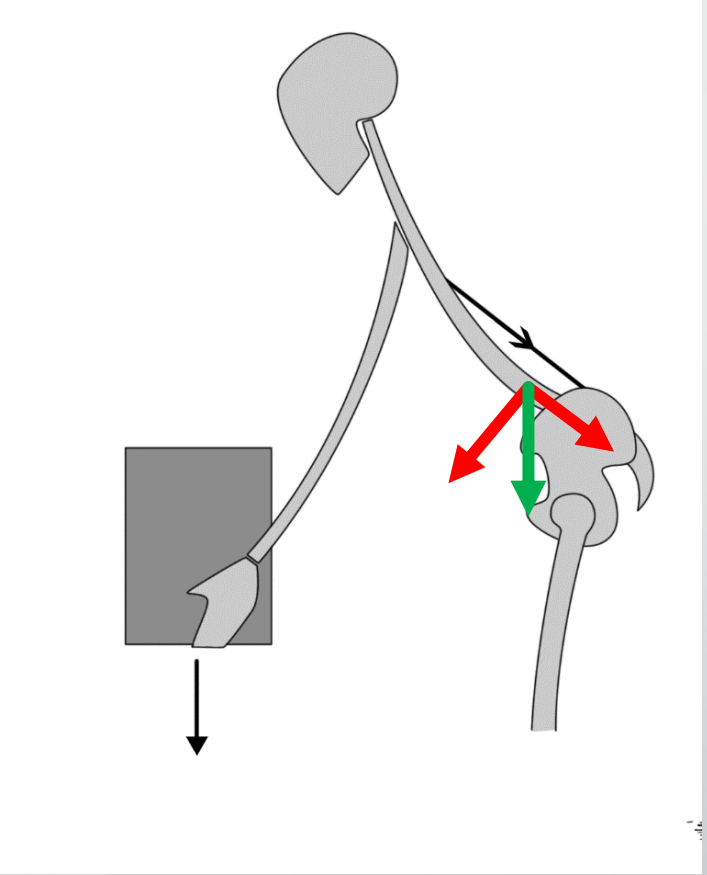
- Prevention implications… potentially NB
- Rehab implications:
  - McKenzie with lateral bend?
  - Facets problematic

Aultman and McGill

Movement Matters

This is where the rubber meets the road!

Good form matters: Shear support

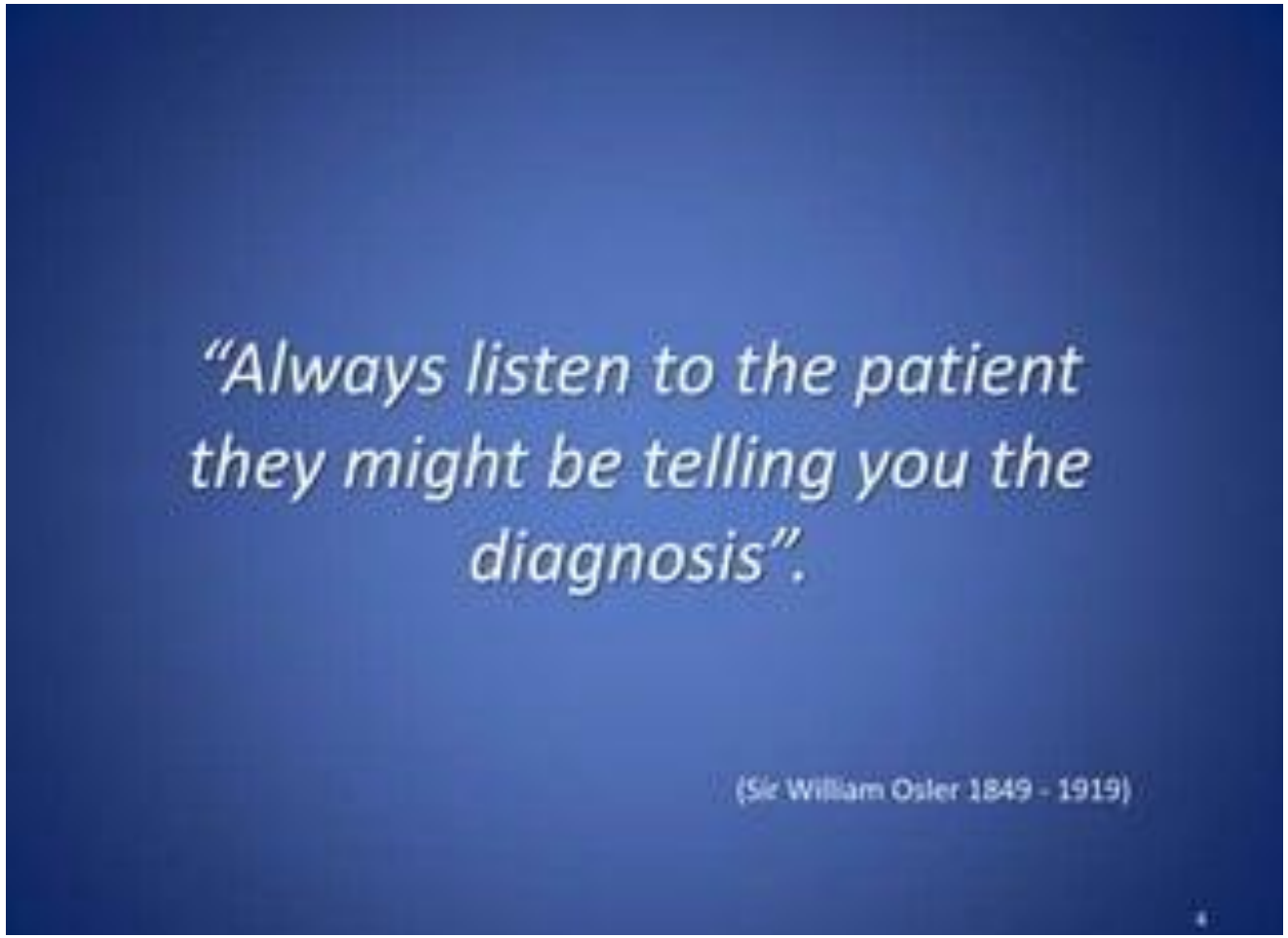


Case 2: male, 55 yoa, office worker, wt training, long Hx of back pain

- Now…
  - The smallest things can trigger the back
    - Rolling over in bed
    - Tying up shoes
    - Reaching in the back seat of the car
  - All in the back and glut area – nothing in the legs for years
  - Seems to be right and left sides can move around from spot to spot

DDx: ?

- Take the time to listen
- Injury mechanisms
- Loading history
- Injury cascade
- The context of the past is so important!



Spine Stability

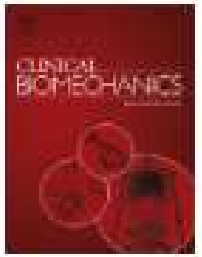
Few have ever measured it… many talk about it!

Injury Cascade?

Changes in form and function!

In vitro…

Clinical Biomechanics
Volume 36, July 2016, Pages 1-7



Disc height loss and restoration via injectable hydrogel influences adjacent segment mechanics in-vitro

Christian Balkovec [a], Andrea J. Vernengo [b], Stuart M. McGill [a]

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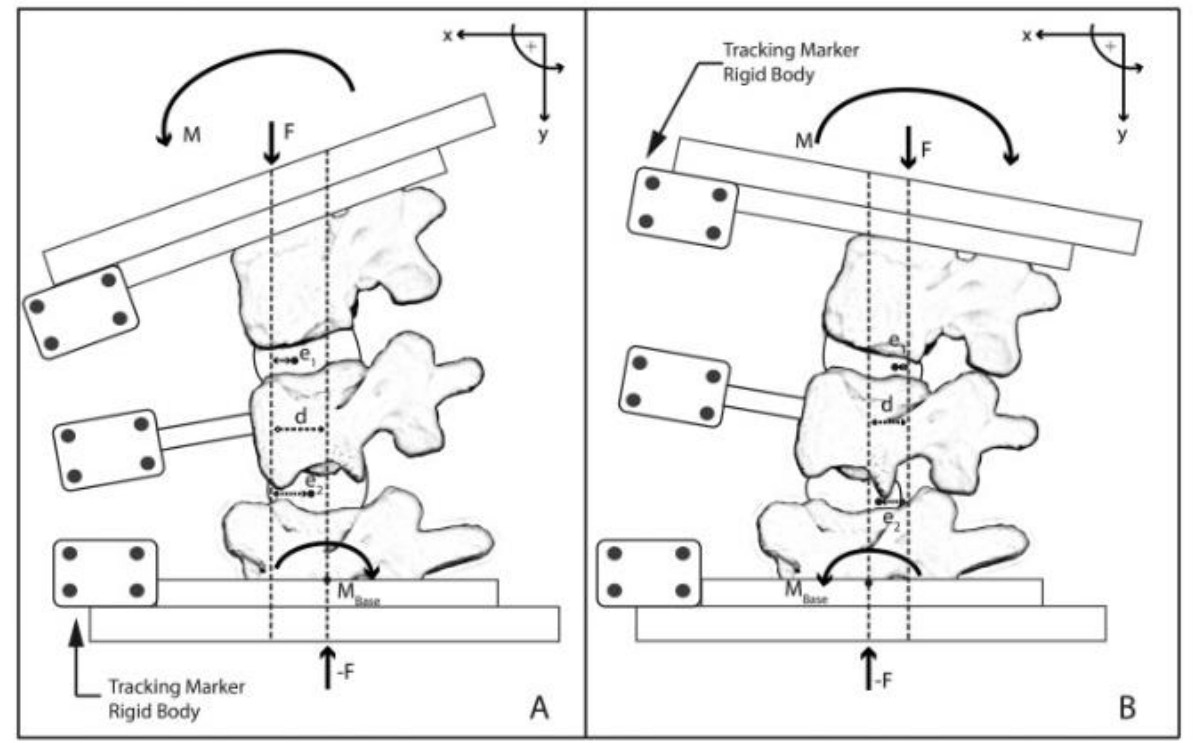
https://doi.org/10.1016/j.clinbiomech.2016.05.004



$M_{e1} = -Fe_1 - M$

$M_{e2} = -Fe_2 - M$

$M_{Base} = -Fd - M$

$M_{e1} = Fe_1 + M$

$M_{e2} = Fe_2 + M$

$M_{Base} = Fd + M$

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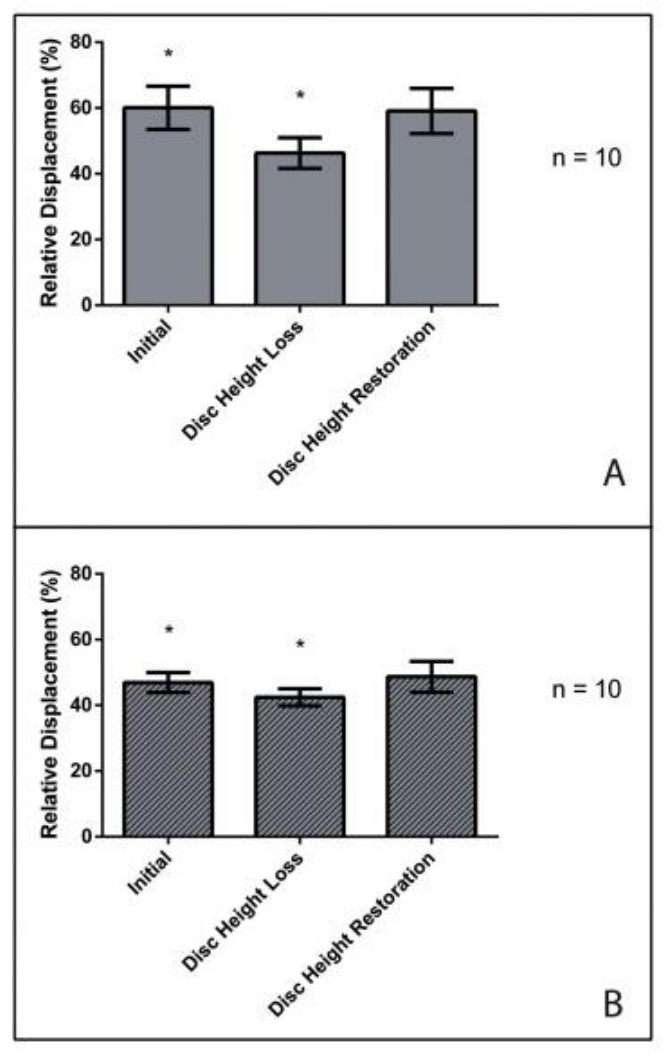

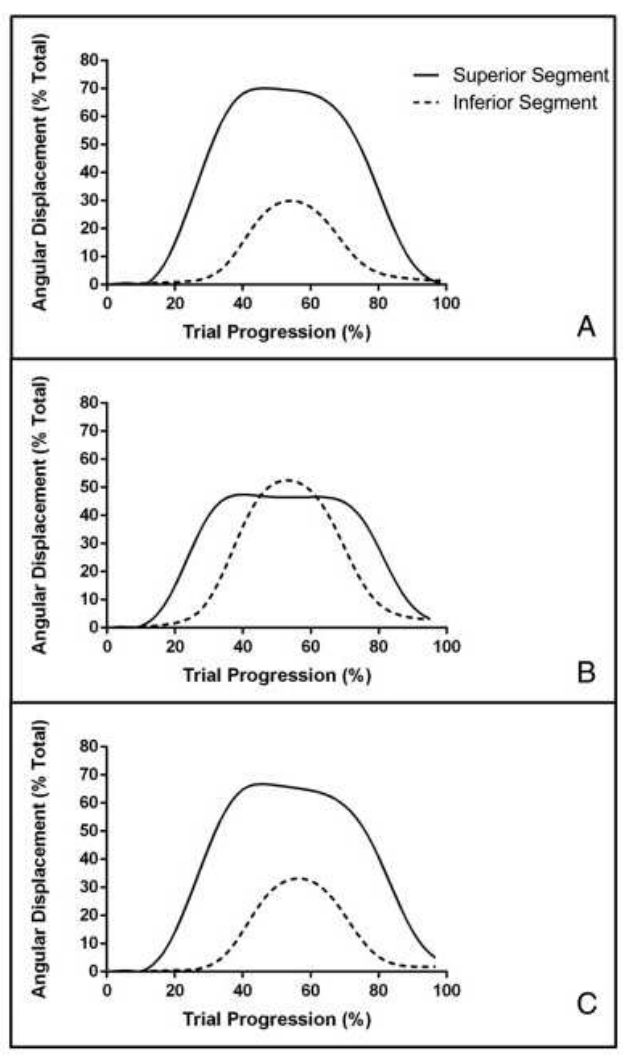

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In vivo…

Computer Methods in Biomechanics and Biomedical Engineering

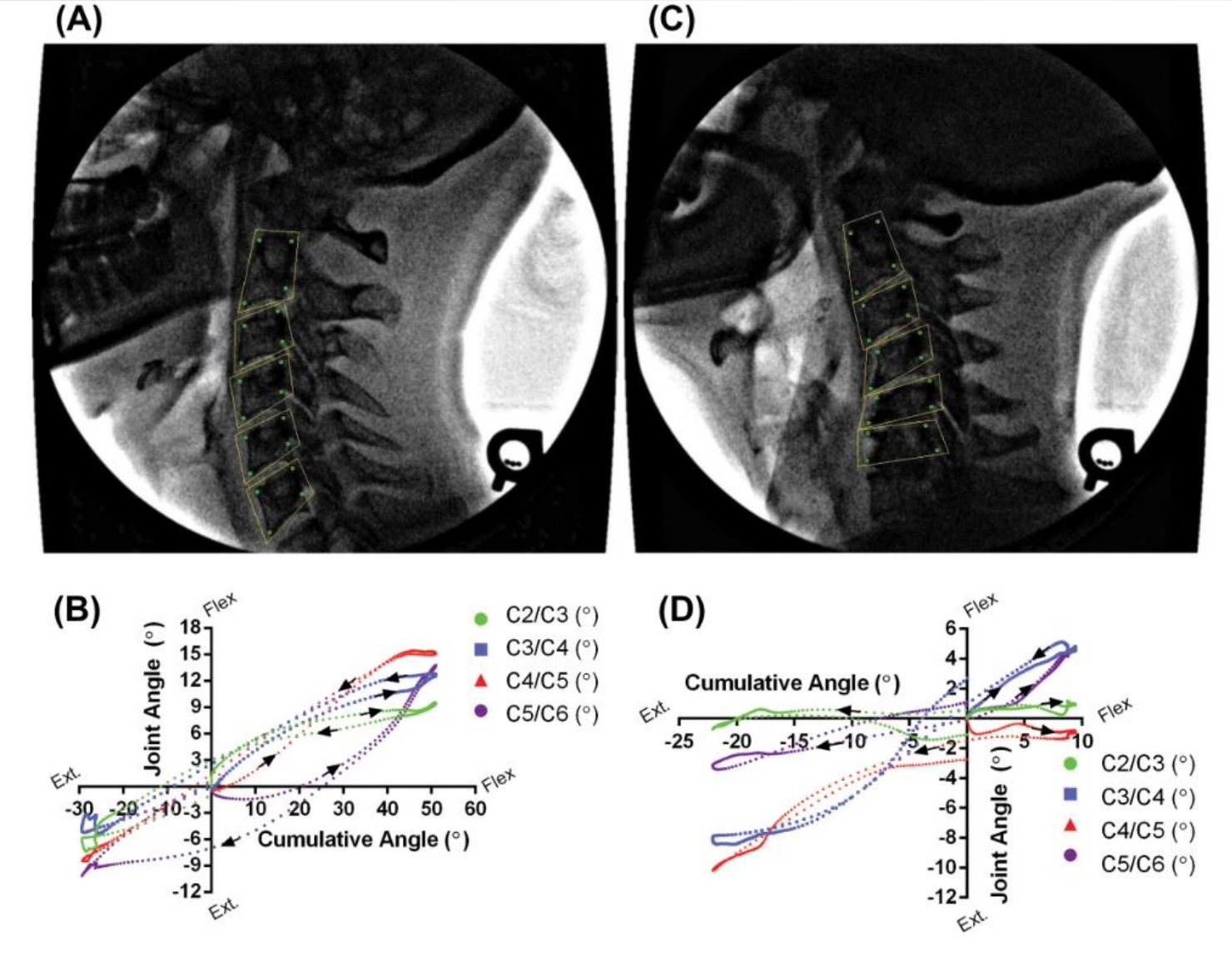
Original Articles

A videofluoroscopy-based tracking algorithm for quantifying the time course of human intervertebral displacements

Christian Balkovec, Jim H. Veldhuis, John W. Baird, G. Wayne Brodland & Stuart M. McGill

Pages 794-802 | Received 26 Nov 2016, Accepted 01 Mar 2017, Published online: 15 Mar 2017

Download citation https://doi-org.proxy.lib.uwaterloo.ca/10.1080/10255842.2017.1302435 Check for updates


(A)
(C)
(B)
Flex
Ext.
Joint Angle (°)
Cumulative Angle (°)
C2/C3 (°)
C3/C4 (°)
C4/C5 (°)
C5/C6 (°)
(D)
Cumulative Angle (°)
Joint Angle (°)

Clinical Biomechanics
Volume 56, July 2018, Pages 11-17

Digital tracking algorithm reveals the influence of structural irregularities on joint movements in the human cervical spine

Christian Balkovec [a], Jim Veldhuis [b], John W. Baird [c], G. Wayne Brodland [b, d], Stuart M. McGill [a]

Show more

https://doi.org/10.1016/j.clinbiomech.2018.04.015

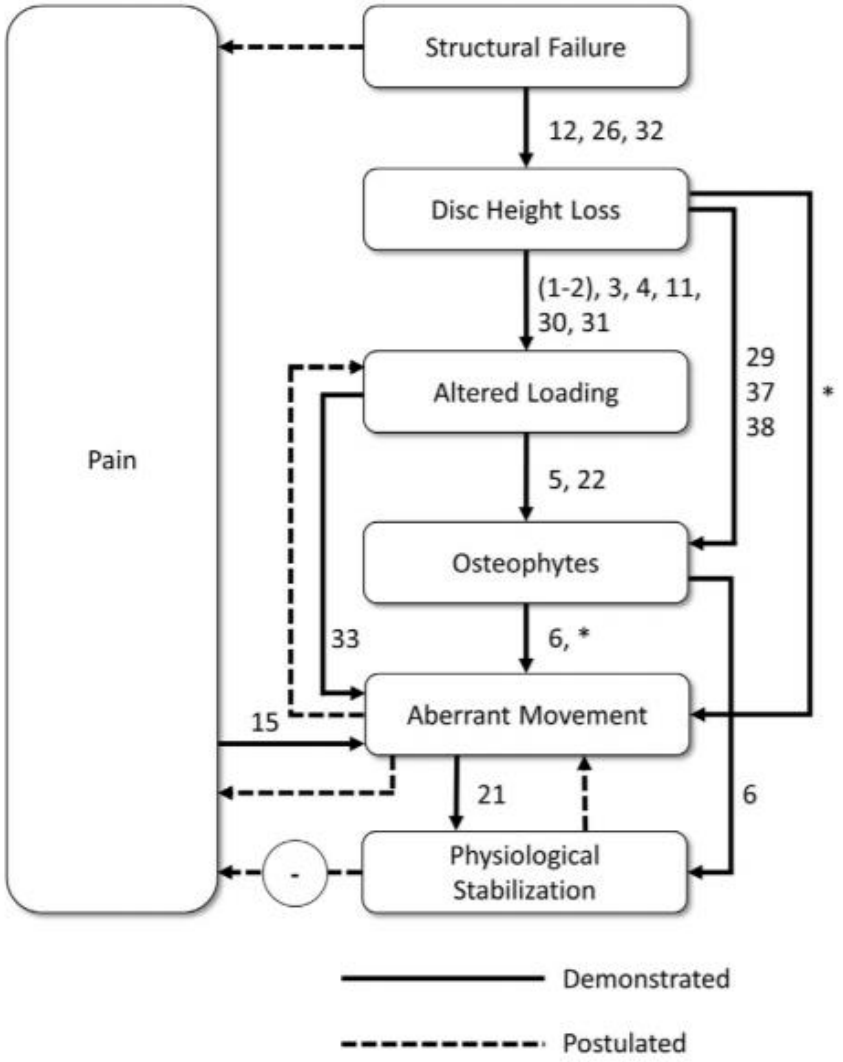


Fig. 1. Connections between spinal injury, pathology and function. The figure shows how factors such as structural failure, disc height loss, altered loading, aberrant movement, and physiological stabilization can affect each other. Established relationships are shown with solid lines and numerical citations (citations in brackets provide indirect support), while tentative ones are shown with dashed lines; references are listed relative to their sequential appearance in the references section. The link containing a circled negative sign indicates a downgrading effect. Asterisks denote relationships identified or strengthened by the present study.

4 issues with stability

- 1. Proximal stiffness/stability for distal athleticism
- 2. Guy wire system facilitated successful load bearing
- 3. Stiffness eliminates micromovements in the joints that lead to pain and tissue degeneration
- 4. Build armour

There is no such thing as non-specific LBP from bench to bedside: The Clinical Application – Part 2

Dr. Edward D J Cambridge, BKin, DC, PhD

There is no such this as non-specific low back pain: The Clinical Application

- Outline for part 2
  - Introduction – Clinical Assessment
  - Re-visit Case 1
    - The Science
    - The Assessment
  - Re-visit Case 2
    - The Science
    - The Assessment
  - Summary and Conclusions
- Global Summary and Challenge to the Profession at large!

"The McGill Approach"

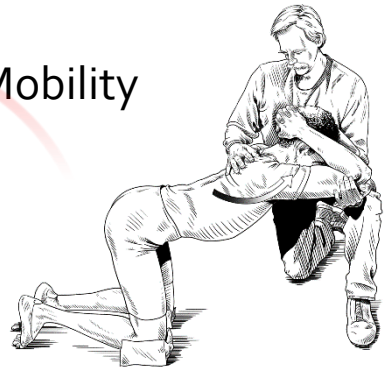
Respite Position

Spine hygiene

PRECISE DIAGNOSIS

Foundation for pain- free movement

Mobility



Stability

Karel Lewit: Wisdom

“The first job of the clinician is to teach the patient the cause of their pain.”

In a nutshell

Creative Processing

Pattern Recognition

Hypothesis Testing

Detective work

Organized systems

Recipes

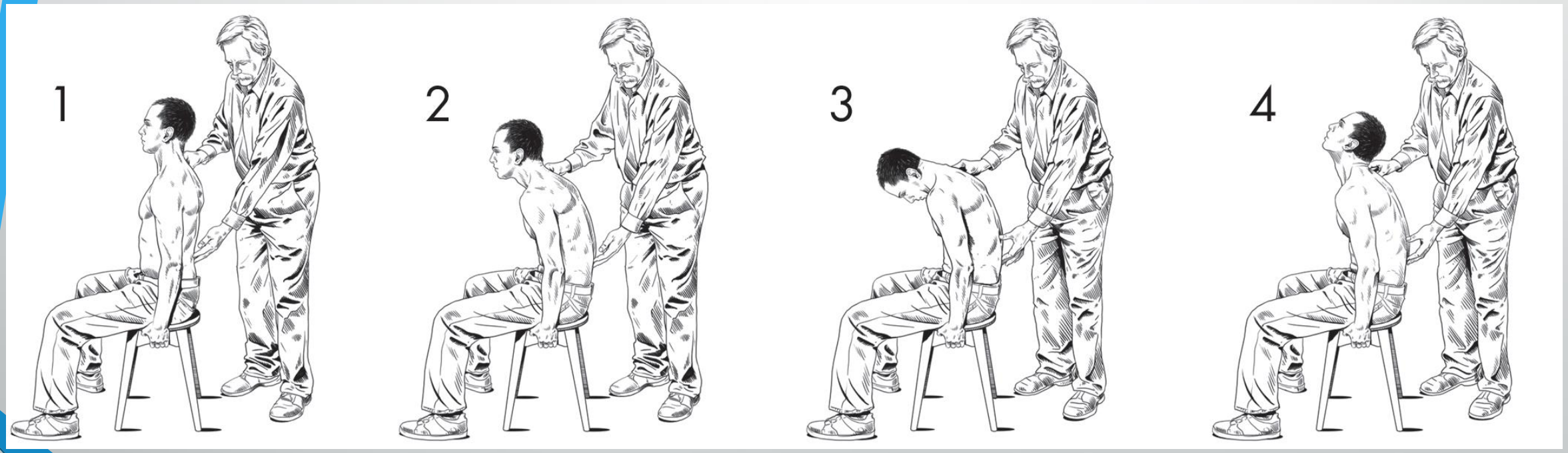
Structured Procedures

Rules

Movement never lies. It is a barometer telling the state of the soul's weather to all who can read it

Martha Graham

Example: Tolerable Motions, Postures, Loads



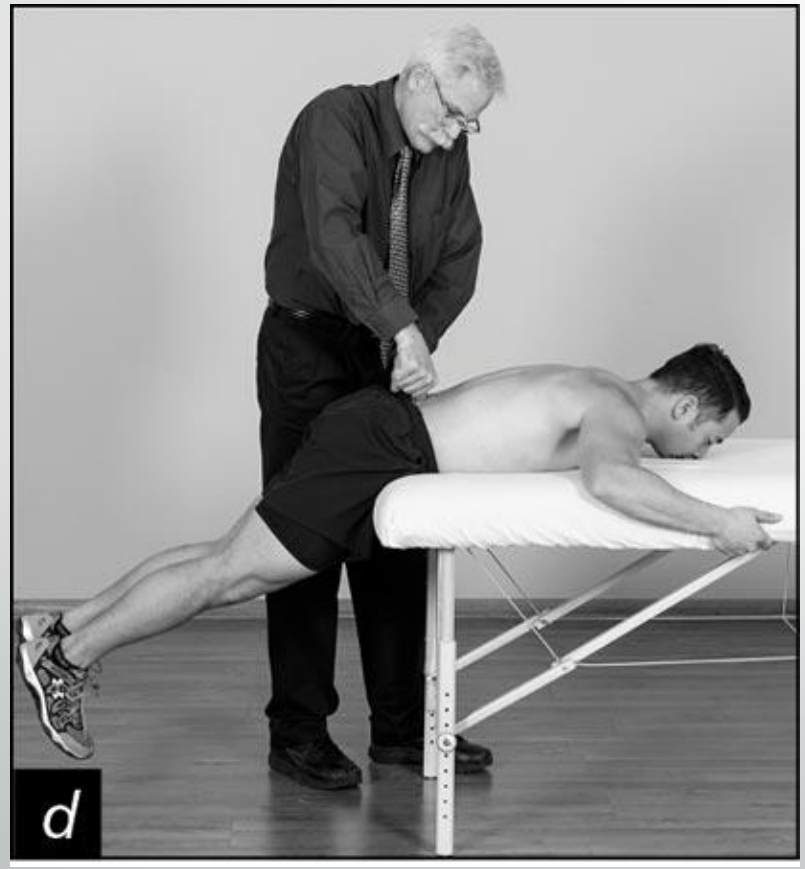
Case 1: Mother of 2, 34 yoa, LBP and Leg pain

- Seated compression test:
  - Pain in flexion, and increases with compression
  - Also increased with cervical spine flexion
  - No pain in neutral or extension – no changes with compression

Case 2: male, 55 yoa, office worker, wt training, long Hx of back pain

- Pain in motion – catches of pain transitioning from posture to posture
  - Pain in flexion at end-range – decreases with compression
  - Pain in extension at end-range – decreases with compression

Prone Instability Test
What takes the pain away?



Modulate stiffness and posture…

Case 1: Mother of 2, 34 yoa, LBP and Leg pain

- Prone Instability Test
  - Pain in lower back in pre-test
  - No pain in test position

U of Pitts – 87% respond well to stability program

Case 2: male, 55 yoa, office worker, wt training, long Hx of back pain

- Prone Instability Test:
  - Pain – 7/10 in pre-test position
  - Pain 1/10 in test position

A Few More Case Examples

From the Lab

"The McGill Approach"

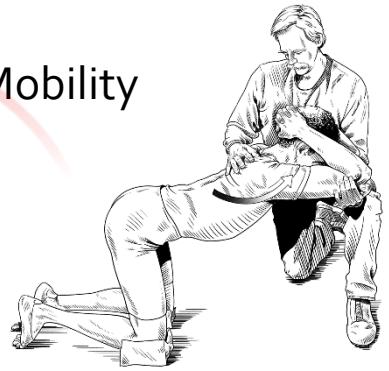
Respite Position

Spine hygiene

PRECISE DIAGNOSIS

Foundation for pain- free movement

Mobility



Stability