

# 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 thing 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!



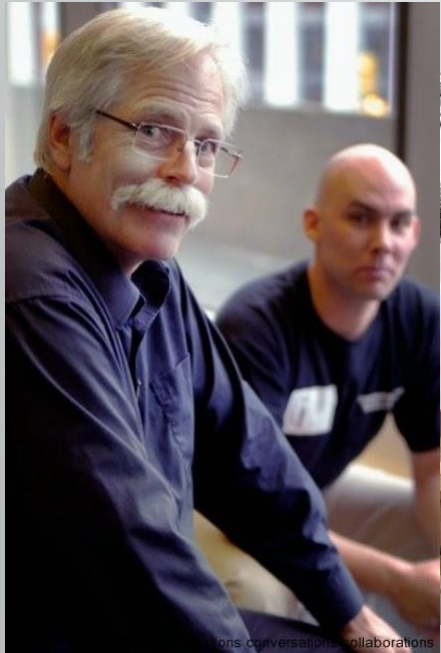


# Case 1: Mother of 2, 34 yoa, LBP and Leg pain

- 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



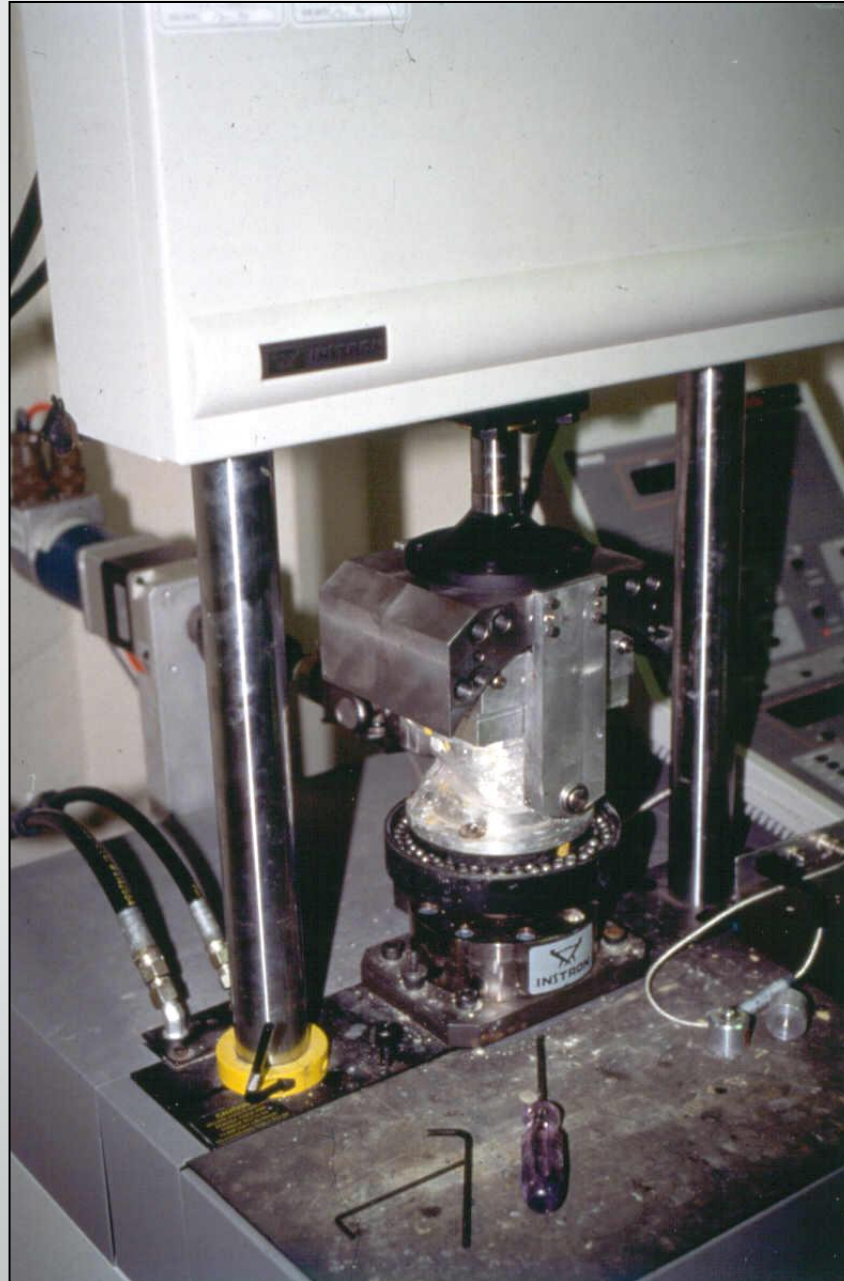


# Spine Mechanics

Anatomy and Normal Mechanics

# Injury Occurs When:

***Applied  
Load*** > **Tissue  
Tolerance**





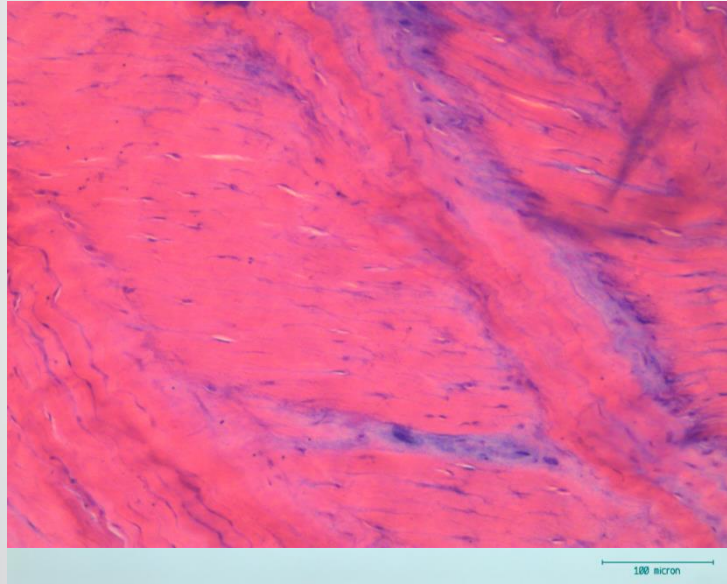


dynamicdiscdesigns.com

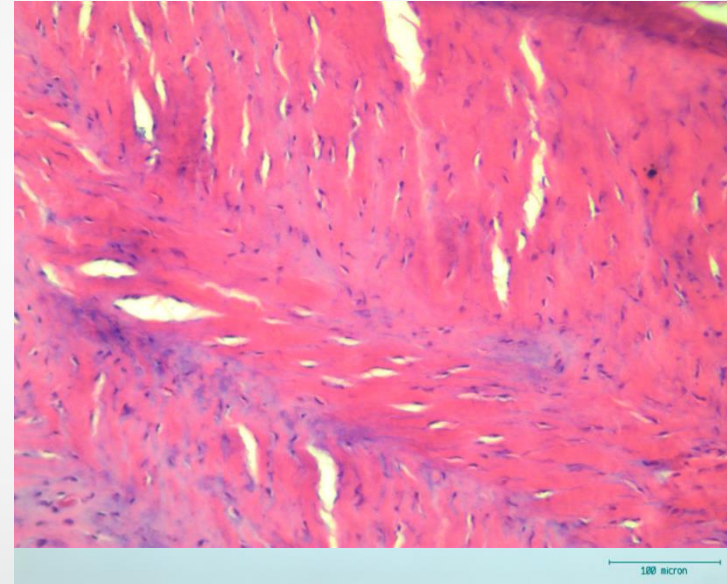




# Micro Damages after 3600 Cycles



**Post static loading (one hour) at 1500 N**



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

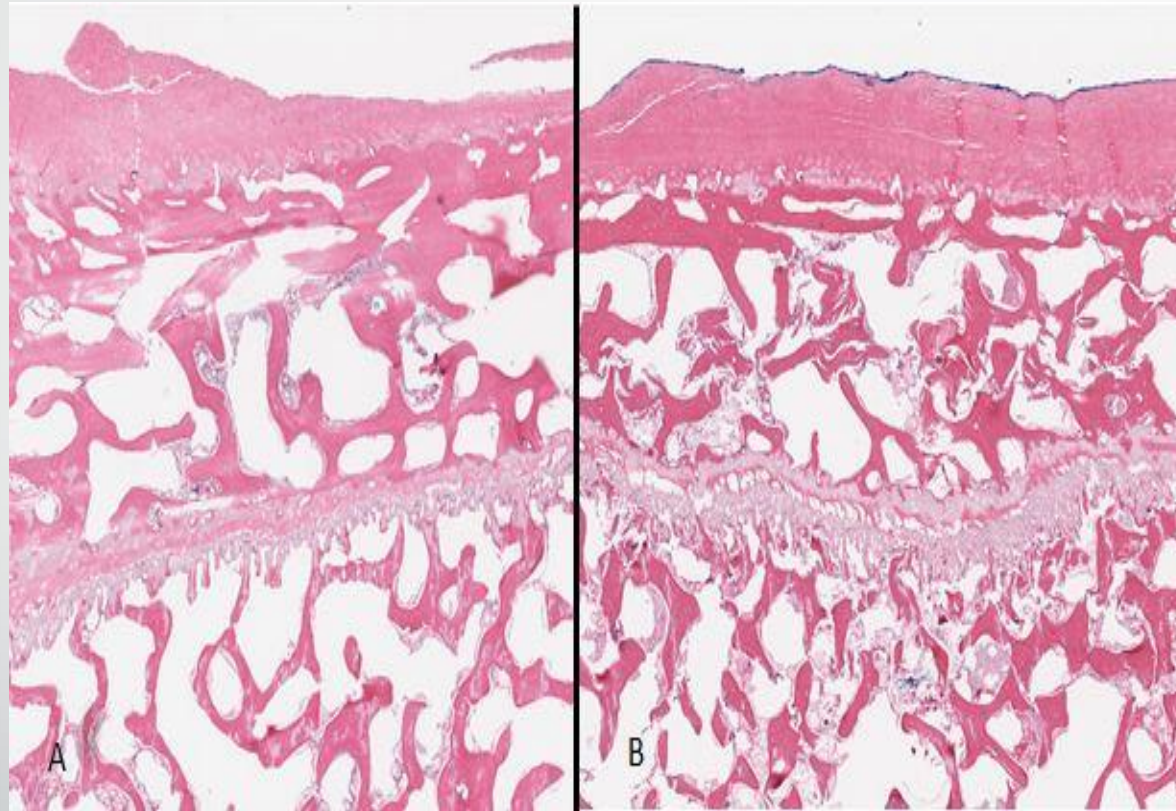
H&E staining of control (left) and flexion-extension cyclic (FEC) loading protocol (left) specimens. Posterior region of annulus fibrosus was dissected following each protocol and immediately fixed in the OCT (optimal cutting temperature). The fixed annulus was cut horizontally (along the layers of lamellae) into 10 $\mu$ m 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.

# 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<sup>\*</sup>; Russo, Fabrizio MD<sup>\*</sup>; Battisti, Sofia MD<sup>†</sup>; Stellato, Luigi MD<sup>†</sup>; Martina, Francesca MD<sup>†</sup>; Del Vescovo, Riccardo MD<sup>†</sup>; Giacalone, Antonino MD<sup>\*</sup>; Borthakur, Arijitt PhD<sup>‡</sup>; Zobel, Bruno Beomonte MD<sup>†</sup>; Denaro, Vincenzo MD<sup>\*</sup>**

# Not just the disc!

Before  
load



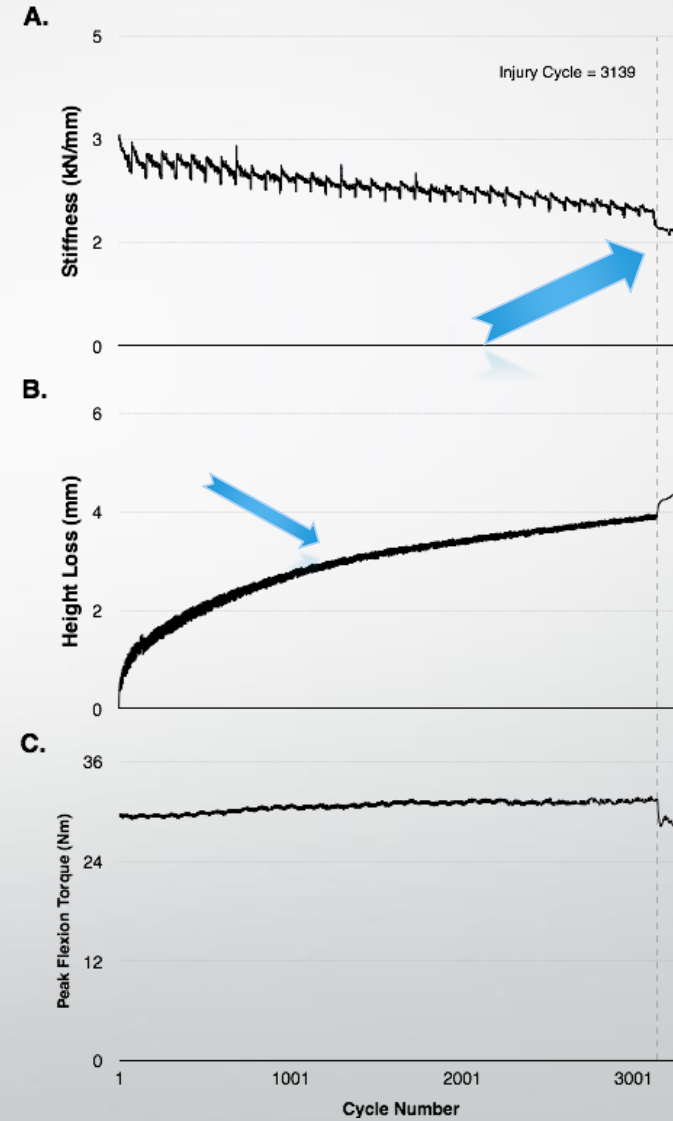
After



# Herniation Process

The endplate and underlying trabecular bone also appears damaged

# When did the injury occur?



# 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

# Flexion and Lateral Bend Influence Herniation

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

Aultman and McGill

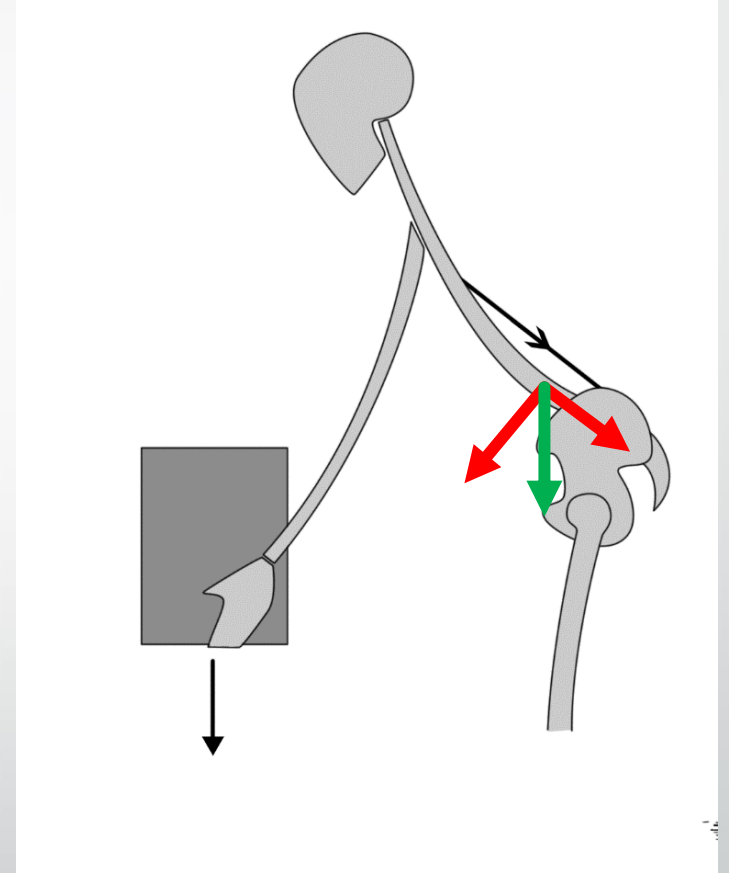


# Movement Matters

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!

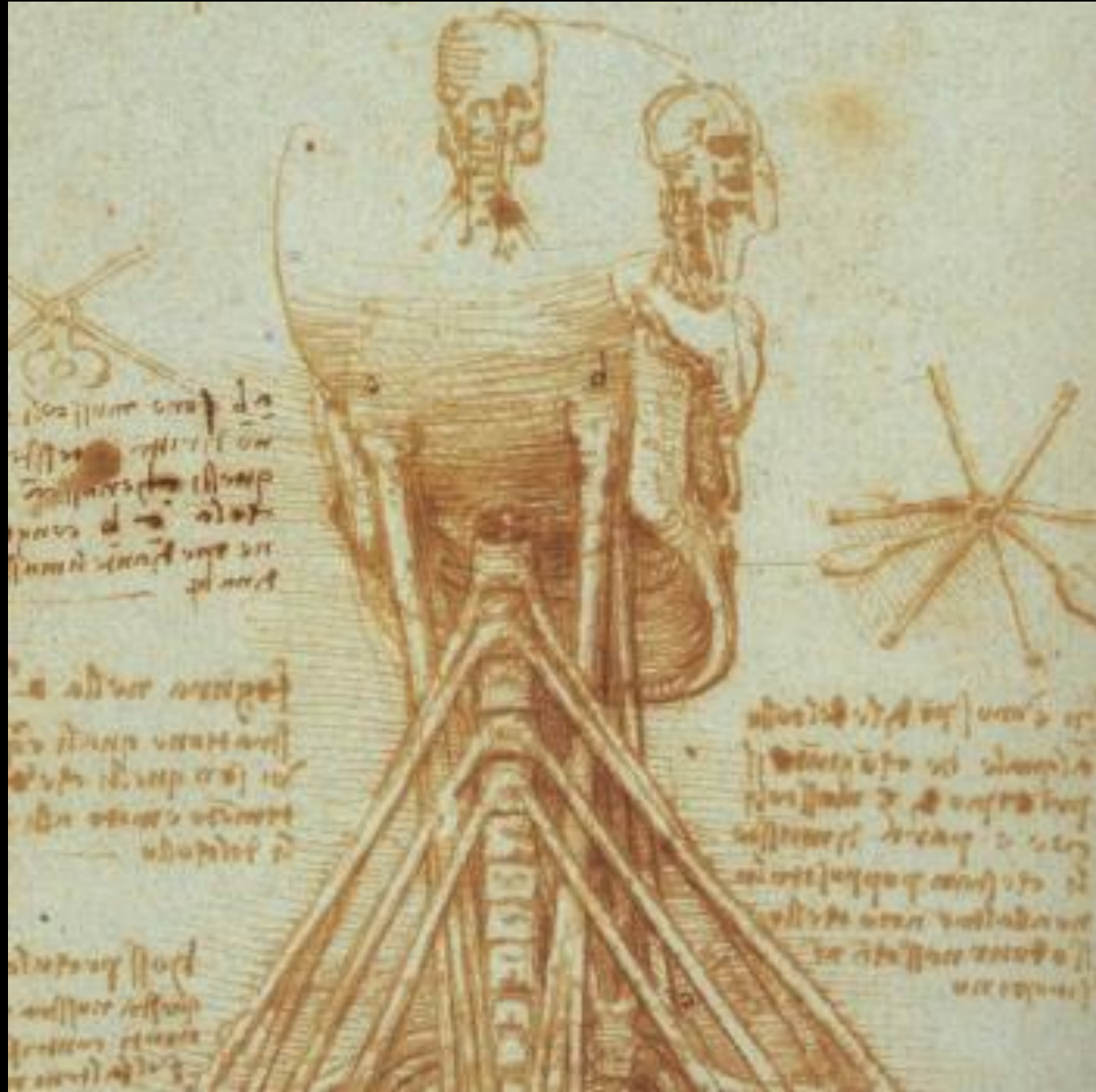
*“Always listen to the patient  
they might be telling you the  
diagnosis”.*

(Sir William Osler 1849 - 1919)



# Spine Stability

Few have ever measured it... many talk about it!





# Injury Cascade?

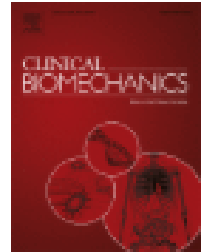
Changes in form and function!

# In vitro...



Clinical Biomechanics

Volume 36, July 2016, Pages 1-7



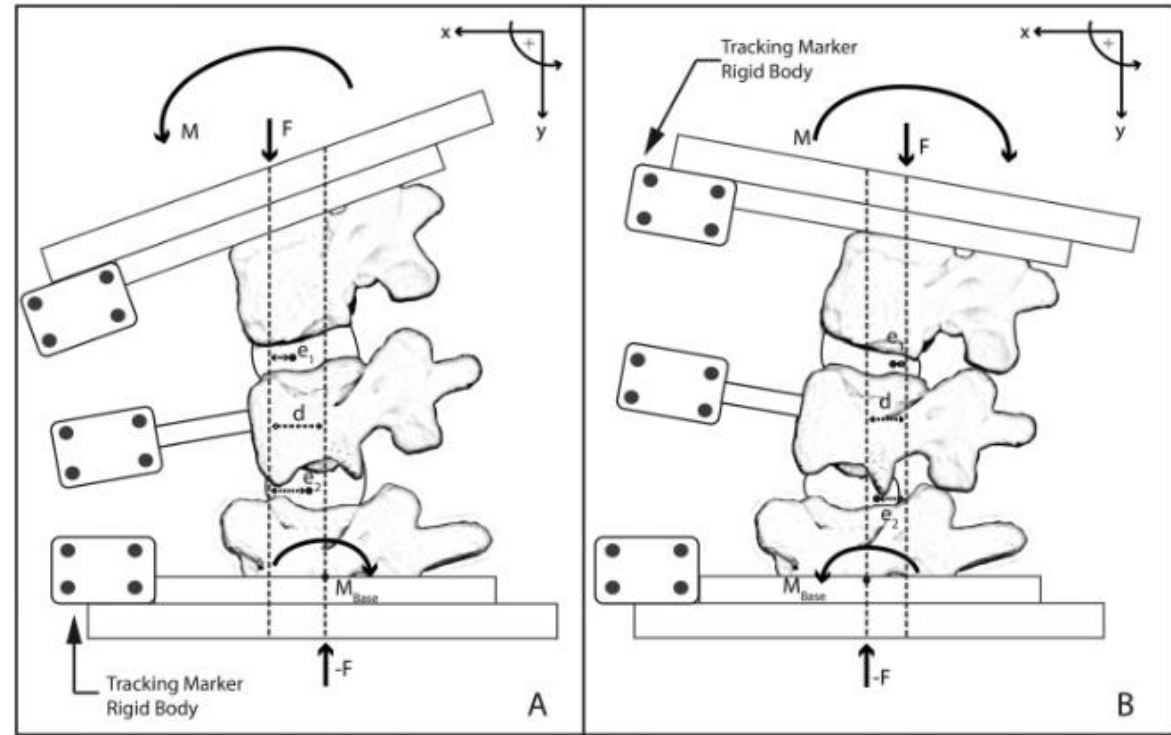
## Disc height loss and restoration via injectable hydrogel influences adjacent segment mechanics in-vitro

Christian Balkovec <sup>a</sup>  , Andrea J. Vernengo <sup>b</sup>, Stuart M. McGill <sup>a</sup>

 [Show more](#)

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

[Get rights and content](#)



$$M_{e1} = -Fe_1 - M$$

$$M_{e2} = -Fe_2 - M$$

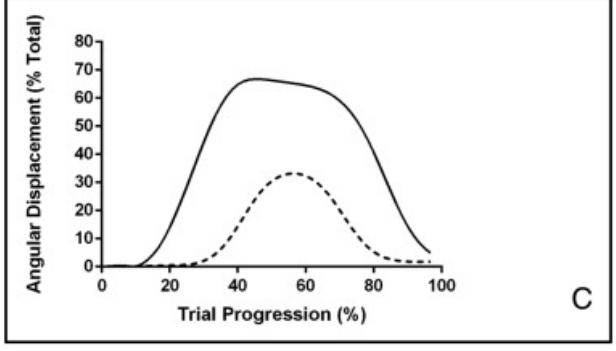
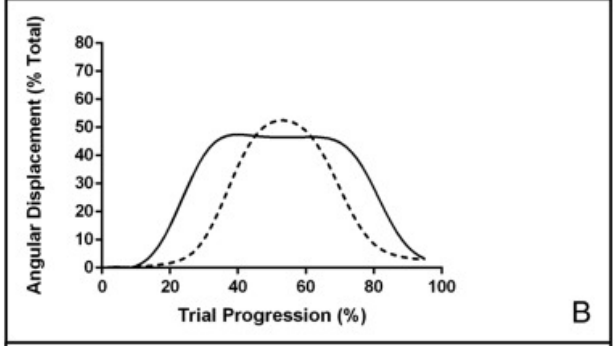
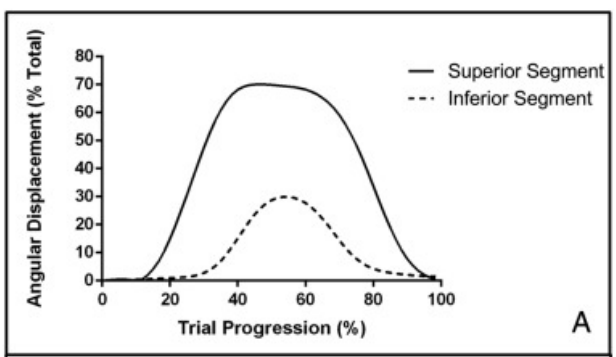
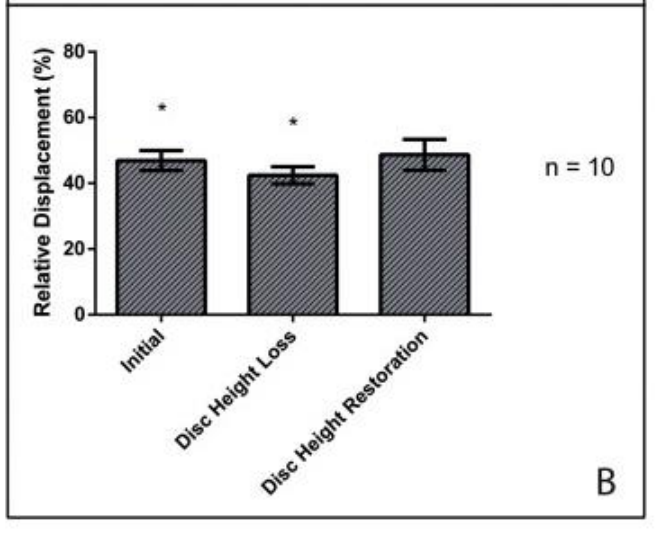
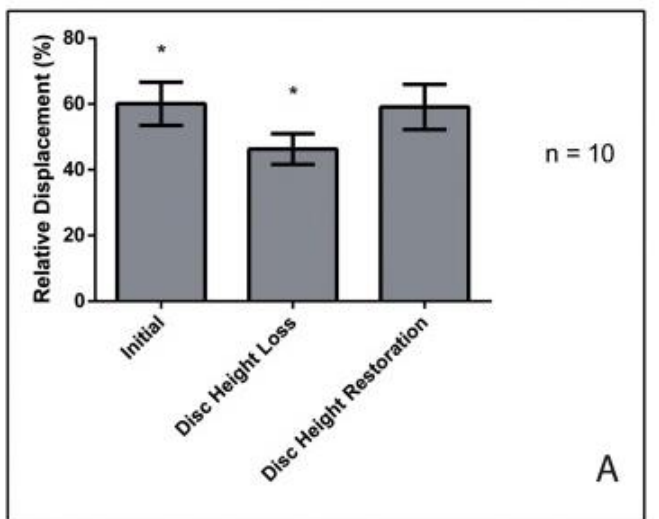
$$M_{Base} = -Fd - M$$

$$M_{e1} = Fe_1 + M$$

$$M_{e2} = Fe_2 + M$$

$$M_{Base} = Fd + M$$






# 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

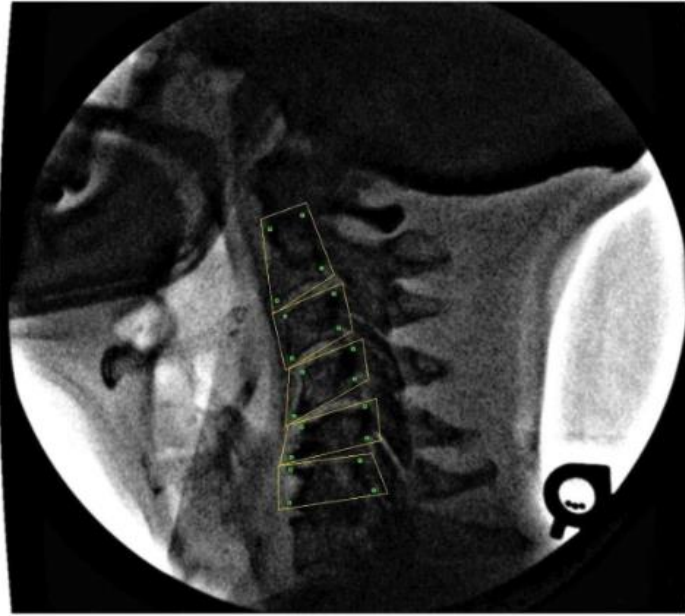
 Download citation  <https://doi-org.proxy.lib.uwaterloo.ca/10.1080/10255842.2017.1302435>

 Check for updates

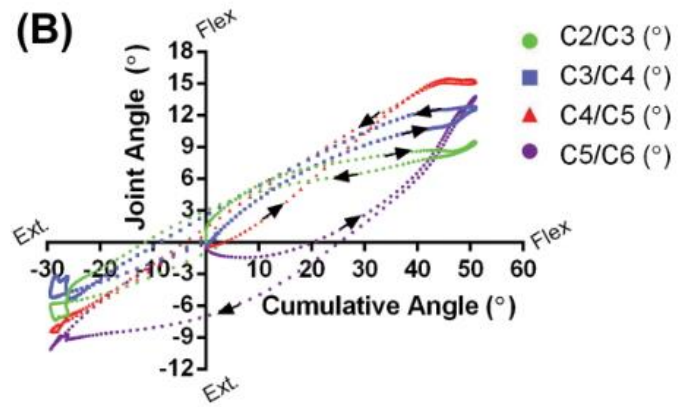
(A)



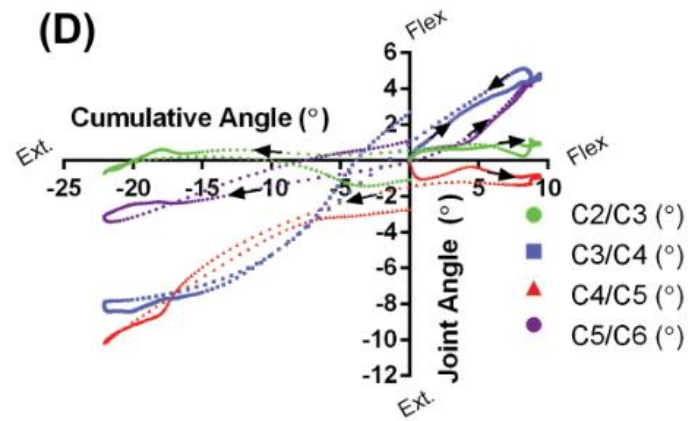
(C)



(B)



(D)





Clinical Biomechanics

Volume 56, July 2018, Pages 11-17



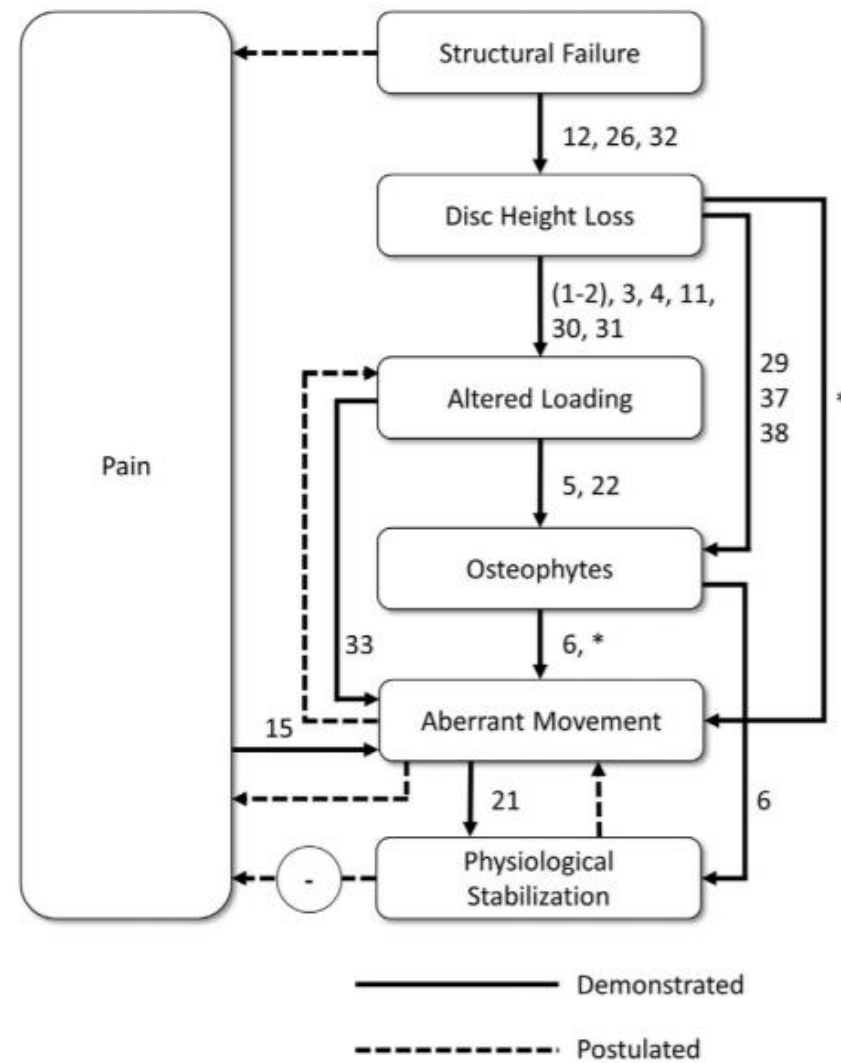
## Digital tracking algorithm reveals the influence of structural irregularities on joint movements in the human cervical spine

Christian Balkovec <sup>a</sup> ✉, Jim Veldhuis <sup>b</sup>, John W. Baird <sup>c</sup>, G. Wayne Brodland <sup>b, d</sup>, Stuart M. McGill <sup>a</sup>

[Show more](#)

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

[Get rights and content](#)

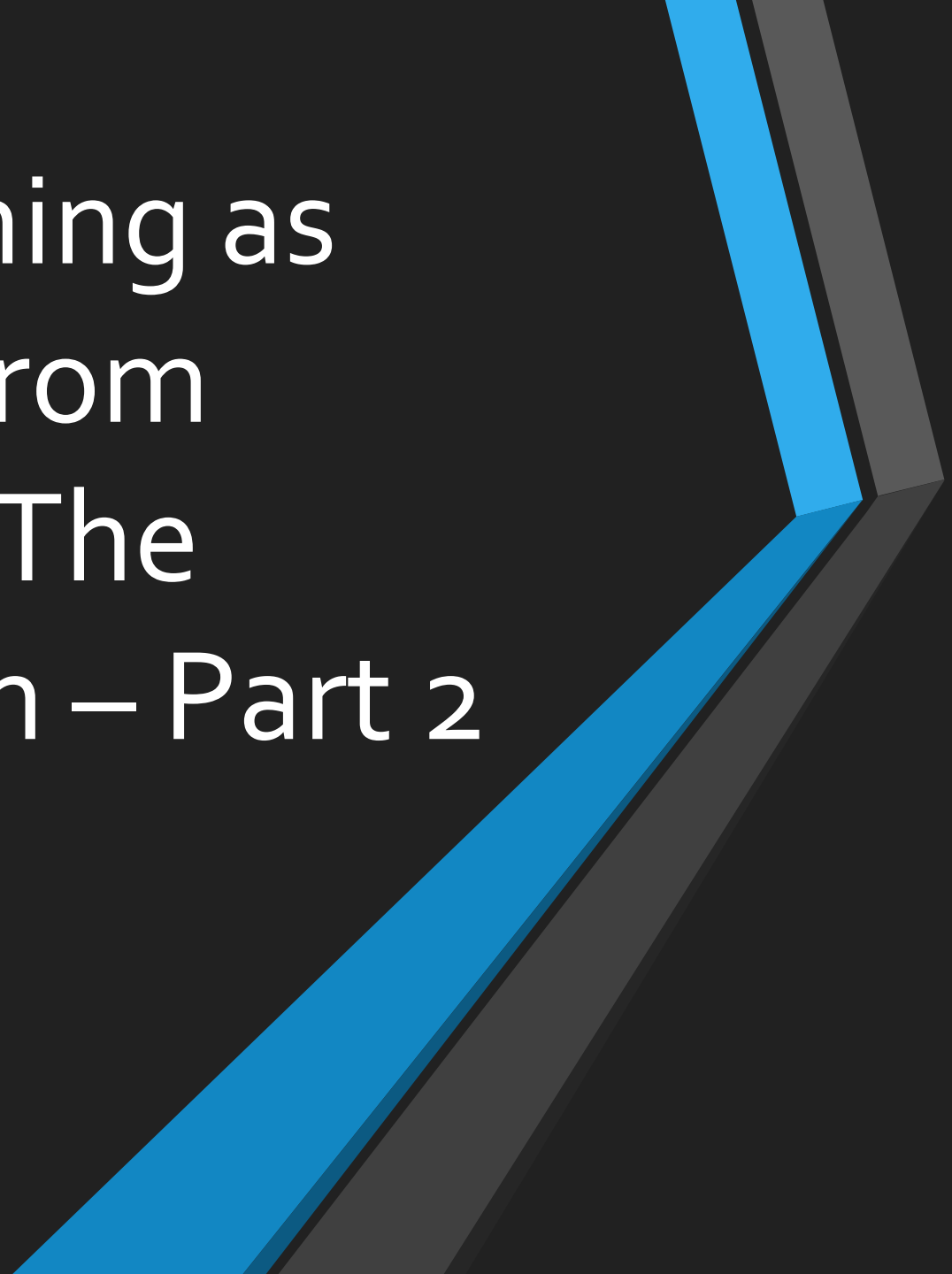


**Fig. 1.** Connections between spinal injury, pathology and function. The figure shows how factors such as structural failure, disc height loss, altered loading, aberrant movement, and physiological stabilization can affect each other. Established relationships are shown with solid lines and numerical 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

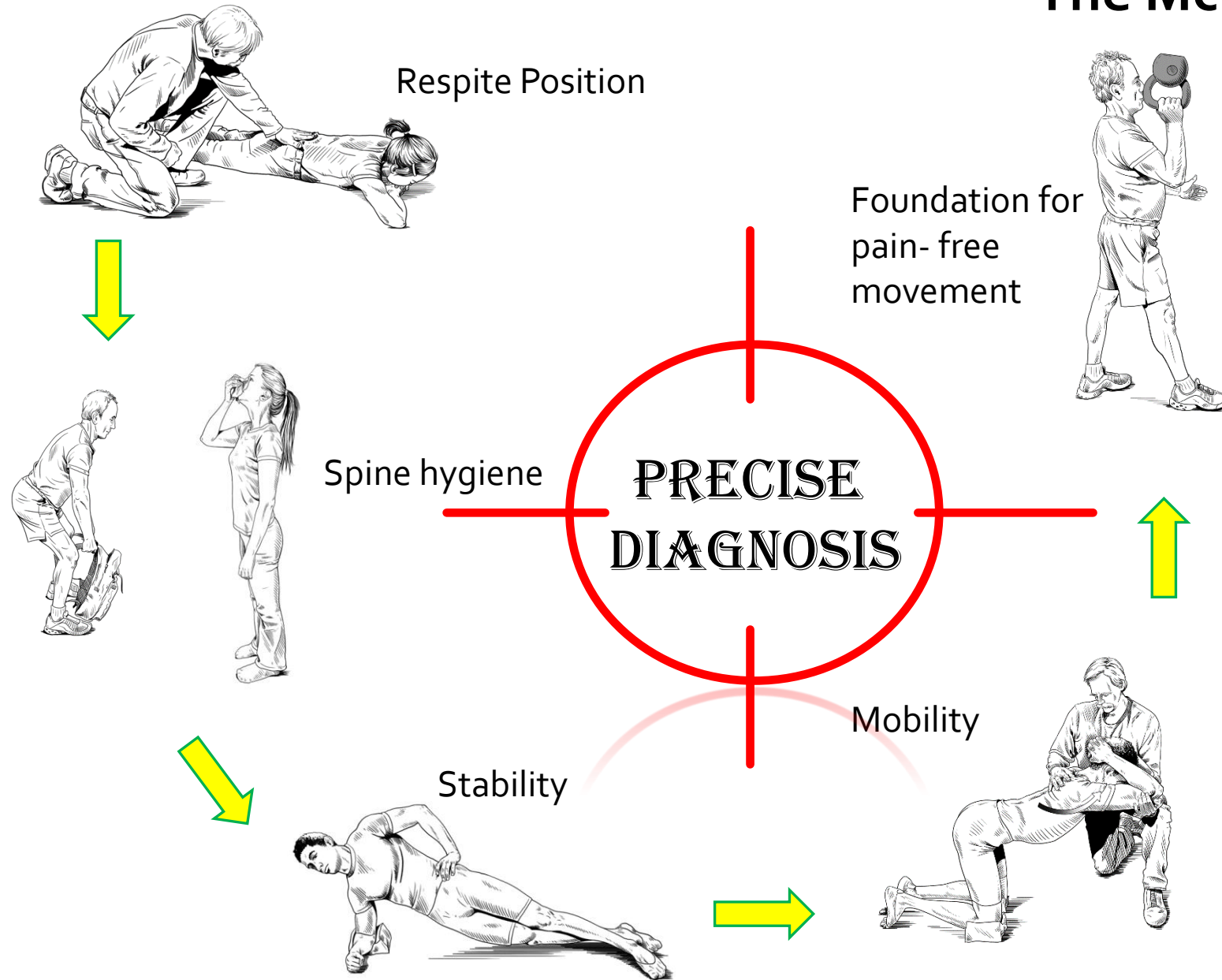
Dr. Edward D J Cambridge, BKin, DC, PhD

# There is no such thing 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"





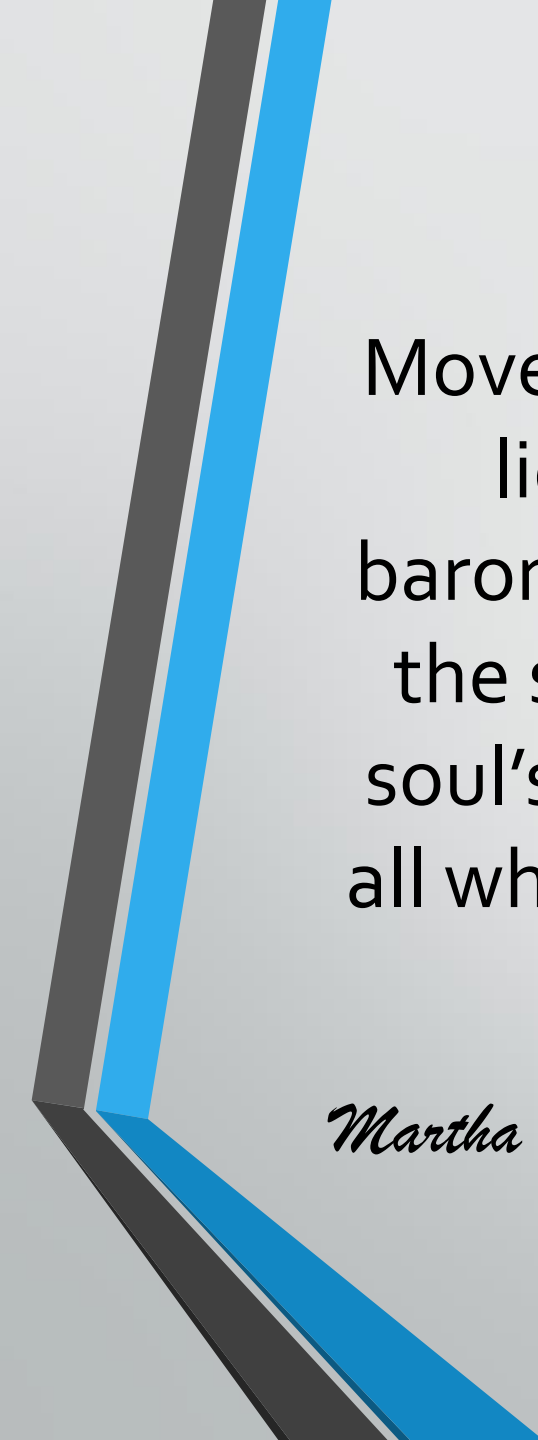
# Karel Lewit: Wisdom

**“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

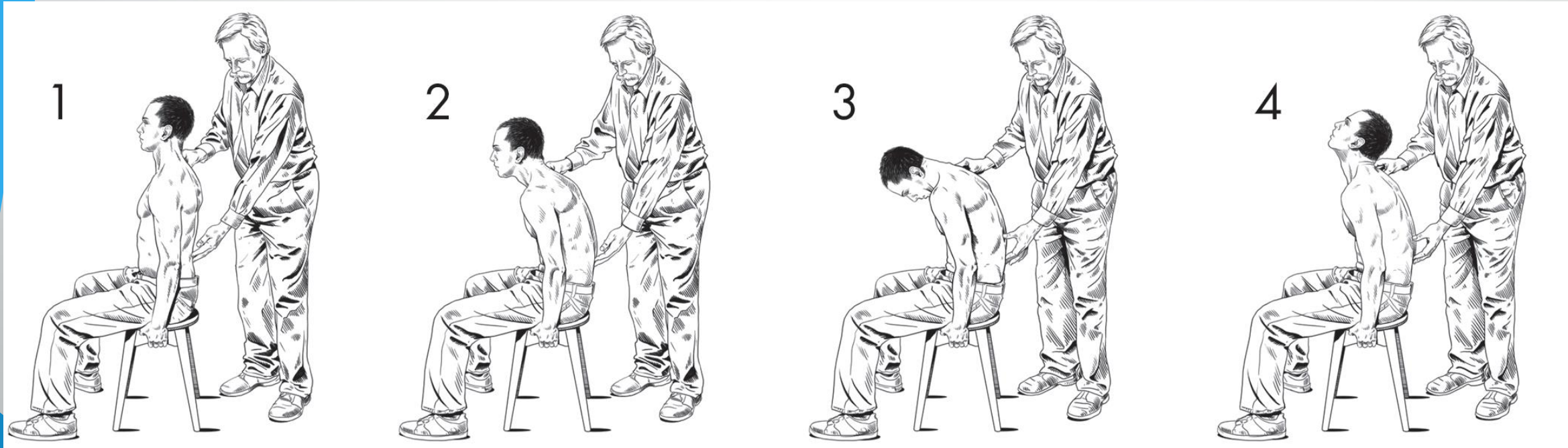
Organized systems  
Recipes  
Structured Procedures  
Rules



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"

