THE BODY and the BIKE
A kinetic chain analysis of cycling overuse injury

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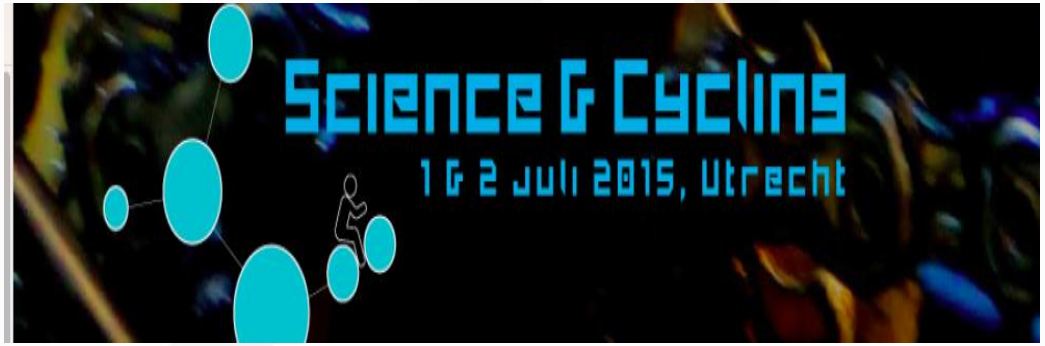
LA TROBE UNIVERSITY

AUSTRALIA



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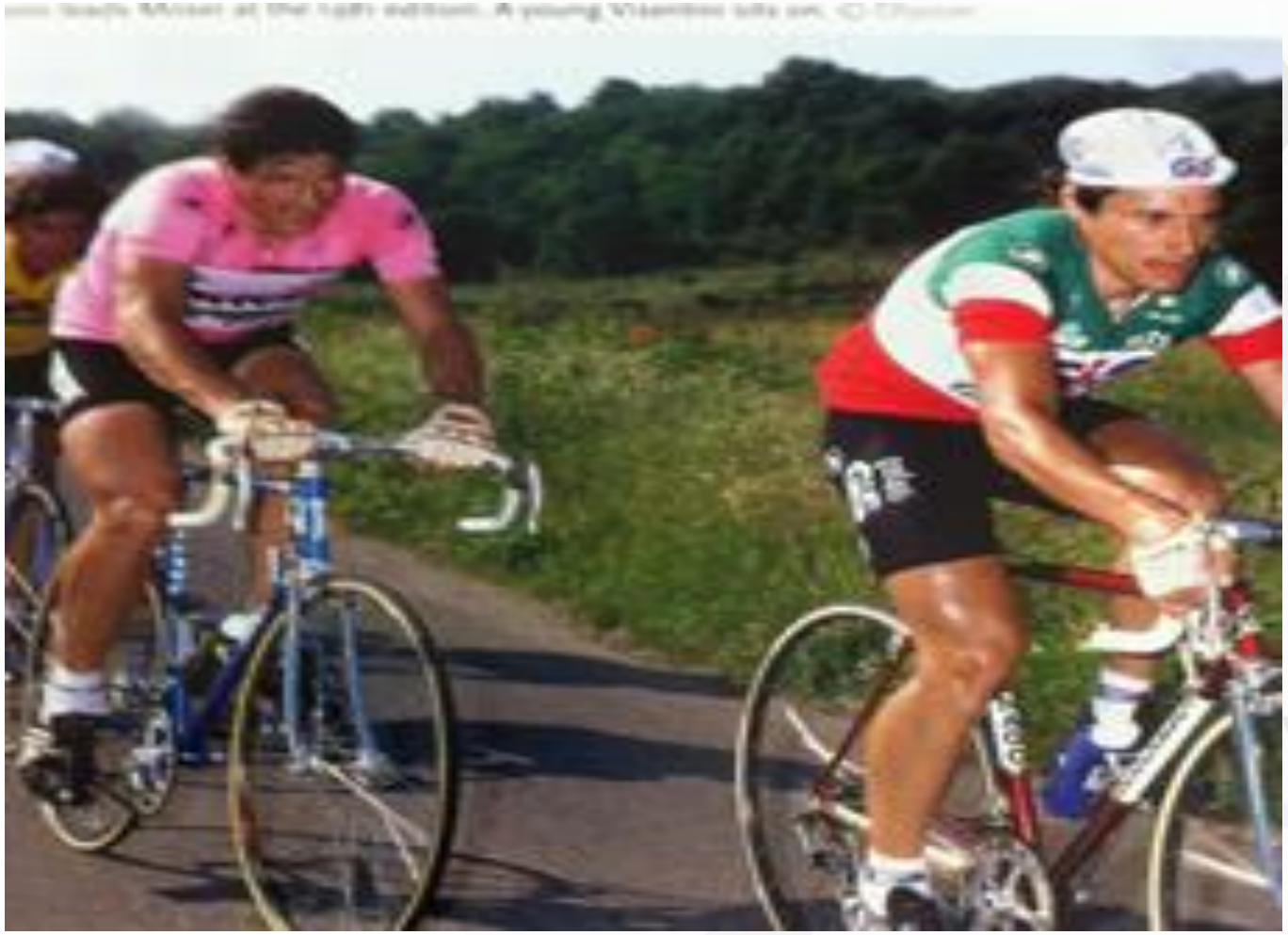

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The VISA score: An index of severity of symptoms in patients with jumper's knee (patellar tendinosis) 1998

- Paul J Visentini#
- Karim M Khan#*
- Jill L Cook#$
- Zoltan S Kiss^
- Peter R Harcourt%
- John D Wark#
- for the Victorian Institute of Sport Tendon Study Group

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Dear Paul,

Notice of Offer of Admission to Doctor of Physiotherapy Candidature

Offer: I am pleased to inform you that you have been accepted for higher degree candidature at this University in the Doctor of Physiotherapy. Full details of this offer appear below.

Application ID Number: 87046157

Course Load: Part Time

Commencement Date: 02 March 2015

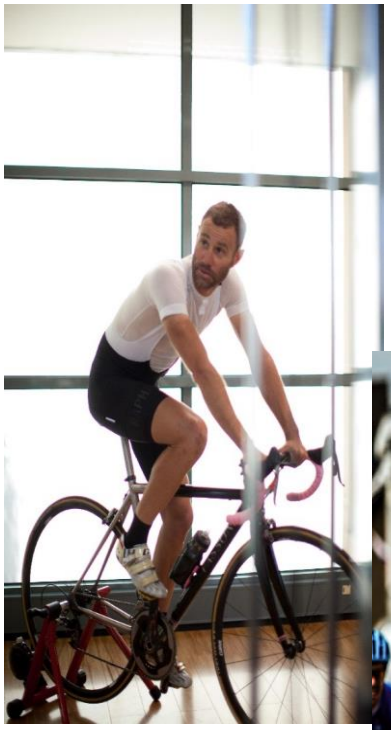
Expiry date: 31 December 2022

Faculty of Health Sciences

206 Physiotherapy

Research Topic: **Clinical Measures of Kinetic Chain Function in Cycling and Running and their Relationship to Injury**

Supervisor(s): **Dr Tania Pizzari (Principal Supervisor)**
Mr Adam Semciw (Co-supervisor)



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REINA
LA

Why?

- Curiosity
- Little evidence
  - ***bike + overuse pain + risk factors***
- Risk Factors are a guide to aetiology and management
- Bike Set-Up & Injury
  - PLUMB LINE ?
  - KNEE ANGLE ?
  - SEAT HEIGHT ?
  - ACTIVATION and KINEMATICS ?
- Dogma !

What?

- Cycling Kinetic chain

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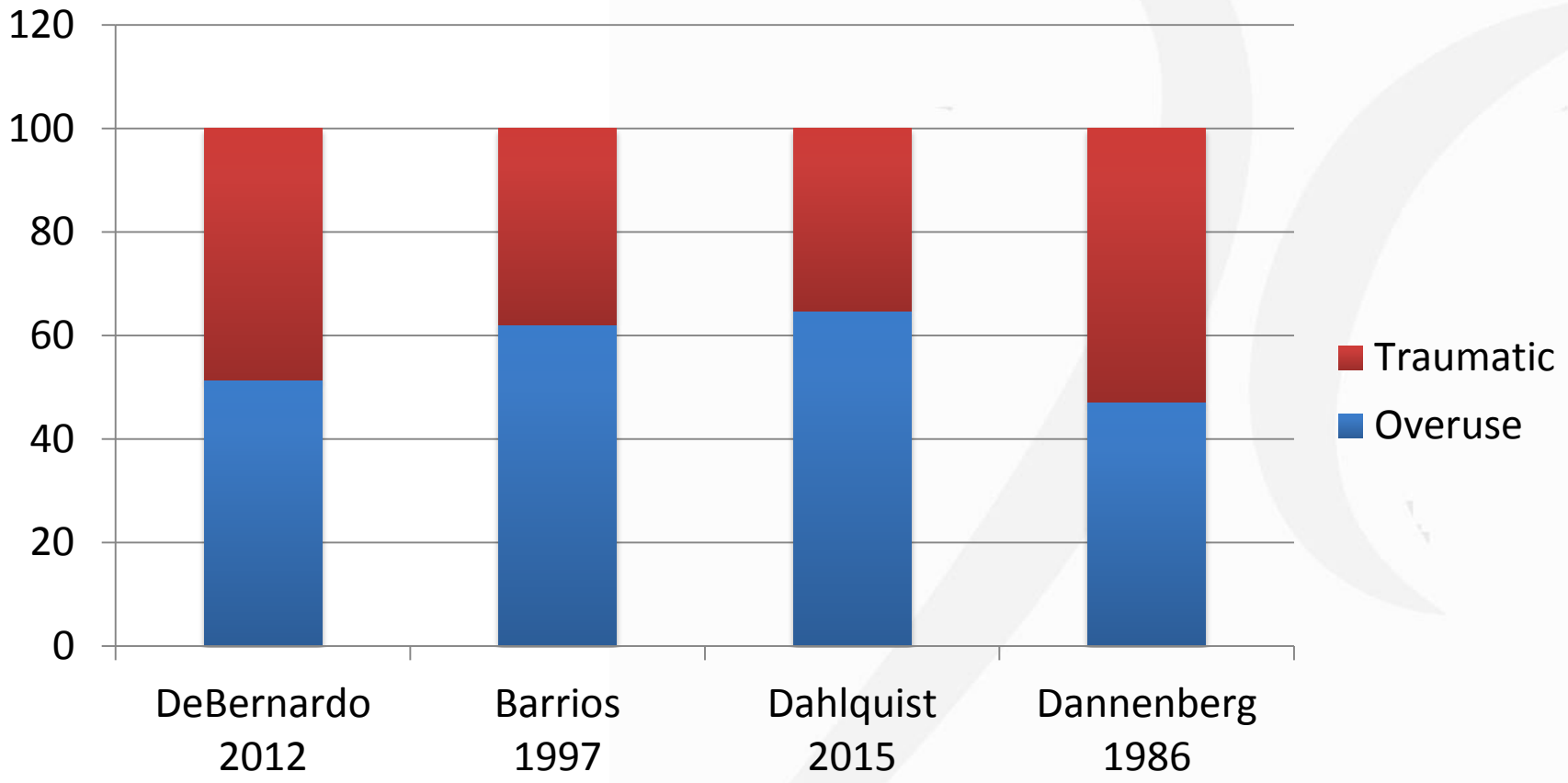
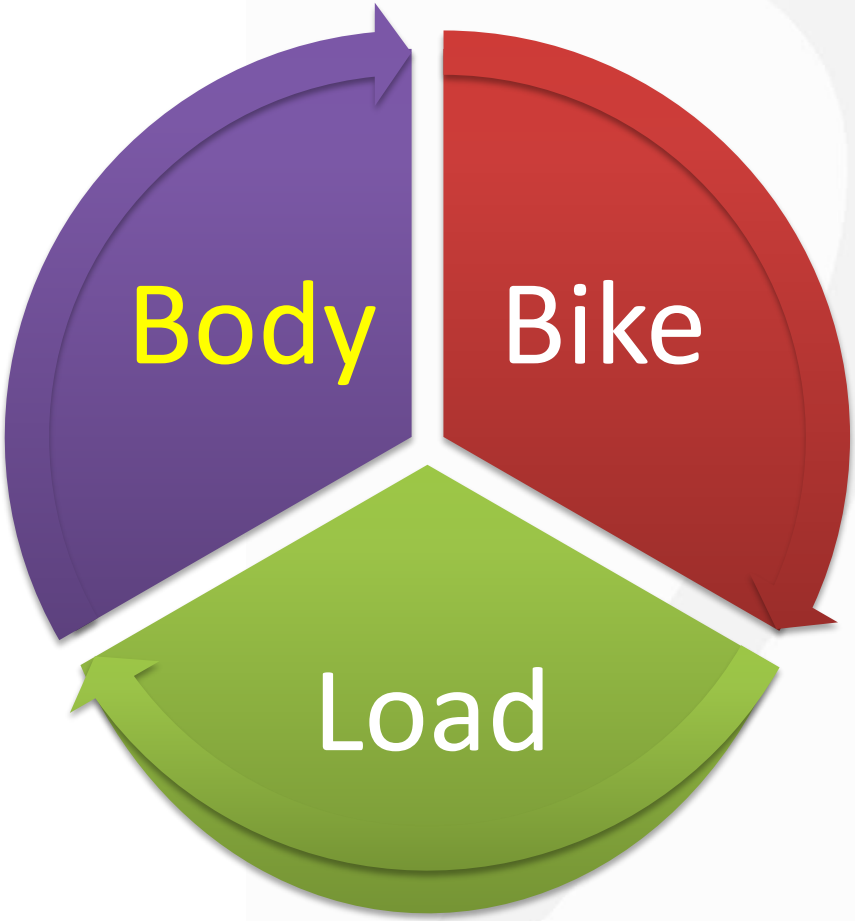
Gregor 1996

- Greogor 1996 – "..knowledge of ..load sharing among all segments responsible for the co-ordination of energy delivery to the crank is important.."
- Van Ingen Schenau 1989 "…uniarticular muscles POWER PRODUCERS and bi-articular POWER DISTRIBUTORS…."

Epidemiology



Tissue Overuse / Overload



Overuse Model based on Load Variables and Kinetic Chain Deficiency

- 90 RPM
- 5 hours
- 27,000 pedal strokes R/L
- Mechanotransduction!!
- “Be the cell”

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MECHANOTRANSDUCTION

Process by which the body converts mechanical loading into cellular responses

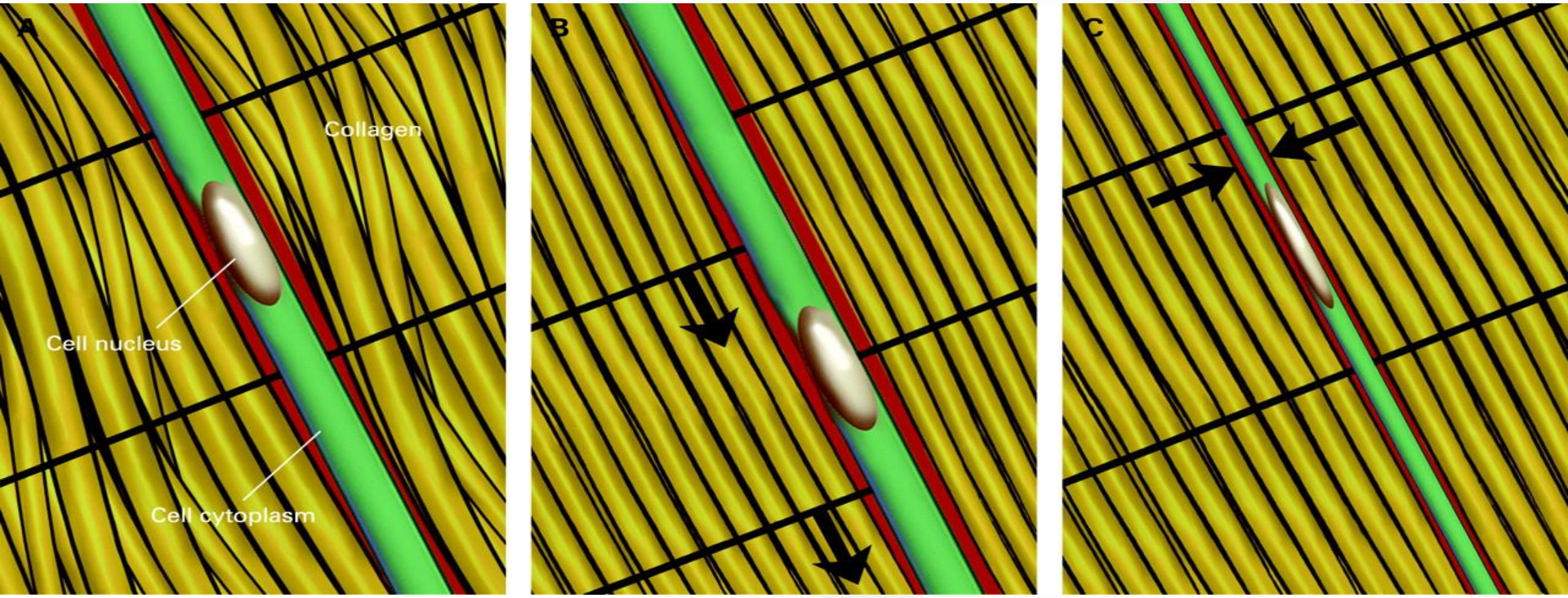
These cellular responses promote structural change

Mechanotherapy is the employment of mechanotransduction for the stimulation of tissue repair and remodelling

(Khan 2009)

Loading Theory

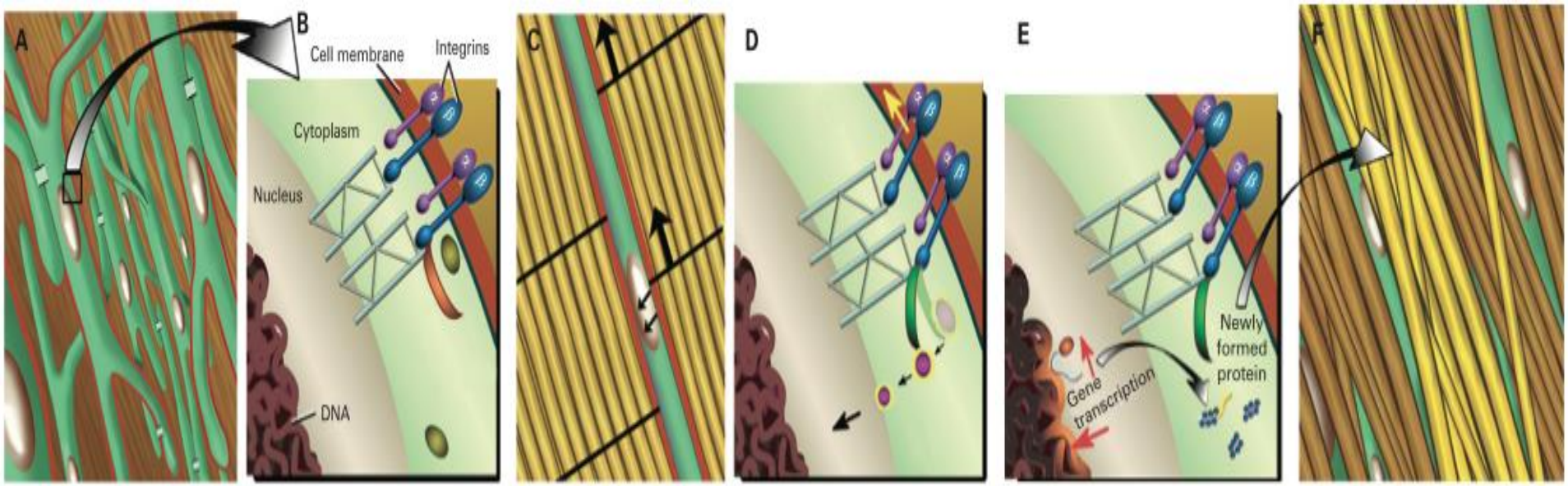
MECHANOTRANSDUCTION



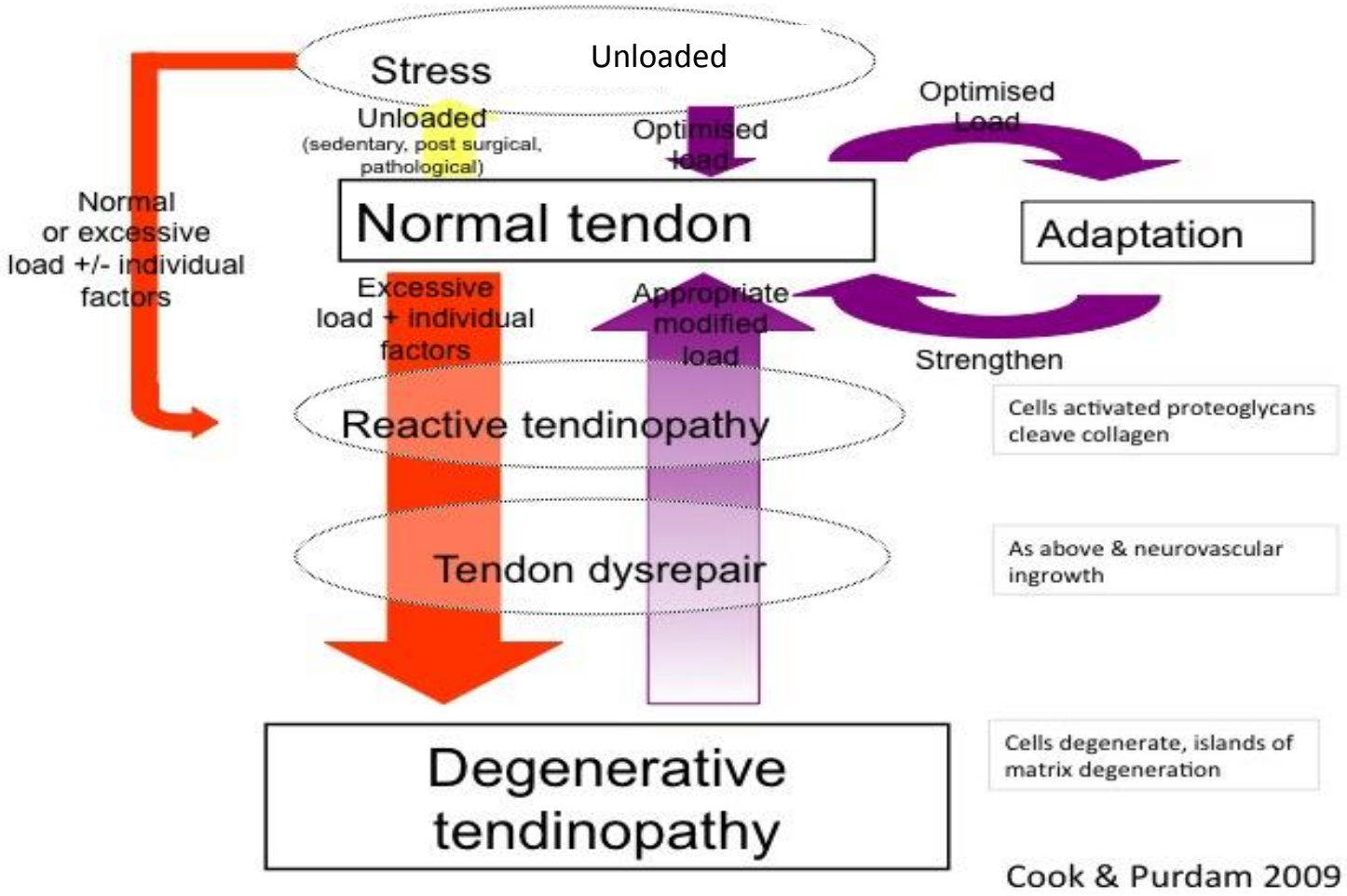
(Khan 2009)

Loading Theory

MECHANOTRANSDUCTION



Tissue Response - TENDON



Tissue Response

ARTICULAR CARTILAGE (Pollard 2008)

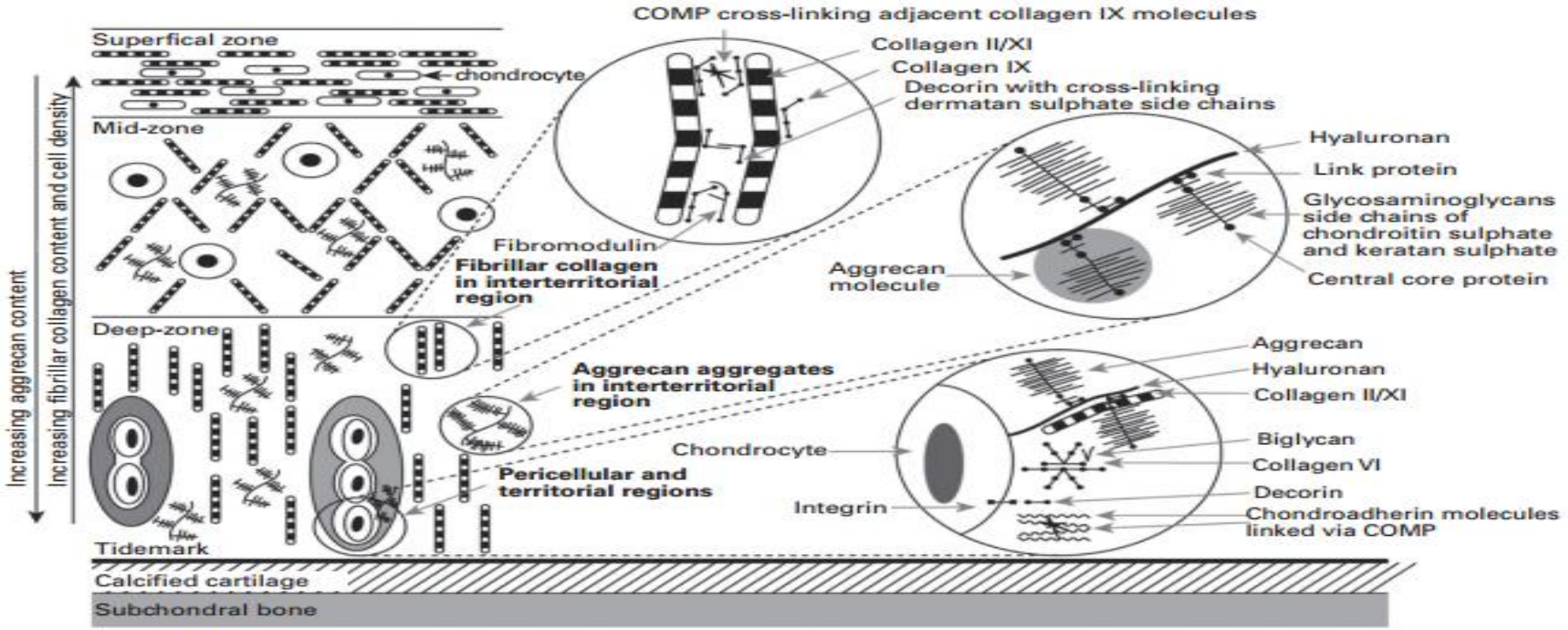


Fig. 1

Schematic illustration of the zones and compartmentalisation of articular cartilage (left side), and the molecular interactions in the territorial and interterritorial regions and structure of aggrecan and its formation into aggregates (right side) (COMP, cartilage oligomeric matrix protein).

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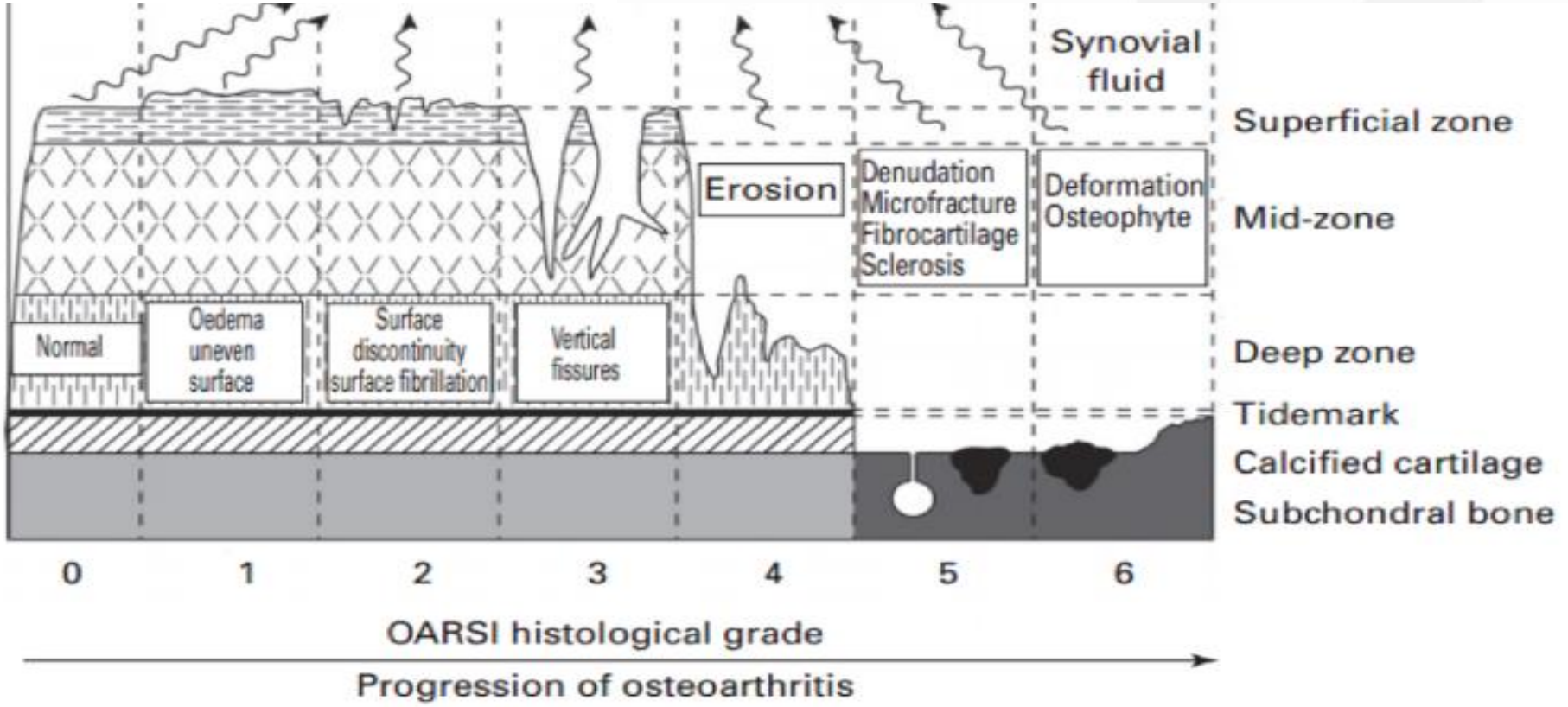
Tissue Response

ARTICULAR CARTILAGE (Pollard 2008)



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Tissue Response

MUSCLE – Mueller-Wolfhardt 2012

Table 2 Classification of acute muscle disorders and injuries

A. Indirect muscle disorder/injury	Functional muscle disorder	Type 1: Overexertion-related muscle disorder	Type 1A: Fatigue-induced muscle disorder
			Type 1B: Delayed-onset muscle soreness (DOMS)
		Type 2: Neuromuscular muscle disorder	Type 2A: Spine-related neuromuscular Muscle disorder
			Type 2B: Muscle-related neuromuscular Muscle disorder
	Structural muscle injury	Type 3: Partial muscle tear	Type 3A: Minor partial muscle tear
			Type 3B: Moderate partial muscle tear
		Type 4: (Sub)total tear	Subtotal or complete muscle tear
			Tendinous avulsion
B. Direct muscle injury		Contusion	
		Laceration	

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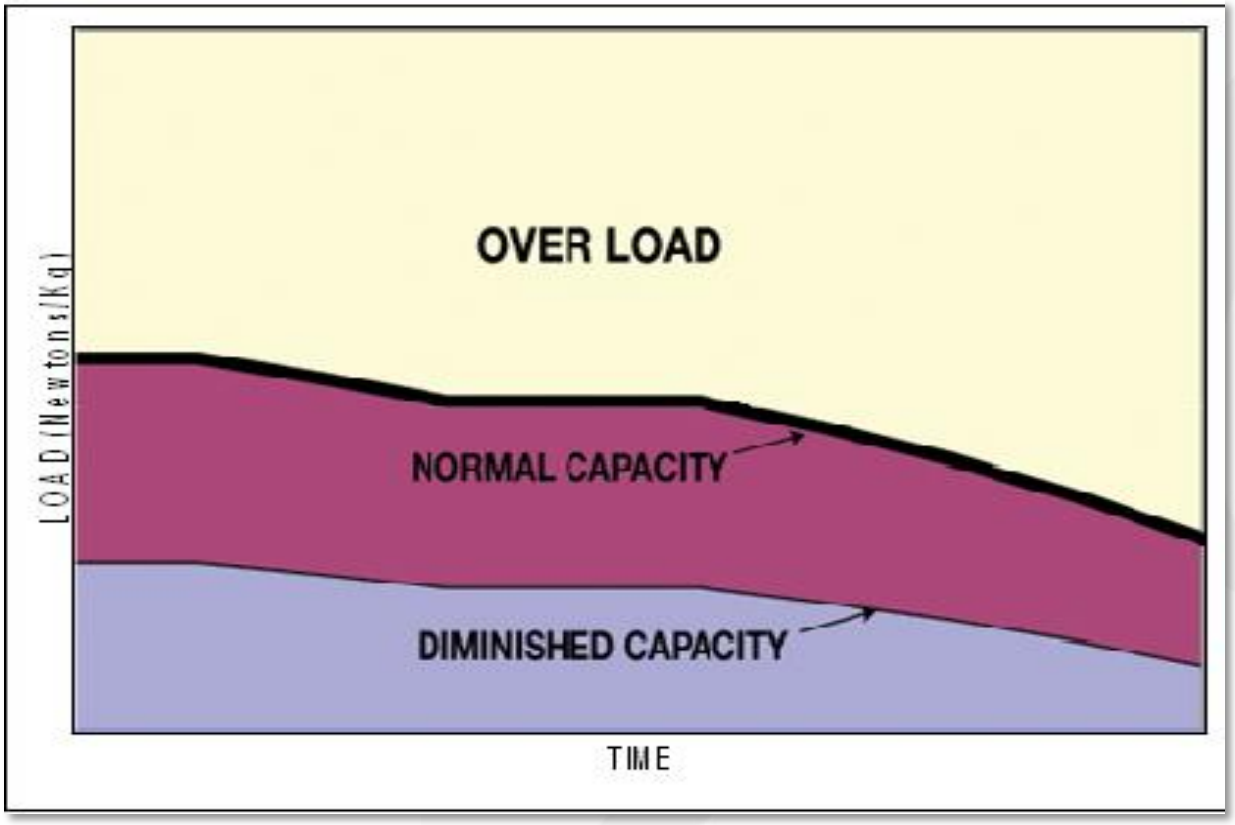
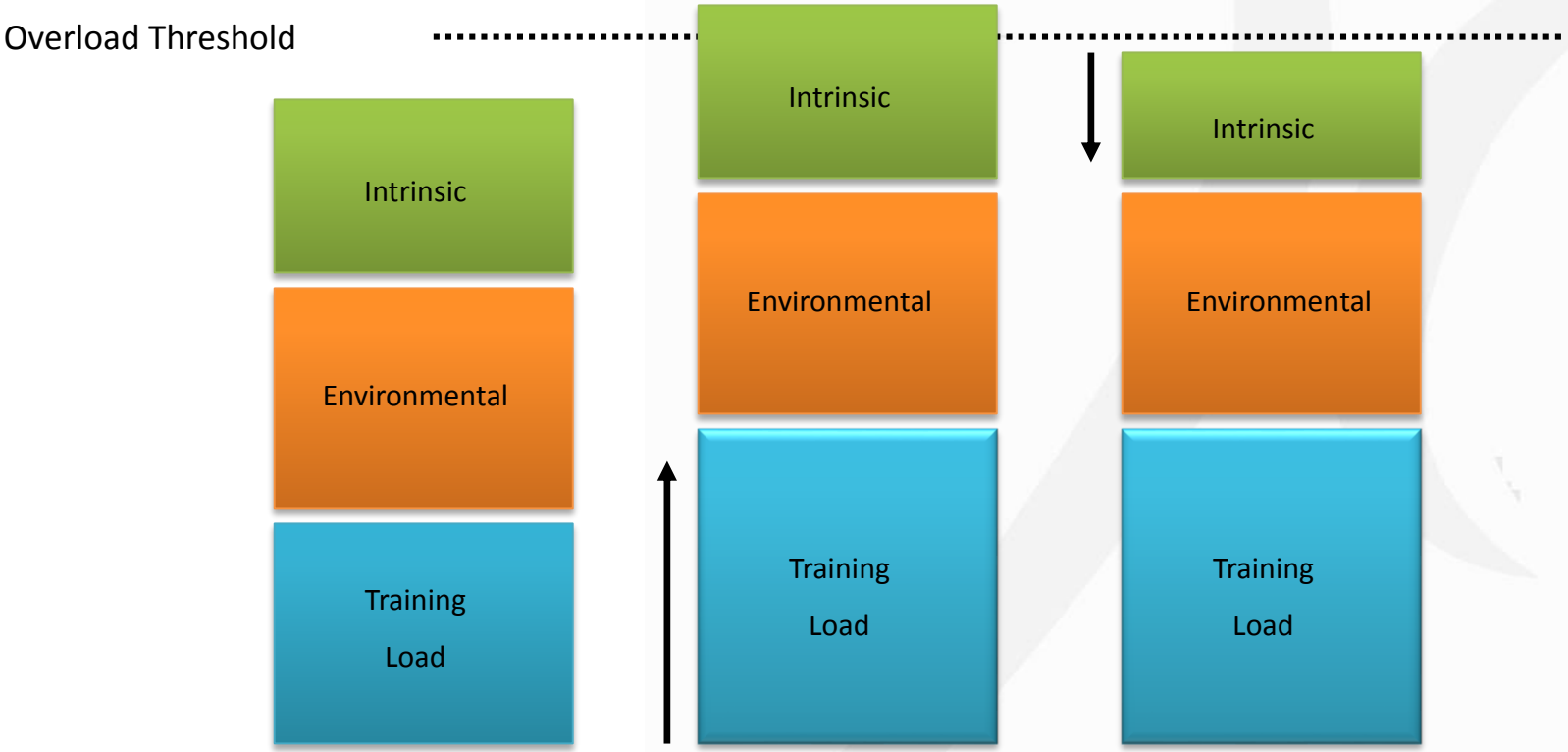
Loading Theory

CAPACITY



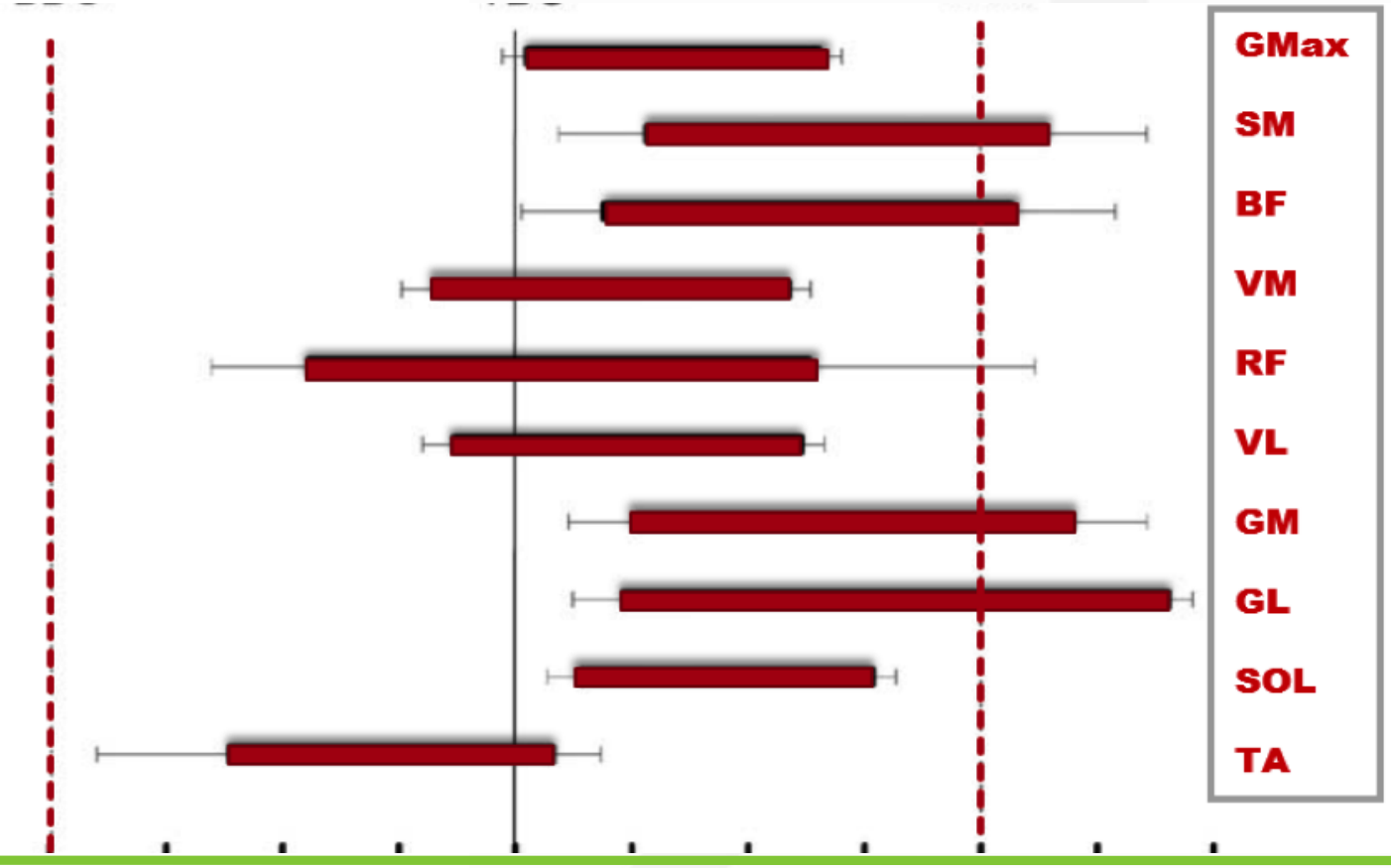
Loading Theory

CAPACITY



PERFECT ACTIVATION

Hug 2009



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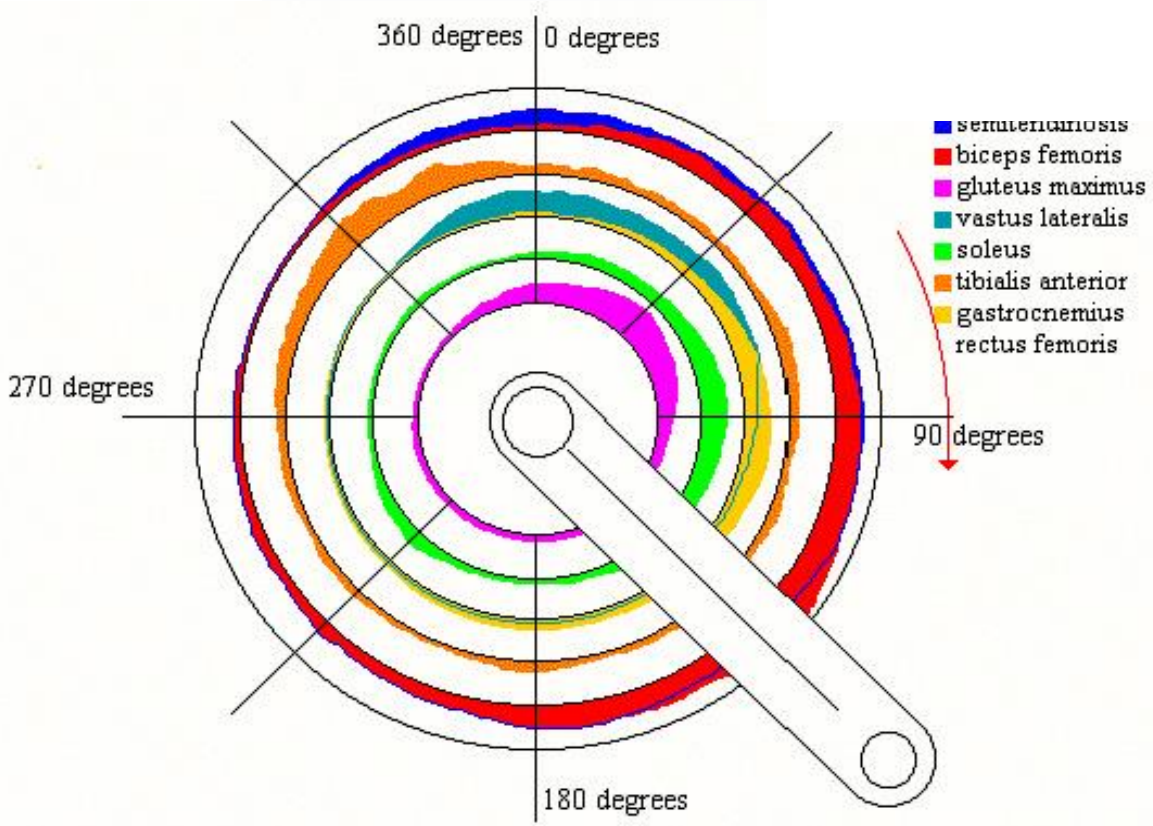
Muscles in Cycling



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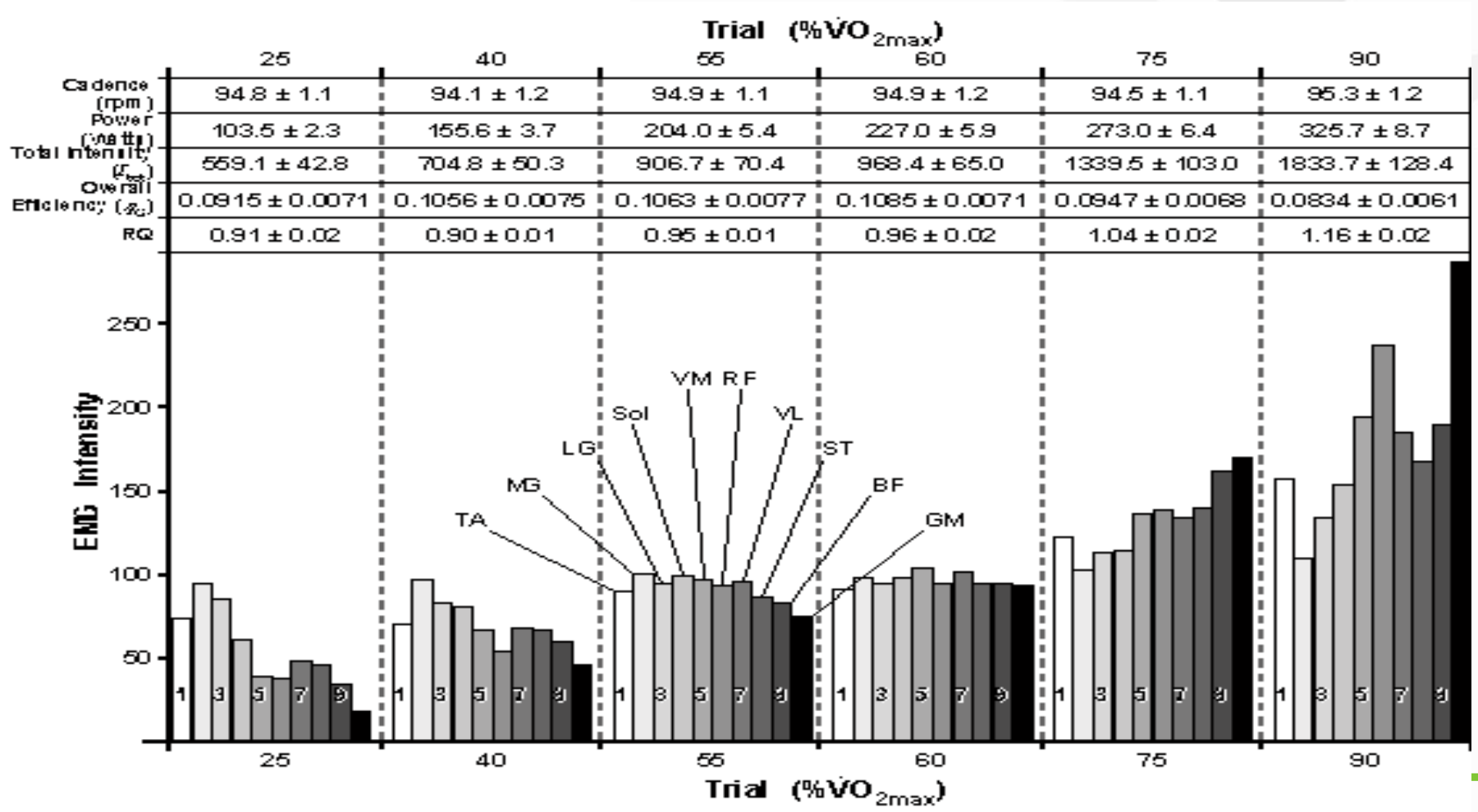
MUSCLE CO-ORDINATION PATTERNS in CYCLING

Ollie Blake 2012



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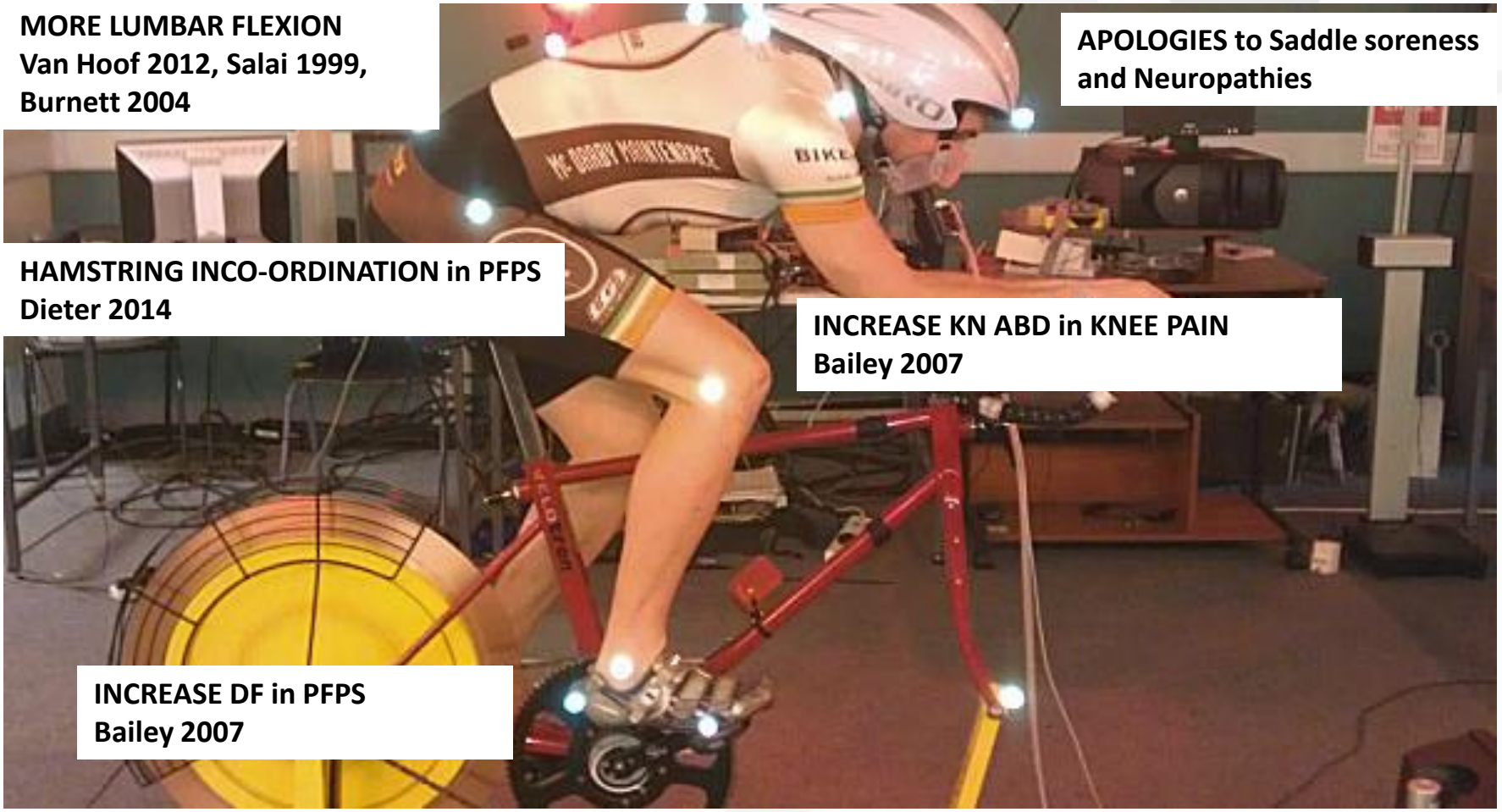
WHAT CAUSES PAIN + INJURY?

- **RISK FACTOR:** Pain vs “Imperfect”
- **LEAP of FAITH:** High Load/Fatigue is aberrant = “imperfect”
- **EXTRAPOLATE:** Land-based theories – walk, run, jump

EVIDENCE

Risk Factor



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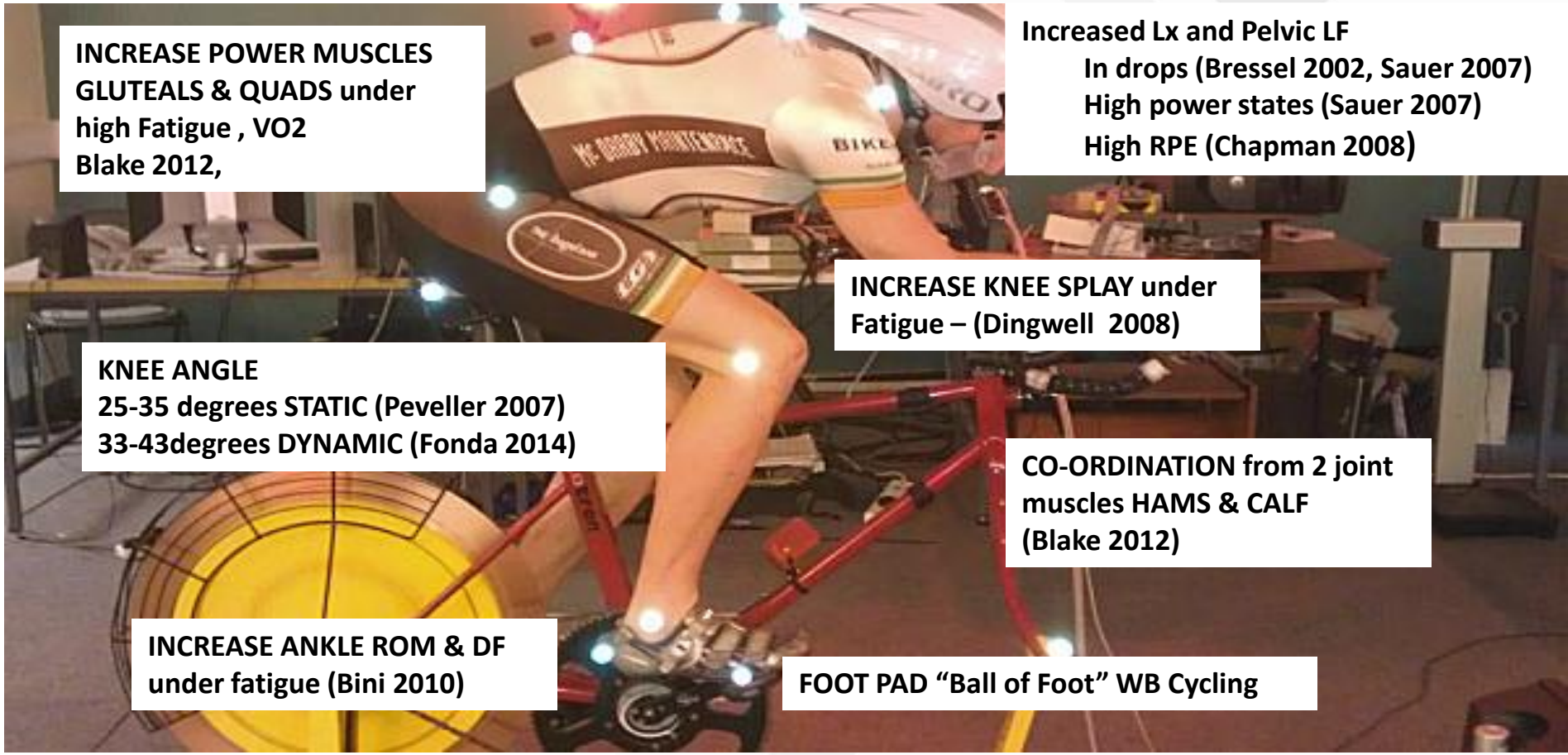
EVIDENCE

Performance



INCREASE POWER MUSCLES GLUTEALS & QUADS under high Fatigue , VO2 Blake 2012,

Increased Lx and Pelvic LF
- **In drops (Bressel 2002, Sauer 2007)**
- **High power states (Sauer 2007)**
- **High RPE (Chapman 2008)**

INCREASE KNEE SPLAY under Fatigue – (Dingwell 2008)

KNEE ANGLE
25-35 degrees STATIC (Peveller 2007)
33-43degrees DYNAMIC (Fonda 2014)

CO-ORDINATION from 2 joint muscles HAMS & CALF (Blake 2012)

INCREASE ANKLE ROM & DF under fatigue (Bini 2010)

FOOT PAD "Ball of Foot" WB Cycling

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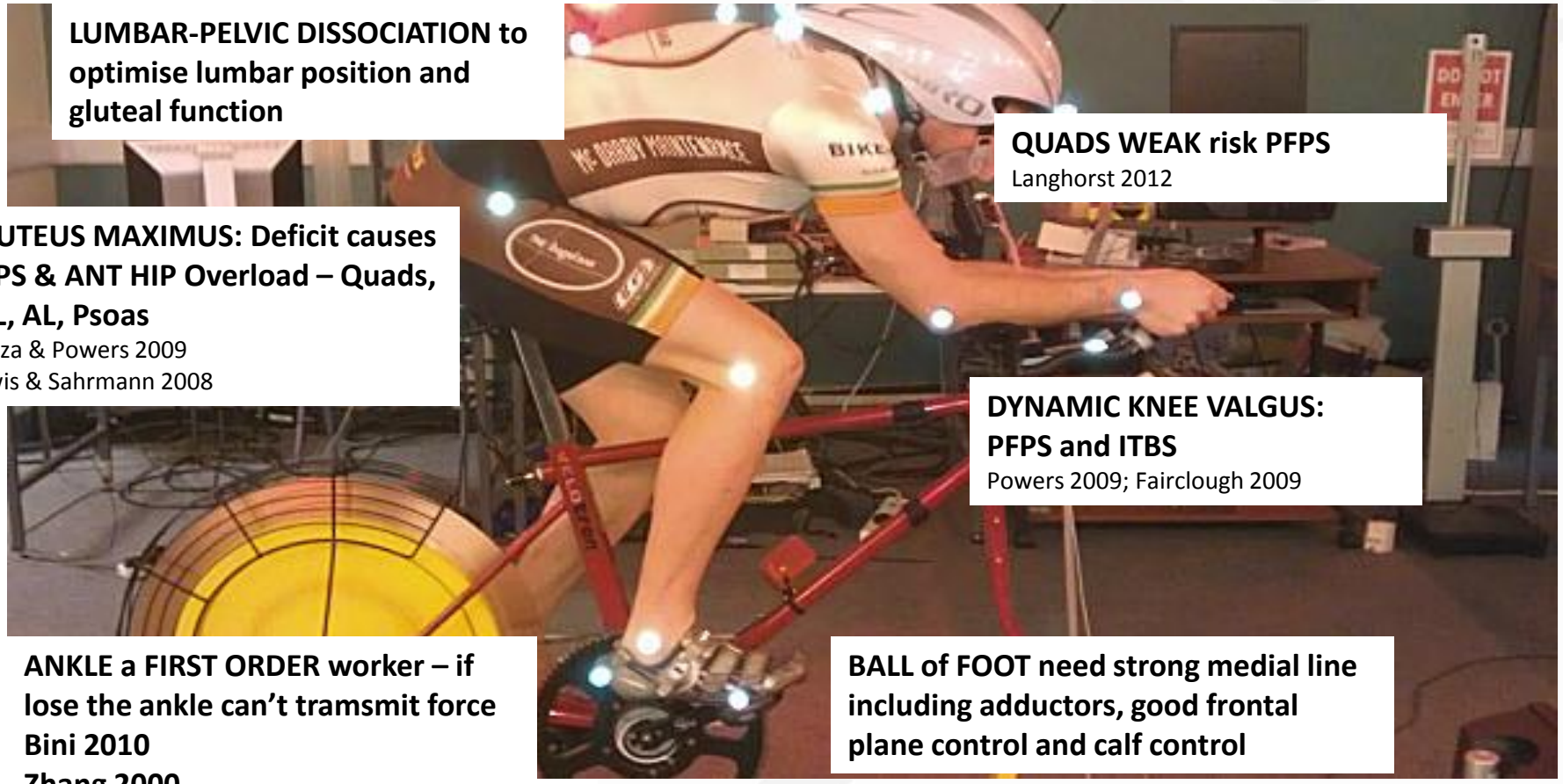
EVIDENCE

Extrapolate Land



LUMBAR-PELVIC DISSOCIATION to optimise lumbar position and gluteal function

QUADS WEAK risk PFPS
Langhorst 2012

GLUTEUS MAXIMUS: Deficit causes PFPS & ANT HIP Overload – Quads, TFL, AL, Psoas
Souza & Powers 2009
Lewis & Sahrmann 2008

DYNAMIC KNEE VALGUS: PFPS and ITBS
Powers 2009; Fairclough 2009

ANKLE a FIRST ORDER worker – if lose the ankle can't tramsmit force
Bini 2010
Zhang 2000

BALL of FOOT need strong medial line including adductors, good frontal plane control and calf control

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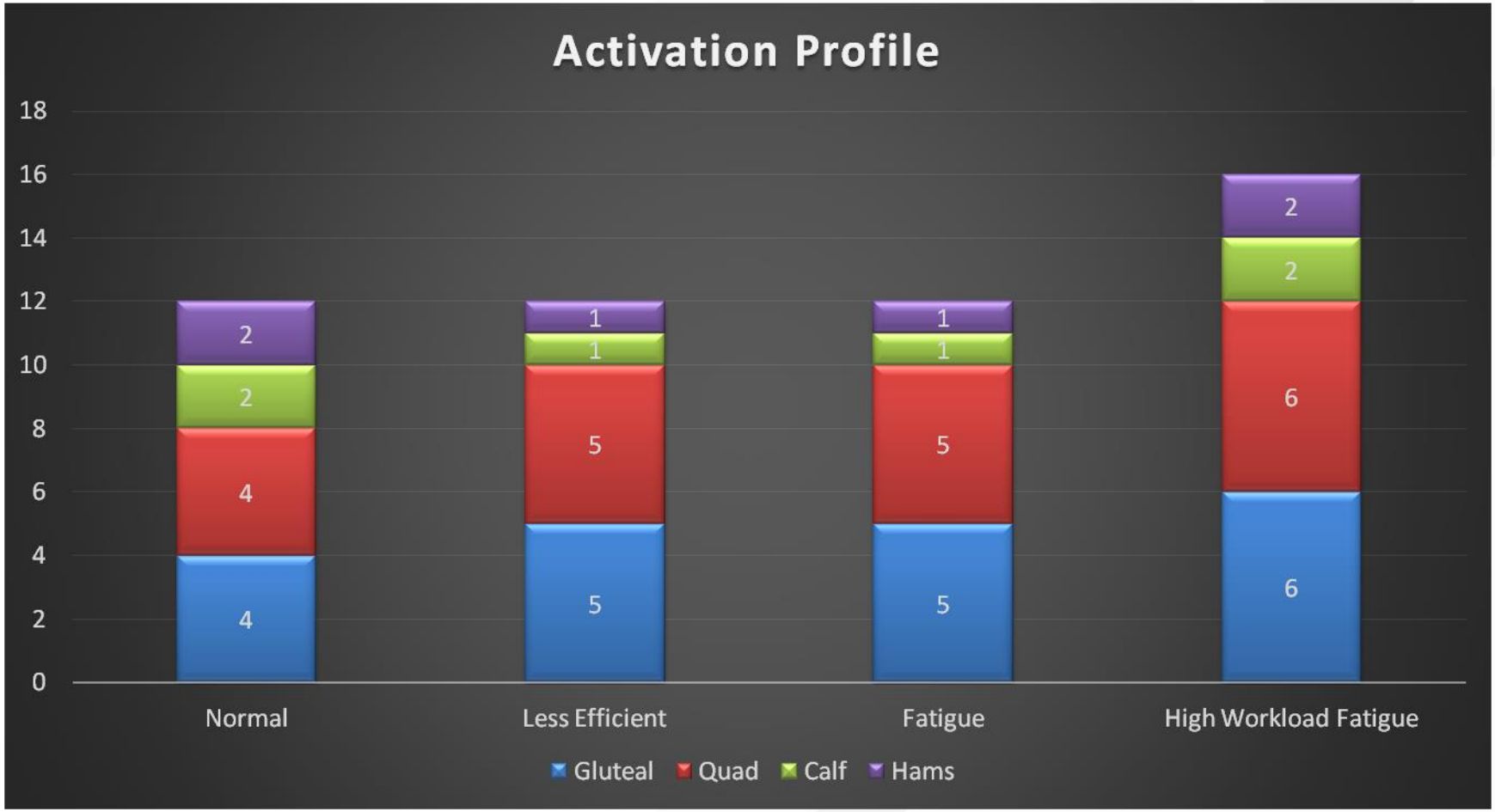
LOAD MASTERY

Cycling Closed Chain Summary

- **Foot and ankle:**
  - **DF Increase, Line of Force Medial Foot (not lateral)**
- **Knee:**
  - **Tibial abduction knee pain, DKV, Knee Angle 25-35 deg STATIC / 33-43 Dynamic, Quads Strength**
  - **Quadriceps Overload + PFC factors, PFPS and Hamstring Activation**
- **Hip:**
  - **Gluteus Maximus activation theory + "if deficient"**
  - **Anterior Overload theory - Add Magnus, Deep Rotators, Sciatic N**
- **Lumbar-Pelvic:**
  - **Lx FL, Pelvis-Lx Dissociation**

SUMMARY



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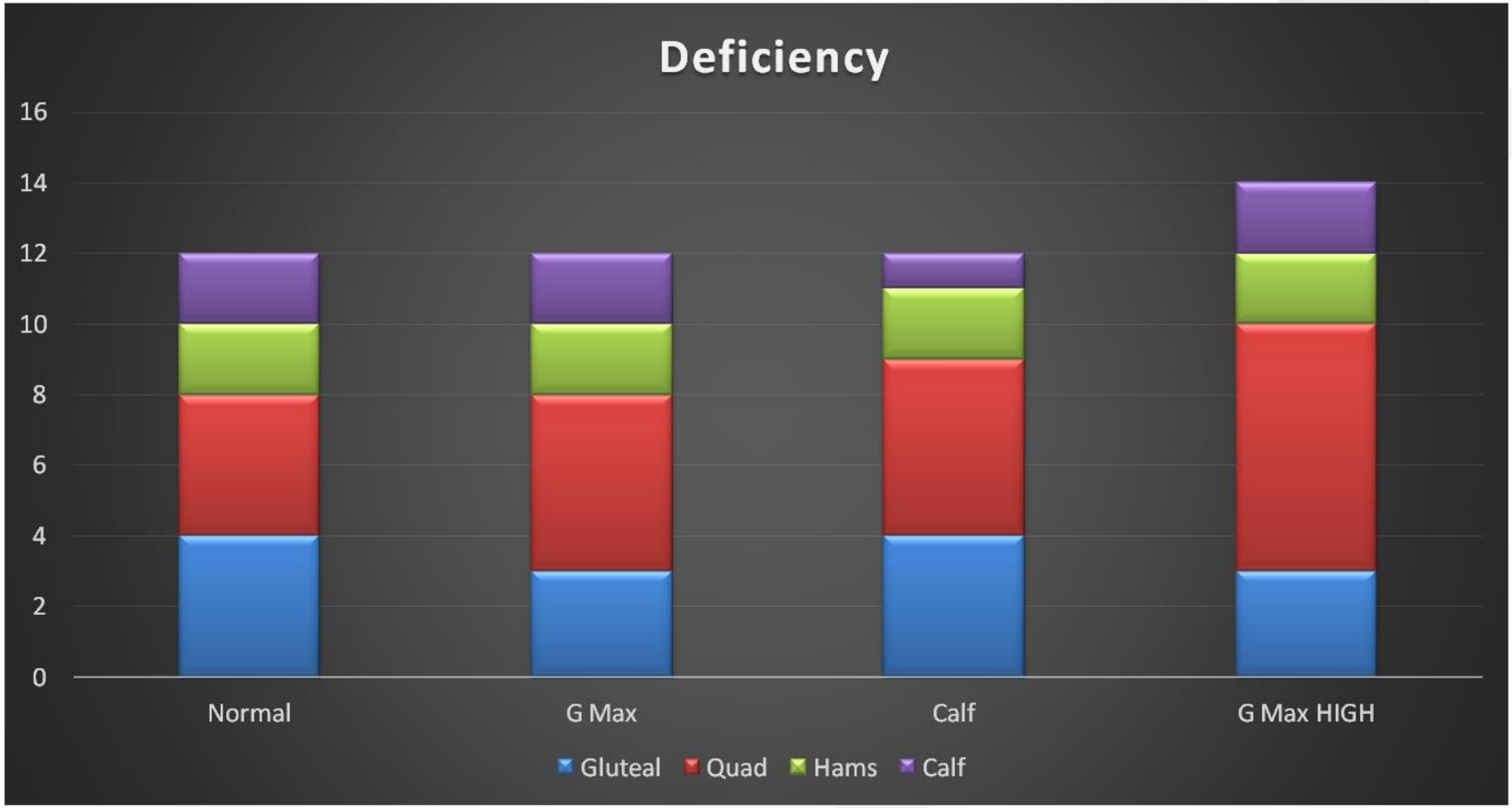
SUMMARY



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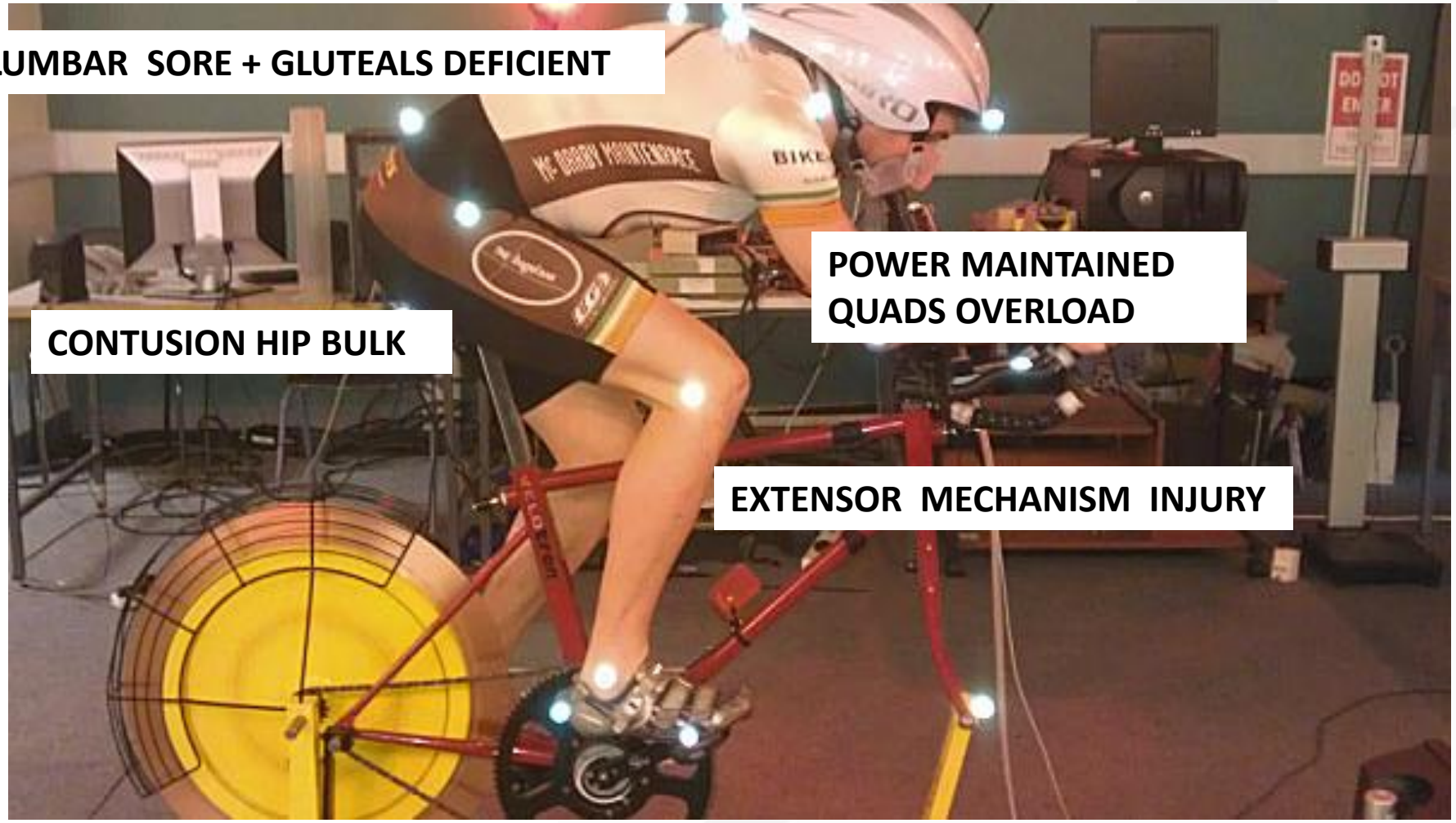
Case Study

- S/E
- O/E
- BikeFit
- Video
- Reasoning
- Management
  - Hands-On
  - Rehabilitation
  - Bike
  - Technique
  - Riding Load

TREVOR-fall hip right



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LUMBAR SORE + GLUTEALS DEFICIENT

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THANK-YOU

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