Time to jump off the 'patho-anatomical wagon'?

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ccre spine Spinal Pain, Injury & Health

CONROD Centre of National Research in Disability and Rehabilitation Medicine

The Centre for Magnetic Resonance

Motor Accident Insurance Commission

Patho-anatomical and patho-physiological features of Whiplash

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Cost$

$230+ billion USD

$530 + million AUS

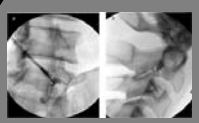
(Blincoe et al, 2002); MAIC figures

Where is the problem (s)?

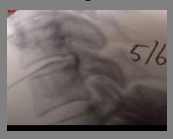
Where em (s)?

Ligamentous

Facetogenic

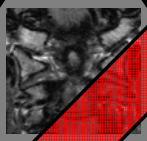


Discogenic



Where em (s)?

Ligamentous



Facetogenic

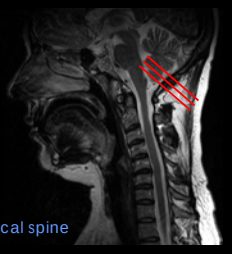
Discogenic

Up to 90% of asymptomatic subjects would show signs of lumbar DDD

~40% of healthy subjects over 40 years of age would demonstrate similar/same findings on c-spine scans

Muscle changes have been observed clinically

Lumbar spine



Upper Cervical spine

Kader et al, 2000; Hyun et al., 2007

What do we know?

Presence of paraspinal muscular alterations has been observed clinically with MRI

What do we know?

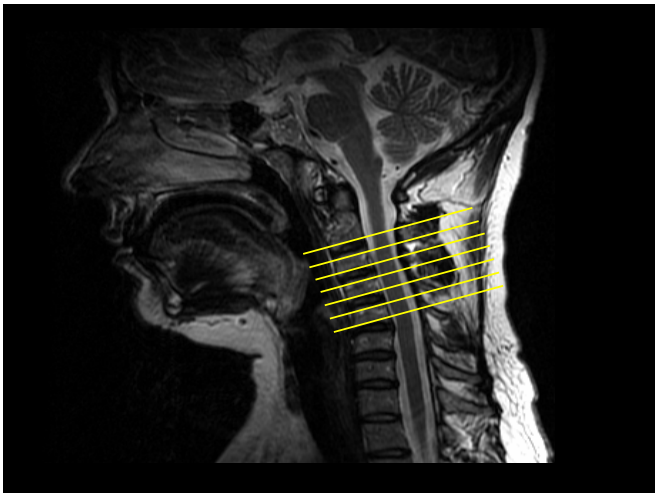
Recent musculoskeletal MRI research in asymptomatic and symptomatic subjects

Elliott et al., 2005, 2006, 2007, 2008

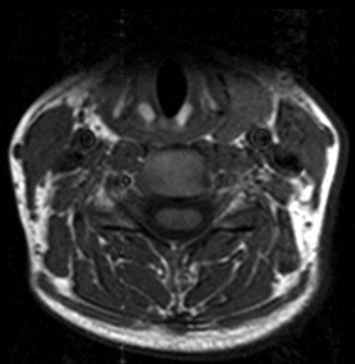
What needs to be answered?

Are these muscular changes on MRI associated with the clinical signs and symptoms of persistent WAD?

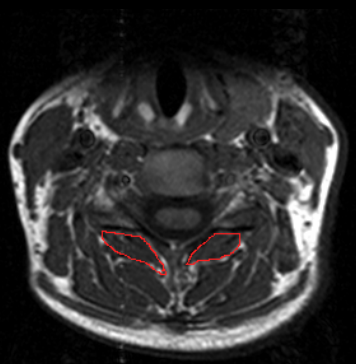
Are these muscular changes UNIQUE to WAD?



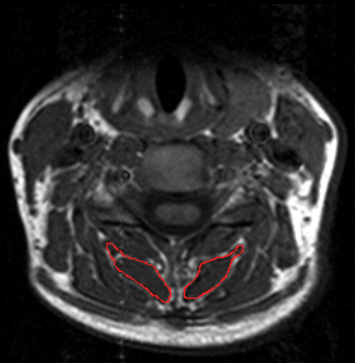
Cervical Paraspinal Musculature



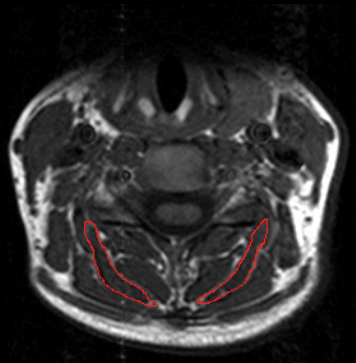
Multifidus



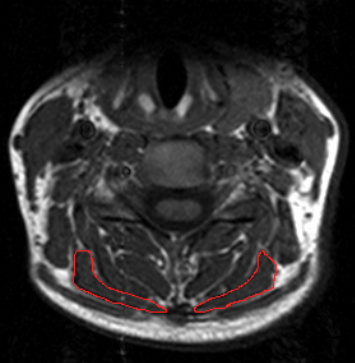
Semispinalis Cervicis



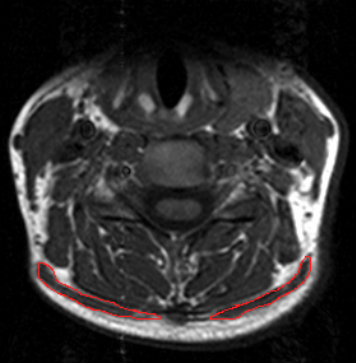
Semispinalis Capitis



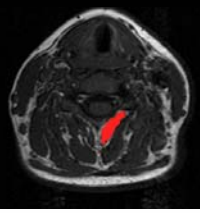
Splenius Capitis

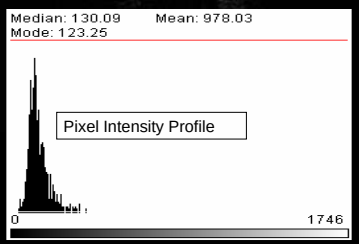


Upper Trapezius



MRI Measure

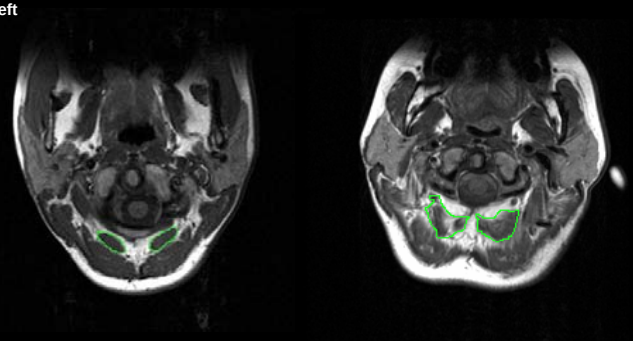




www.mricro.com
Rorden, 2000

RCPMIN

Left

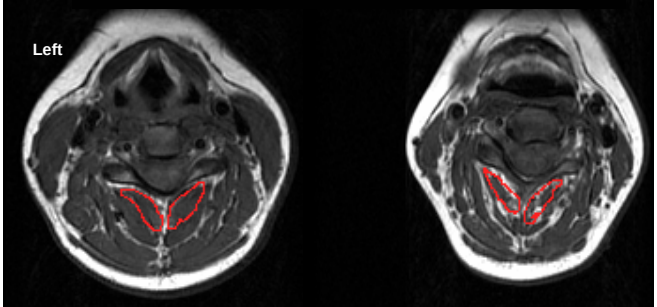


Healthy control

WAD

C3 Multifidus

Left

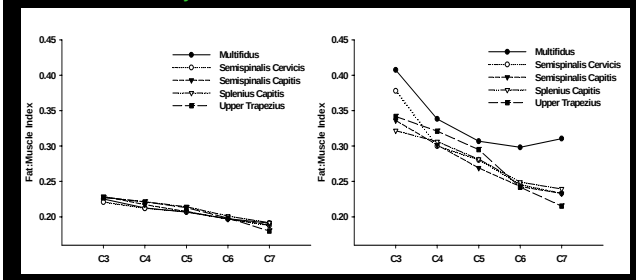


Healthy control

WAD

Elliott et al., 2006

Healthy Control WAD



Mean differences for the fat indices in the cervical extensor muscles across segmental levels (C3-C7) (p <0.0001)

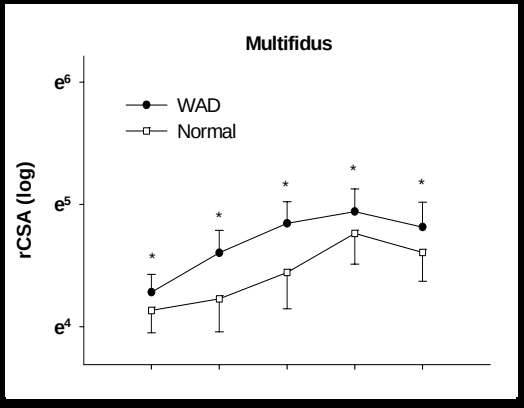
113 Females
79 WAD & 34 Normal

(Elliott et al., 2006)

What about Cross-Sectional Area (mm^2) of the Cervical Extensors on MRI?

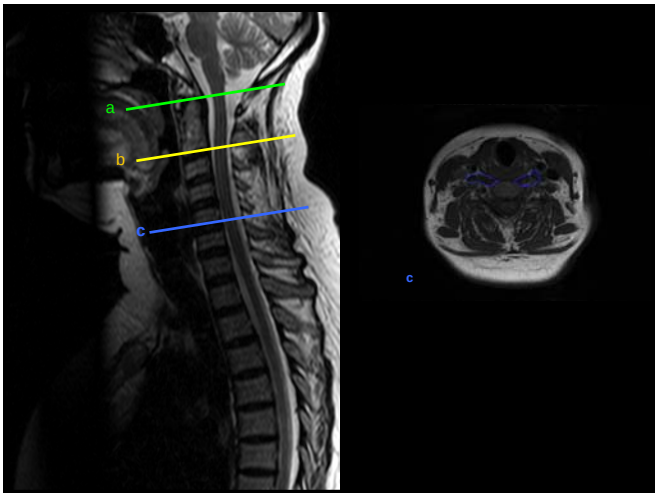
Elliott et al., Man Ther, 2008

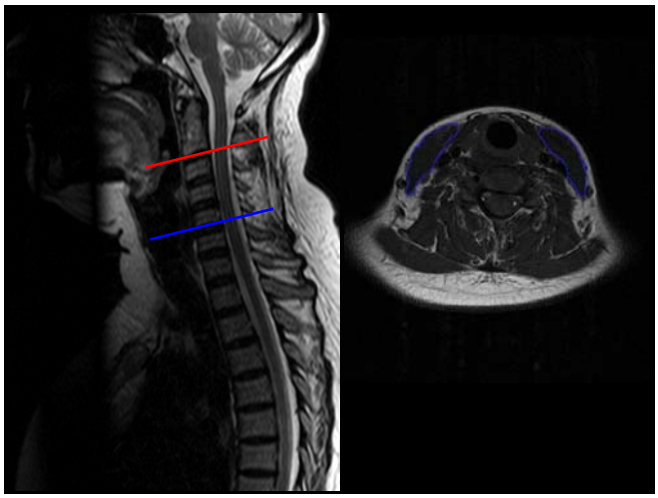
The rCSA of extensor musculature (C3-C7) for the WAD and healthy control groups (Log values, averaged across side). * p<0.01

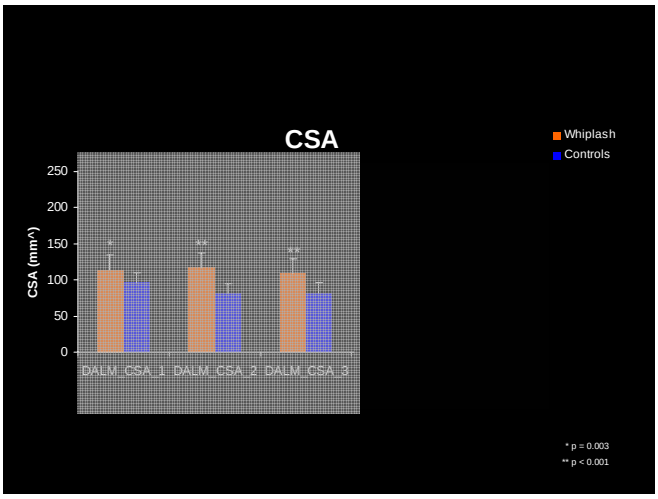


(Elliott et al., 2008)

Do Similar Changes Occur in the Deep Anterior Neck Muscles?

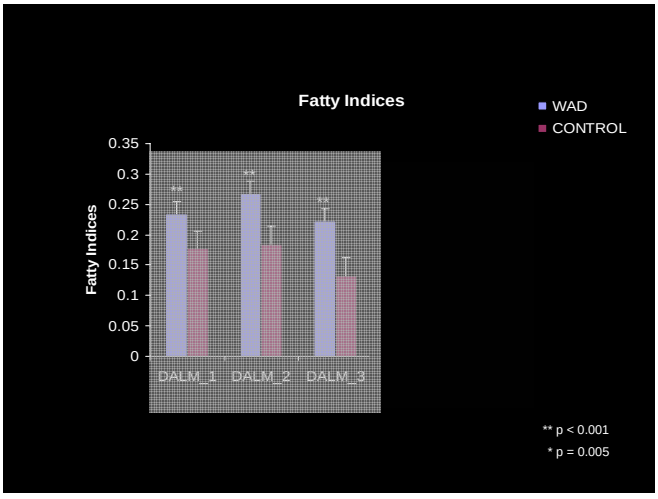


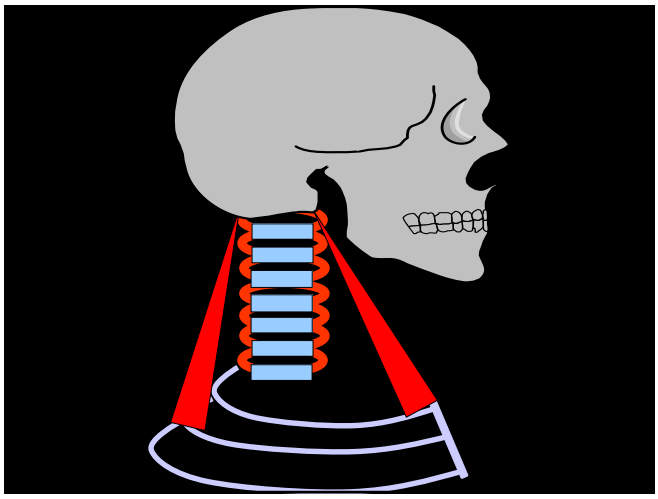




Could these changes reflect fatty Infiltrate?

Elliott et al., submitted



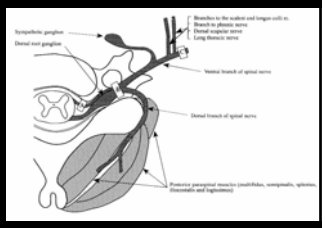


Summary

- Muscular degeneration is present both the anterior and posterior muscles in persistent WAD
- These changes may be detrimental to the optimal recovery of patients with WAD

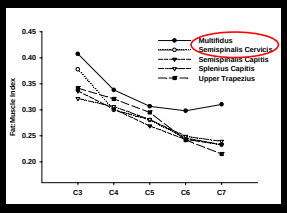
Mechanisms

- Pro-inflammatory factors?
  - Lefaucheur et al., 1996; Foss et al., 1997; Dulor et al., 1998; Elavy et al., 1999; Nukada et al., 2000; Hodges et al., 2006
- Sympathetic?
  - Passatore and Roatta, 2006; Dodt et al., 2003; Karlsson et al., 1995
- Pre-ganglionic?
  - Hayashi et al., 2002; Uetani et al., 1997
- Denervation?
  - Reckenstein et al., 1993; Haig, 2002; Hyun et al., 2007



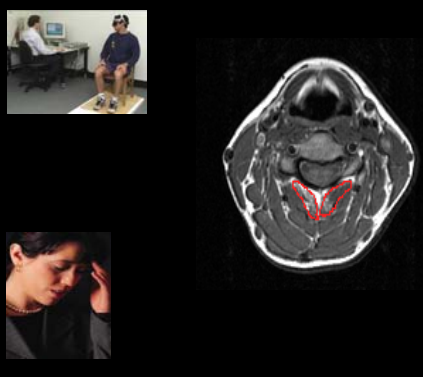
Mechanisms

- Variable disuse?
  - Type I v Type II fibers; spindle density



Uhlig et al., 1995; Eldred et al., 1997; Richmond et al., 1999; Kulkarni et al., 2001; Boyd-Clark et al., 2002; Liu et al., 2003

Do the MRI Findings Relate to Signs/Symptoms of Chronic WAD?



Demographics

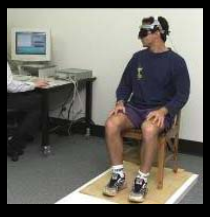
Group n = 113 Females	Age (years) (SD)	BMI (kg/m²) (SD)	NDI (SD)	Duration (mos) (SD)	Compensation Status (% yes)
WAD (n = 79)	29.7 (7.7)	25.1 (5.73)	45.5 (15.9)	20.3 (9.55)	51/79 = 65%
Control (n = 34)	27.0 (5.6)	23.0 (4.44)	--	--	--

Measures

Measures of Motor Function

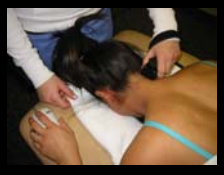
Active Cervical Range of Movement (ROM)

Joint Position Error



Quantitative sensory tests

Temperature Pain Thresholds



Pressure Pain Thresholds

Psychological tests

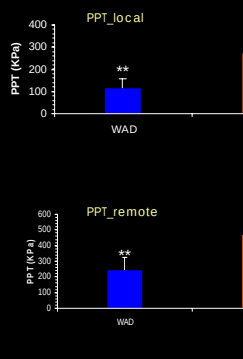
- GHQ-28
  - Somatic symptoms
  - Anxiety/insomnia
  - Social function
  - Severe depression
- TSK
  - fear of movement/reinjury
- Impact of events scale (IES)

  Posttraumatic stress symptoms
  - Intrusion
  - Avoidance

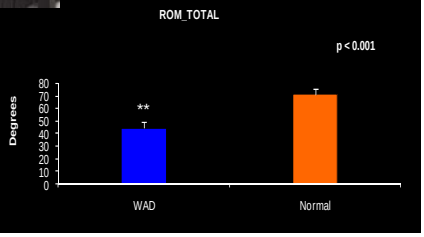
Variable	WAD (n = 79)	Control (n = 34)
Neck Disability Index (/100)	45.5 (15.9)	-
Impact of Events Scale (/75)	23.3 (17.9)	-
Tampa scale of Kinesphobia (/68)	42.7 (7.0)	-
Dizziness Handicap Inventory (/13)	8.3 (2.9)	-
GHQ - Total	30.5 (12.9)	13.8 (6.6)*
HPT*	39.8 (2.9)	47.3 (2.1)*
PPT - local	115.6 (40.9)	275.3 (92.5)*
PPT - remote	240.5 (77.9)	473.7 (150.7)*
ROM total	44.5 (12.0)	71.1 (4.5)*
JPE*	3.7 (1.5)	1.7 (0.5)*

* p < 0.001

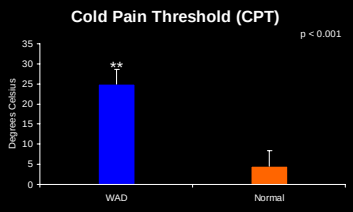
Pressure Pain Thresholds

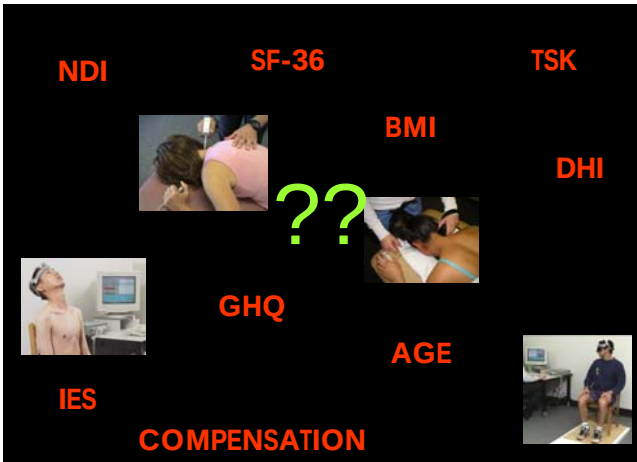


TOTAL ROM



COLD PAIN THRESHOLDS





- r^ = 0.28 (7.8% of variance explained)
- Larger sample size
- More heterogeneity

Findings

- Fatty replacement of muscle is present in chronic WAD
- All of the chronic WAD subjects demonstrate signs of abnormal pain processing and psychological distress
- Necessary to sub-group

Are These Muscular Changes a Unique Feature of Persistent WAD?

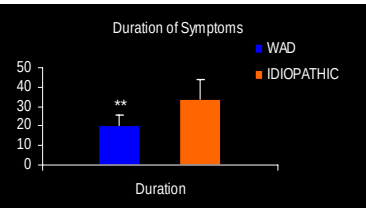
Fatty Infiltration is not a Feature of Persistent Insidious Onset Neck Pain

Elliott et al., 2008 Clin Radiol

Study Design

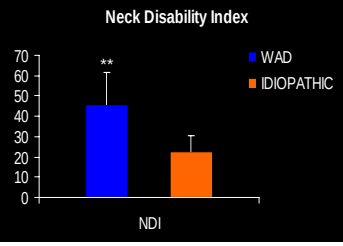
- 102 subjects
  - 79 WAD
  - 23 Idiopathic

Group	Age (years) (SD)	Duration (Months) (SD)
WAD	29.7 (7.7)	20.3 (9.55)
Idiopathic	29.2 (6.7)	33.7 (20.6)



Idiopathic subjects had longer duration of symptoms
p < 0.001

WAD subjects had higher reports of pain and disability
p < 0.001



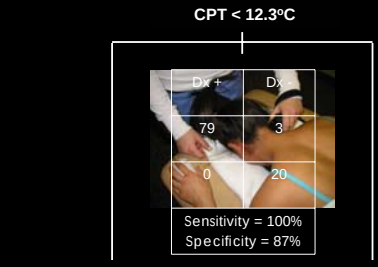
Classification tree illustrating the determination of the condition based on average MRI fat in cervical extensor musculature

Idiopathic 23/0

Whiplash 0/79

Atkinson & Therneau, Recursive Partitioning (RPART), 2000

Classification tree illustrating the determination of the condition based on average CPT



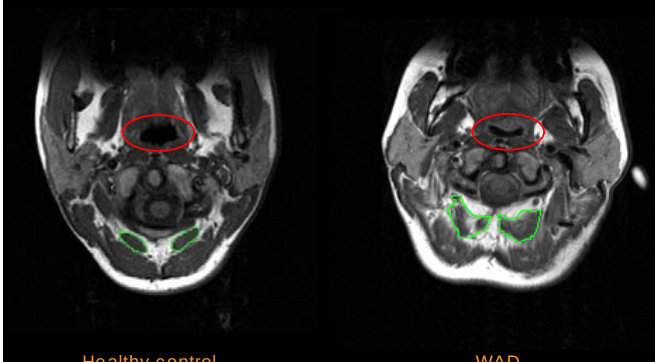
Idiopathic 20/0

Whiplash 3/79

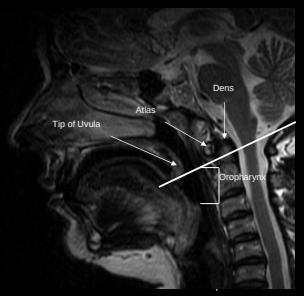
Atkinson & Therneau, Recursive Partitioning (RPART), 2000

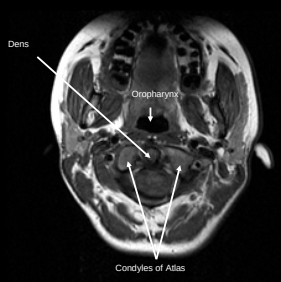
Other investigations……

Oropharynx Morphometry

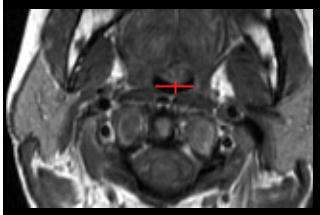


Healthy control WAD

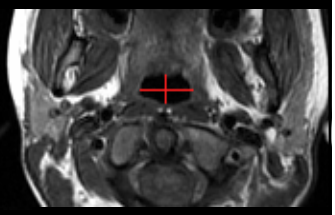




Elliott et al., 2008 *Oto Laryngol Head Neck Surg*

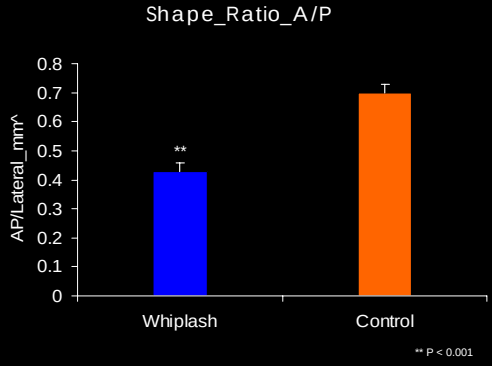


Whiplash



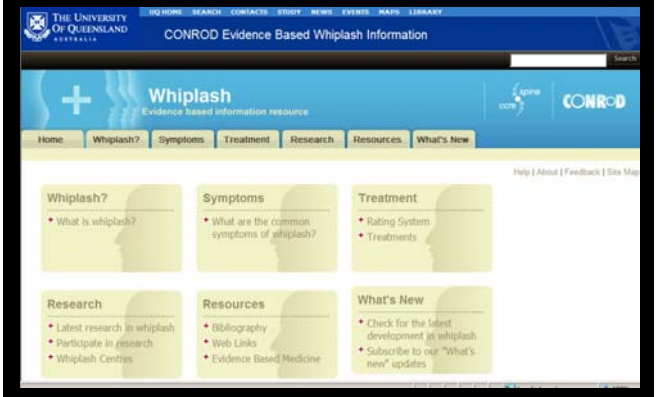
Control

Elliott et al., 2008 *Oto Laryngol Head Neck Surg*



Summary

- Fatty replacement of muscle appears to be unique to persistent WAD
- It is only these subjects who demonstrate signs of abnormal pain processing and psychological distress
- Findings also include changes to the size/shape of the oropharynx
- MRI and sensory tests are showing promise with regards to assessment of persistent WAD



http://www.som.uq.edu.au/whiplash

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THANK YOU

2009James Elliott, 2005