



The Myth of 'Tendinitis'

GP CME Conference

Rotorua

20 June 2008

Cognitive dissonance

A psychological term describing the uncomfortable tension that may result from having two conflicting thoughts at the same time

The theory of cognitive dissonance states that contradicting cognitions serve as a driving force that compels the mind to acquire or invent new thoughts or beliefs, or to modify existing beliefs, so as to reduce the amount of dissonance (conflict) between cognitions

Time to abandon the “tendinitis” myth

*Painful, overuse tendon conditions
have a non inflammatory pathology*

BMJ Volume 324 16 March 2002, p626

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Sydney, Australia

The thrust of the 2002 editorial

- Many practitioners still believe that patients who present with overuse 'tendinitis' have a largely inflammatory condition and will benefit from anti-inflammatory medication
- Animal studies show that within 5 days of tendon insult/macrotrauma, tendinosis is present and inflammatory cells are absent (3rd Edition of Brukner and Khan)
- It has been known since 1976 that histologically there is no inflammation in overuse tendon conditions
- They are often chronic conditions (*You all know this*)

“What’s in a name?”

Words have a certain power to guide the way we think

Sharma and Maffulli, J Musculoskeletal Neuronal Interaction 2006; 6(2):181-190
Review article on the biology of tendon healing

Tendinitis/Tendonitis - an inflamed tendon

- a histopathological term

Tendinosis – this also is a histopathological term

Tendinopathy

- a generic descriptor of the clinical conditions in and around tendons arising from **overuse**

Fordyce:

A pioneering pain psychologist's
opinion on the value of information

“Information is to behaviour
as spaghetti is to a brick”

Perpetuating the myth

Excerpts from a 2008 newspaper article in a medical column

Treatment for inflamed elbows

“...inflammation in the origin of the muscles around the elbow produces pain and swelling”

“...inflammation in the muscles develops as a result of a repetitive strain injury, or secondary to a direct blow...”

“The first step is to take a regular anti-inflammatory medications
... ...the next step is to consider local steroid injections.

This group of ‘topical steroids’ acts to damp down inflammation locally... ...These steroids are very good at reducing inflammation and as a result, easing pain.”

Chronic Tendinopathies are

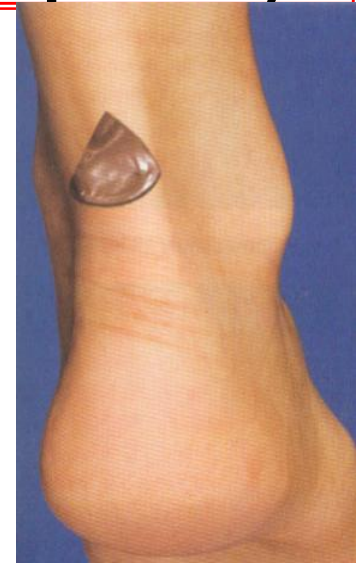
- common disabling
- often “managed” with NSAID’s or depot steroids injections

Tendinopathies are a significant burden to society

- In terms of medical costs
- in terms of occupational costs
- In terms of quality of life

Using nitric oxide to treat tendinopathy

Br. J. Sports Med 2007;41;227-231 George A C Murrell
University NSW



NO is a small free radical generated by nitric oxide synthases (NOS)
Following injury to a tendon, NO is induced by the 3 NOS
NOS activity is upregulated in tendinopathy
In animal models, tendon healing is reduced if NOS is inhibited
When additional NO is added, tendon healing is enhanced
In 3 randomised clinical trials, NO via a GTN patch enhanced subjective and objective recovery in patients with tennis elbow, Achilles tendinosis and supraspinatus tendinosis

Patients were randomised to two groups in each trial.

Group 1: 35 & 39

Group 2: 29 & 33

Group 3: 28 & 28

1. Tennis Elbow @ 24/52

2. Achilles tendinosis @ 24/52

3. Supraspinatus tendinosis @ 26/52

	GTN	Placebo
	81 (p = 0.005)	60
	78 (p = 0.001)	49
	46 (p = 0.007)	24

% asymptomatic for activities of daily living

1.25mg/24 hrs or

Placebo patch

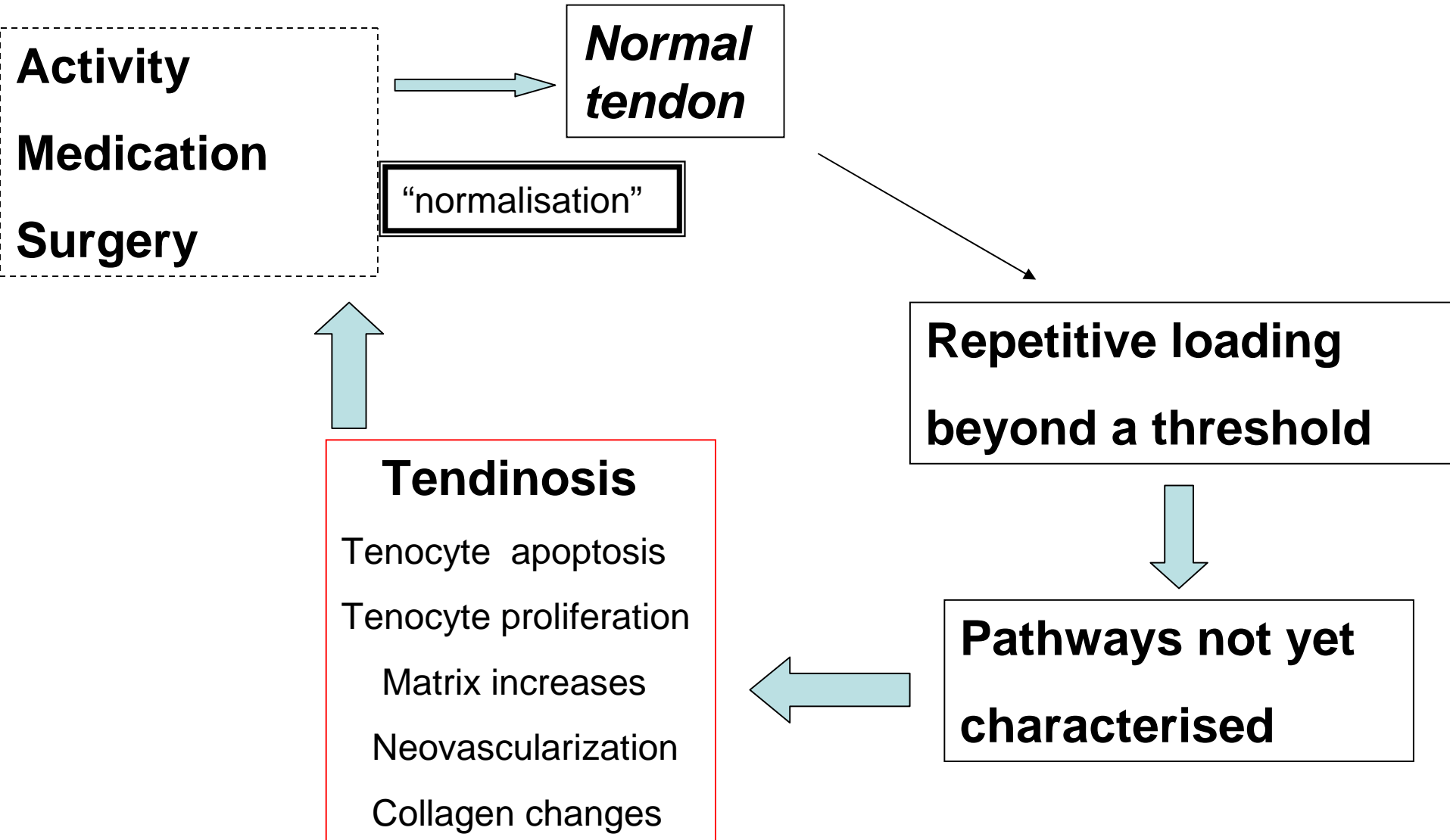
Both the patient & clinical examiner were blinded.

In each trial the patients received education & exercises

Does short term inflammatory 'tendinitis' precede the non inflammatory 'tendinosis'?

- Although this is plausible, there is no evidence of a significant phase of tendinitis in overuse tendinopathy
- Data for this comes from athletes with overuse tendinopathy, animal models of tendinopathy and samples from ruptured tendons
- From human and animal data, it appears that inflammation plays no appreciable role in the pain of chronic tendinopathy
- Symptoms that are present for more than one week are more likely to arise from a non inflammatory mechanism

A different model of tendinopathy





"I'M SORRY DOCTOR, BUT AGAIN I HAVE TO DISAGREE."



"I'M SORRY DOCTOR, BUT AGAIN I HAVE TO DISAGREE."

“Show me the histology” (Oncologist)

- The ethics and practical problems of getting histology from an “acutely” painful tendon
- The prevailing paradigm has been based on assumptions
- The patient presents with pain and local tenderness
- “?Acute?” - the evidence is that tendon pain is the final stage of the process *cf. angina and atherosclerosis*

Tendinosis

- Collagen disarray and separation
- Increased hydrophilic ground substance
- Increased cellularity consisting of tenocytes with myofibroblastic differentiation (tendon repair cells)
- Increased poor quality blood vessels (neovascularization with accompanying nerves)
- Areas of focal 'necrosis' and calcification
- Rarely classic inflammatory cells

A reciprocal relationship exists between the cells and the ECM

Microanatomy

1. Components

a) Cellular: 20% by volume

Fibroblasts (**tenocytes**)

+

(pluripotential mesenchymal cells)

Metaplasia – adipose, osteoblast, chondrocyte

b) Extracellular matrix: 80%

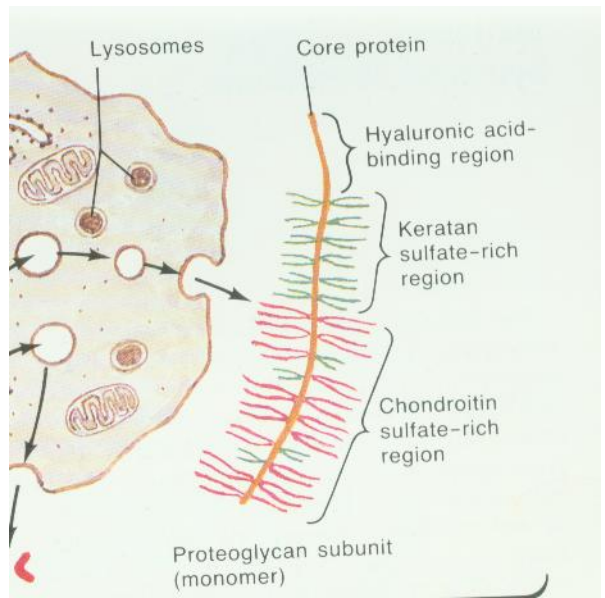
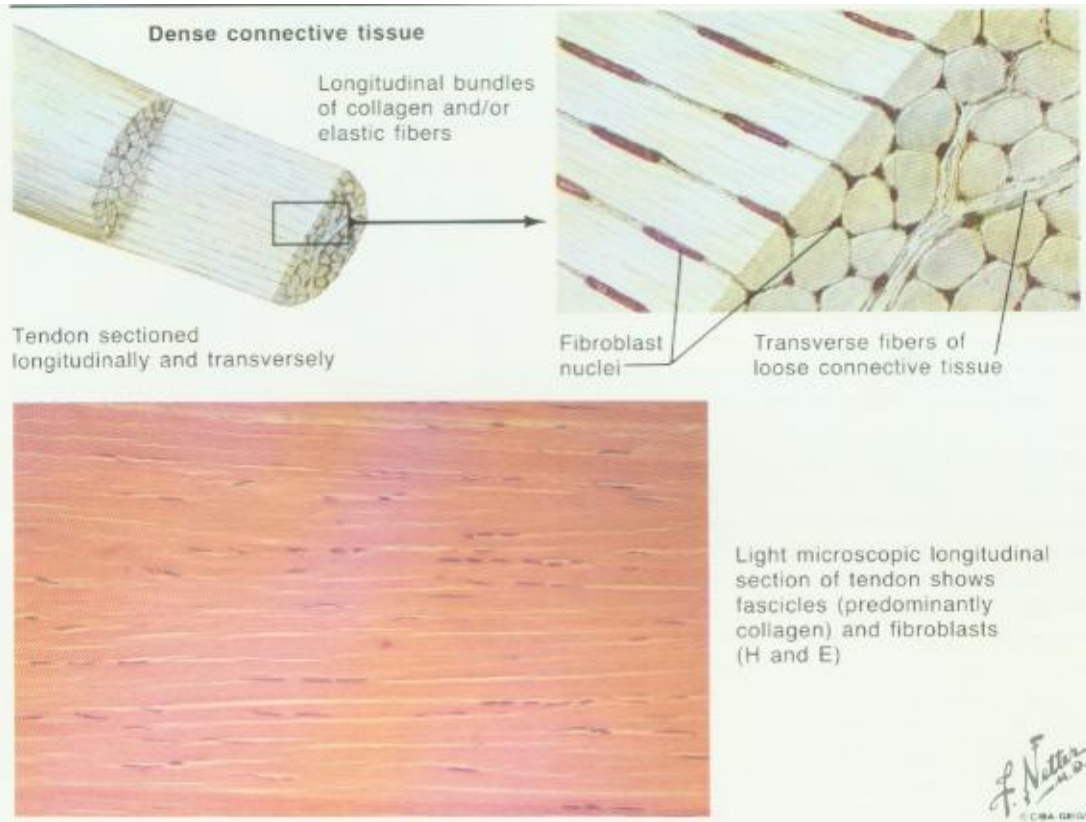
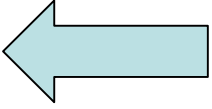
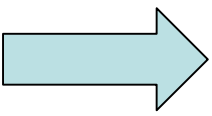
(1) **Water: 65-70% *****

(2) Proteins: 30-35%

(a) **Collagen** (Type I): parallel arrangement

(b) Elastin (1-2%)

(3) **Proteoglycans (Hydrophilic)**



(In addition to the chemical influences)

The current view is that is that the nuclear material, nuclear membrane and cytoskeleton are all linked via the integrins and laminar proteins to the surrounding ECM. There are mechanically active connections between the inner workings of the cell and the ECM, with the possibility of manual therapy working on cellular function, even including genetic expression. (page 47)

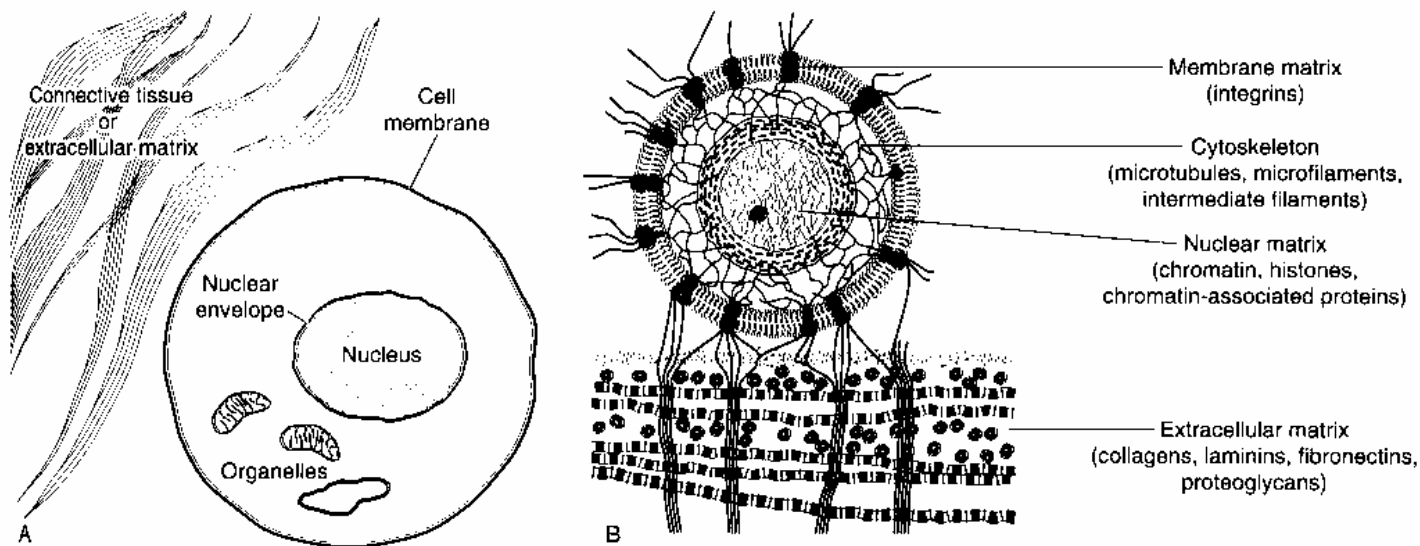


Fig. 1.37 Two views of the relationship between the cell and the surrounding ECM. **A.** The traditional view, in which each element has its autonomy. **B.** The more current view, in which the nuclear material, nuclear membrane, and cytoskeleton are all mechanically linked via the integrins and laminar proteins to the surrounding ECM. (Reproduced with kind permission from Oschman 2000.)



2006/03/18

What is the sequence of structural changes that end in the state of tendinosis?

Let's play who wants to be a millionaire?

What is the first change seen in tendon failure with repetitive use?

1. The hydrophilic ground substance increases?
2. The collagen disarray and separation?
3. Increased tenocyte cellularity?
4. Increased poor quality blood vessels?

Excessive load injures tendons

Optimum load stimulates healing
via mechano-transduction

Underload – no stimulus for repair

The study by Cook et al 2004

- 50 tendon samples from 39 males, 11 females
- **Asymptomatic** i.e. no anterior knee pain
- 47 tendon had normal US appearances
- 2 had changes @ proximal pole of the tendon
- 1 had changes @ distal pole of the tendon

Normal histology from 32 (24 male 8 female)

i.e. **18 with abnormal histology**

No difference in subjects with & without change

No evidence of abnormal vascularity

Pathology tended to be found proximally

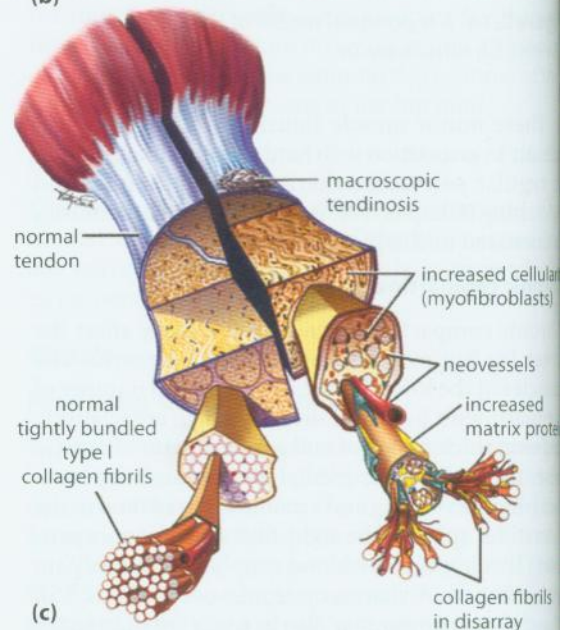


Figure 2.17 Tendon seen under polarized light microscopy. (a) Tightly bundled collagen of normal tendon compared with (b) collagen fibers in disarray. In three dimensions (c), the tissue appears somewhat frayed; abnormal blood vessels are present in parts, and cells are abnormal in number (elevated in parts).

1st human data, Sliver Study using ACL donor site, so the patients were asymptomatic Cook, 2004

Tendon Cells

The tenocyte network may be the primary site of pathology. The tenocyte is a specialised fibroblast.

Tenocyte abnormality appears to be a pre-requisite for matrix and collagen abnormality

Matrix (ground substance) is next

Then **collagen separation**

Finally **neovascularization**, the neurovascular bundle may play a key role in the onset of pain

Abnormal tenocytes
3
Abnormal tenocytes & matrix
6
Abnormal tenocytes & Matrix & Collagen
9

Downhill running rat model

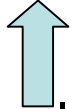


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VEGF – vascular endothelial growth factor 1989

Tendinosis characteristics

ECM pathology



Hypercellularity

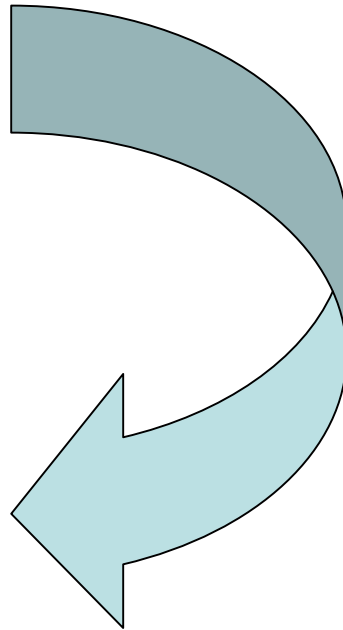


Collagenolysis

Hypertrophy/swelling

Hypervascularity

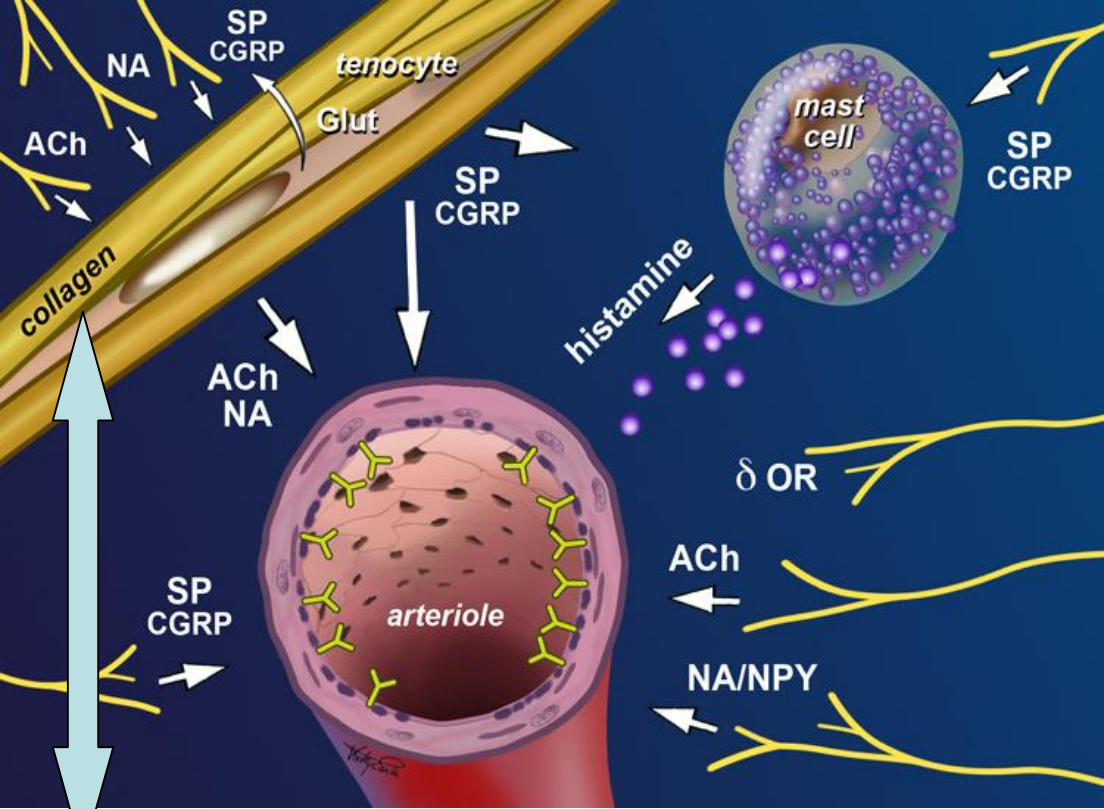
Hyperalgesia



Abnormal Tendons

(H. Alfredson & L. Ohberg
2001)

- No inflammation
- CGRP
- Substance P
- Glutamate
- Lactic Acid
- MMP-1
- VEGF



Ingrowing vessels are associated with increased numbers of mast cells

Sensory and autonomic nerves accompany ingrowing blood vessels

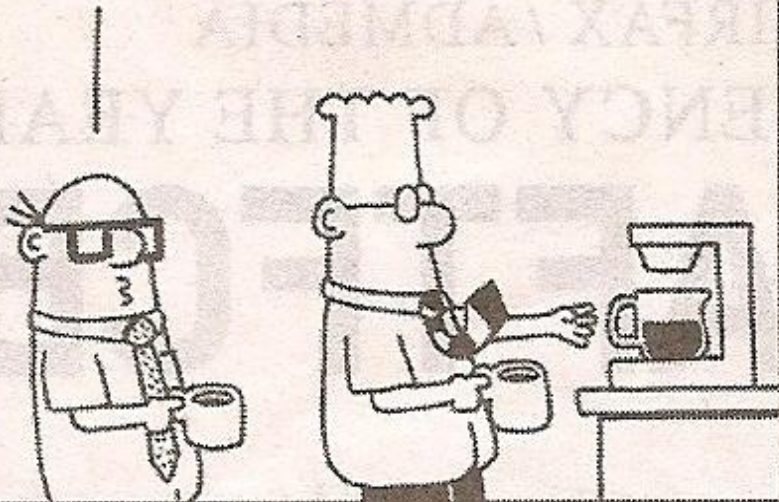
Tenocytes produce ACh, NorA, Substance P, Glutamate, CGRP (Alex Scott)

Brain drugs of the future BMJ 1998; 317 1698 - 701
 Susan Greenfield (The promiscuous transmitter)
 One transmitter may be linked to many disorders, and one disorder to many transmitters
 Classic transmitters have non-classic modulatory functions too
 Substances such as nitric oxide and acetylcholinesterase have unexpected signalling properties

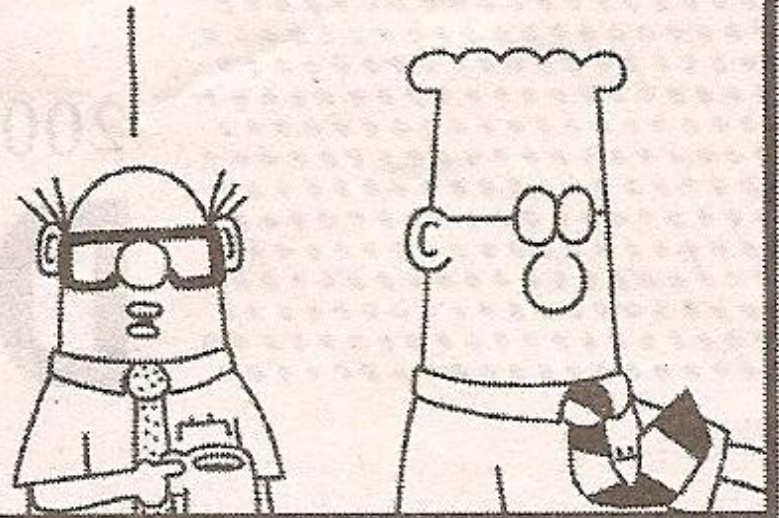
A method of managing tendinopathies

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APPEARING KNOWLEDGE-
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Management of Tendinopathy

- There is no fast fix (Messenger blame - patient/ coach/boss/insurer)
- It needs a change in the mindset – *the public and us*
- Needs structured exercise/occupational rehabilitation
- Physical treatment has the same success rate as surgical treatment (Reserved for failure of conservative Rx)
- There are adjunctive treatments such as GTN and prolotherapy. Evidence for GTN only.

Sanction exercise as therapy

Excessive load injures tendons

Optimum load stimulates healing
via mechano-transduction

Underload – no stimulus for repair

It's about now that we have usually started to
mumble and be peevish

Work & Exercise Guidelines:

Starting work or exercise again may be associated with some pain or discomfort.

Provided this pain does not exceed 5/10 (See faces below), and the pain that is associated with your work or exercises reduces afterwards, then it is OK to continue working or exercising at that level of effort.

If the extra pain associated with work or exercise is still there the next day when you wake, or your pain is increasing each day, then the working level or exercise effort needs to be reduced back to a level that was tolerated.

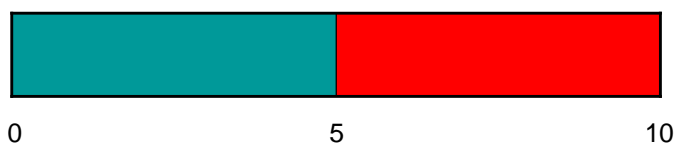
Remain on the reduced level for a week or so before increasing the amount of work or exercise again, to see if this is OK. As you get recover and get stronger the ability to cope with work or exercise increases, so that in due course, usually over several months, you will get back to normal.

The drawing below will help you to monitor your pain and so provide you with a way to judge how you are recovering as you return to work or sport.

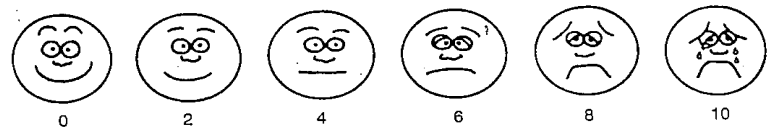
Sibernagel's 2007 AJSM paper [eccentric training]
Based it on other work by Thomee.

Pain Monitoring Model

Based on the 10 point VAS



Pain Faces Scale

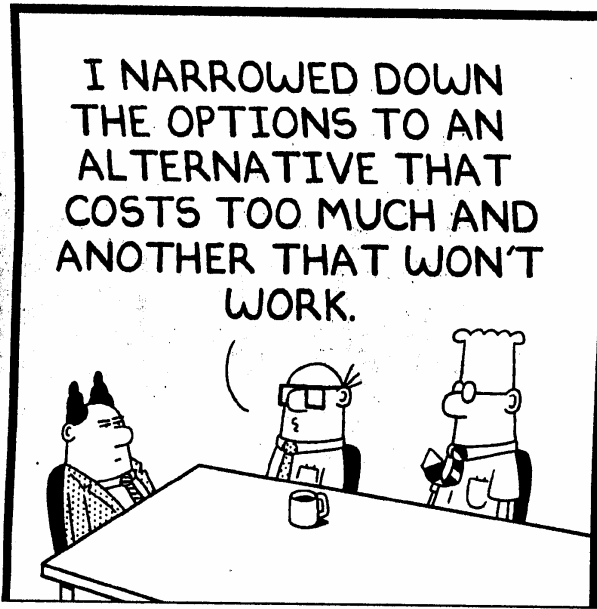


The exercise pain is allowed to reach 5/10 if certain criteria are met

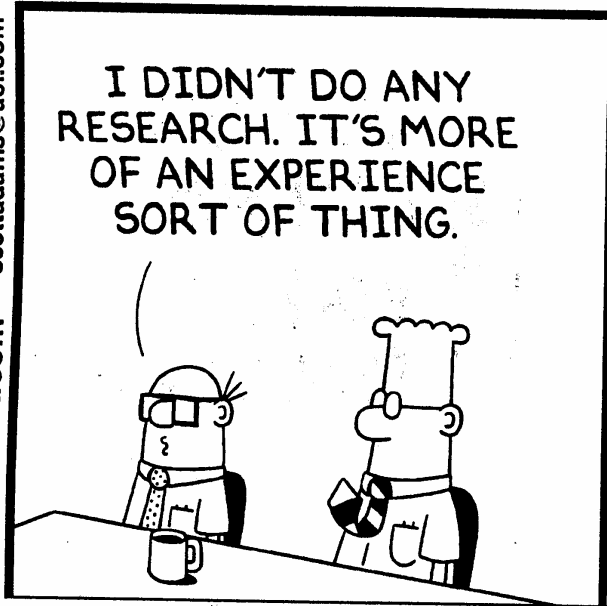
Namely

- ❖ The pain decreases at the end of exercise
- ❖ The pain after exercise has subsided by the following morning
- ❖ The pain and stiffness not allowed to increase day to day or week to week

DILBERT



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There remain many unanswered questions with respect to tendinosis

This is my default position when you ask me questions I don't know the answer to

The end



2006 / 03 / 18

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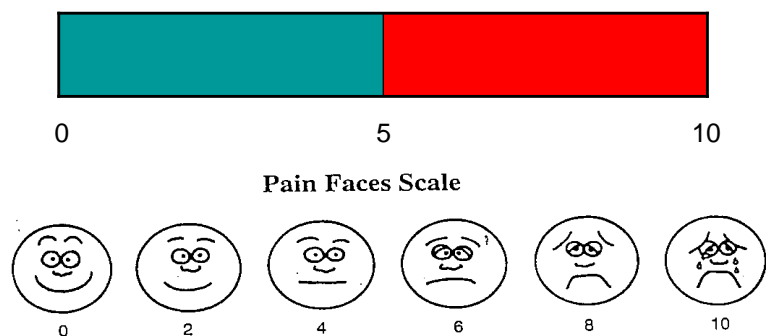
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Practical Use of GTN for Tendinopathy (Br. J. Sports Med. 2007;41;227-231)

There are two products that are available in NZ and seem to be more practical than using the patches.

Rectogesic cream (3M) or GTN ointment (HSL).

The GTN ointment by HSL is slightly cheaper (\$50 vs \$60).

Ask the patient to apply roughly a little fingernail of the ointment (about 1 gram) to the most painful area around the tendon. E.g.

- If it is the Achilles apply it along the back and sides of tendon in middle third if that is where pain is maximal to palpation
- In the shoulder they apply it around the acromion and a little anteriorly over the biceps tendon too
- In the elbow just distal to the attachment of ECRB to the lateral humeral epicondyle.

Write on the script "Rectogesic cream 1gram applied to area of maximum tenderness around painful tendon twice daily. Wash hands well after application."

Explain to the patient that side effects could be light headedness or headache. If they are migraine prone warn them that it may precipitate migraine and that if it does they probably should stop using it.

If they have hypertension and are on antihypertensive meds warn them that they may drop blood pressure a bit too much and should watch for blacking out with getting up suddenly from lying down or sitting up. They generally develop a tolerance to the lightheaded and headachy side effects after a couple of days.

Care is needed if the person is on Viagra etc for erectile dysfunction.

Get them to take Panadol for the first week if headache is intolerable and to wash hands well so that they are not absorbing too much through the skin elsewhere!

Tachyphylaxis does not seem to be an issue.

From the research literature it does not seem that a washout period is required.

Explain to them that the GTN needs to be used long term – like 24 weeks for maximum benefit and that it is for analgesia as well as improving quality and quantity of collagen fibres in the tendon.

Show them the graphs from the Australian research papers so that they can understand the length of time it takes to work and the time expected before the analgesic effect occurs.

My colleague recently had good effect with using it in the knee for a quadriceps tendon (Vastus intermedius and medialis) sprain/tear in a 58 year old male who had wonderful pain relief and gains in strength over a 4 week period now using the GTN.

She has also used it for peroneal tendinopathy in a 32 year old cricketer and a 12 year old ballet dancer.

As regards the age issue, so far none of the teenagers she has used it in have had problems with headache or migraine.

A refinement is to use a 'no touch technique' and apply the ointment directly to the area with the tube nozzle, then occlude with op-site or some other plastic membrane.

This avoids touching the ointment and the occlusion avoids it rubbing off and in theory there will be better penetration.

Headache can be a very real side effect.

You will have to warn them about concurrent use of Viagra etc



“During one particularly productive fortnight in August 1897 Felix Hoffman, a German chemist with the Bayer Company, earned the curious distinction of ‘discovering’ one of the most useful substances known to medicine, and then one of the most deadly”.

bpac.org.nz 2004

- Hoffman’s first discovery was aspirin.
- While it had been known for thousands of years that salicylic acid (SA) from white willow bark had analgesic and anti-inflammatory properties its use was limited by its excruciating digestive side effect
- On the 10 August 1897 Hoffman successfully synthesised pure ASA. ...

- Hoffman handed over his ASA to the pharmacology group for testing and moved on to his next project, looking for a non-addictive substitute for morphine.
- Hoffman’s second discovery, two weeks later, was Diacetylmorphine or heroin – so named because it made Bayer’s guinea-pig workers feel "heroic".
- Marketed as cough remedy
- “Junkie” – selling junk to support their habit

2007 Conference “Gems”

- Bursal pathology is inherently tendinopathy
- Palpation is a lousy measure of outcome
- Apoptosis – acknowledged but role unknown

History

- Change in load – off season, return post injury
- Specific and localised nature of the pain
 - Tendon pain mostly does NOT refer

Load dependent pain

- Dosage dependent pain
- How much load causes how much pain?

Compression Compression Compression

If there is no inflammation is it justified to treat tendinopathies with anti-inflammatory drugs for analgesia?

The consequences of this practice which includes

- G I perforations
- Investigations of anaemia
- Endoscopy for GI pain, nausea
- Renal failure
- Congestive heart failure
- Myocardial infarction
- Transient blindness, mental impairment/confusion
- Anaphylaxis/anaphylactoid reactions
- Asthma/Urticaria

Number of admissions for ADR by drug group

Main drug group	Admissions	Sub-group	Admissions
Cardiovascular (43.3%)	7711	anticoagulants	1779
		diuretics	1552
		beta-blockers	1023
		ACE inhibitors	810
		antiarrhythmics	703
		vasodilators	577
		calcium channel blockers	434
		antihypertensive	288
		aspirin	230
		α-adrenoceptor blocker	155
		lipid-lowering	153
other	7		
Nervous system (17.4%)	3107	opioids	1289
		antidepressants	424
		antipsychotics	362
		anaesthetic	180
		benzodiazepines	159
		antiepileptics	143
		analgesics	121
		other	429
Anti-inflammatory (11.6%)	2074	NSAIDs	1124
		corticosteroids	950

2005 Hospital admissions for adverse drug reactions

This is an underestimate if international experience is any guide.

(15,254 admissions)

Anticoagulants 1779

Diuretics 1552

Opioids 1289

NSAIDs 1124

Beta blockers 1023

Question:

Do these include the now recognised higher rates of cardiac and CNS complications? ('flu)

PETER BRUKNER AND KARIM KHAN

WITH COLLEAGUES

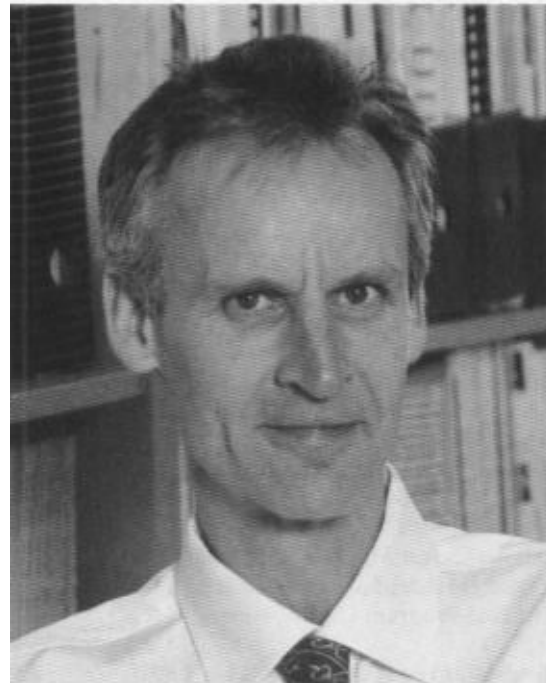
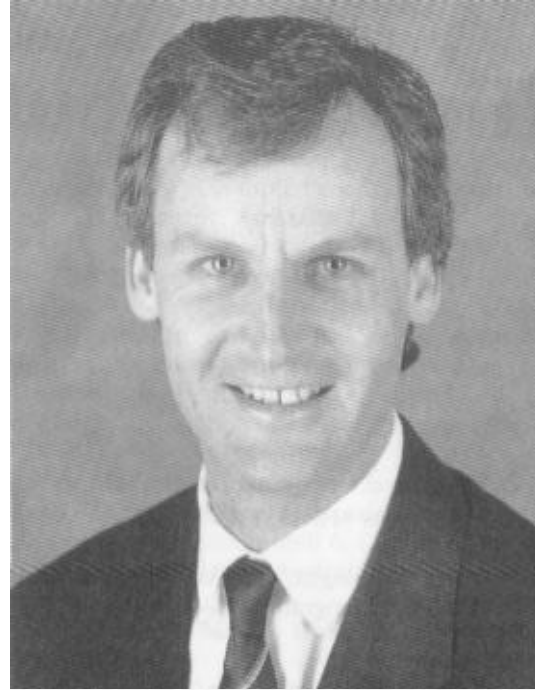
Clinical Sports Medicine



THIRD EDITION

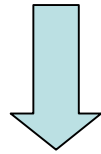


*Keeping you
one step ahead*

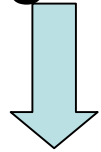


Jill Cook- Diagnosis of Tendinopathy

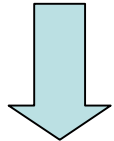
“Clinically there is no gold standard for diagnosis”



Histopathology is the gold standard for pathology



Imaging demonstrates most pathology



Neither of these equals symptoms

Symptoms are what the patient presents with

Samuel Johnston 1709 – 1784

“It is incident to physicians, I am afraid,
beyond all other men,
to mistake sequence for consequence.”

Voltaire 1694 – 1778

“The art of medicine consists in amusing the
patient while Nature cures the disease”

Tendinopathy

1. Injury associated with repetitive sport or work activity

2. *Multifactorial etiology*

A. Overuse (microtraumatic) injuries

Outnumber macrotraumatic injuries 2:1

B. Tendinopathy is considered a “source of major concern in recreational and competitive athletes” (30-40% of sporting injuries)

C. Work-related tendon injury (Bureau of Labor Statistics 2002 Data)

1. 59% women, 41% men

2. Age groups: 35-44, 45-54 (**The Dark Decade?**)

3. Occupations

a) Operators, fabricators, and laborers

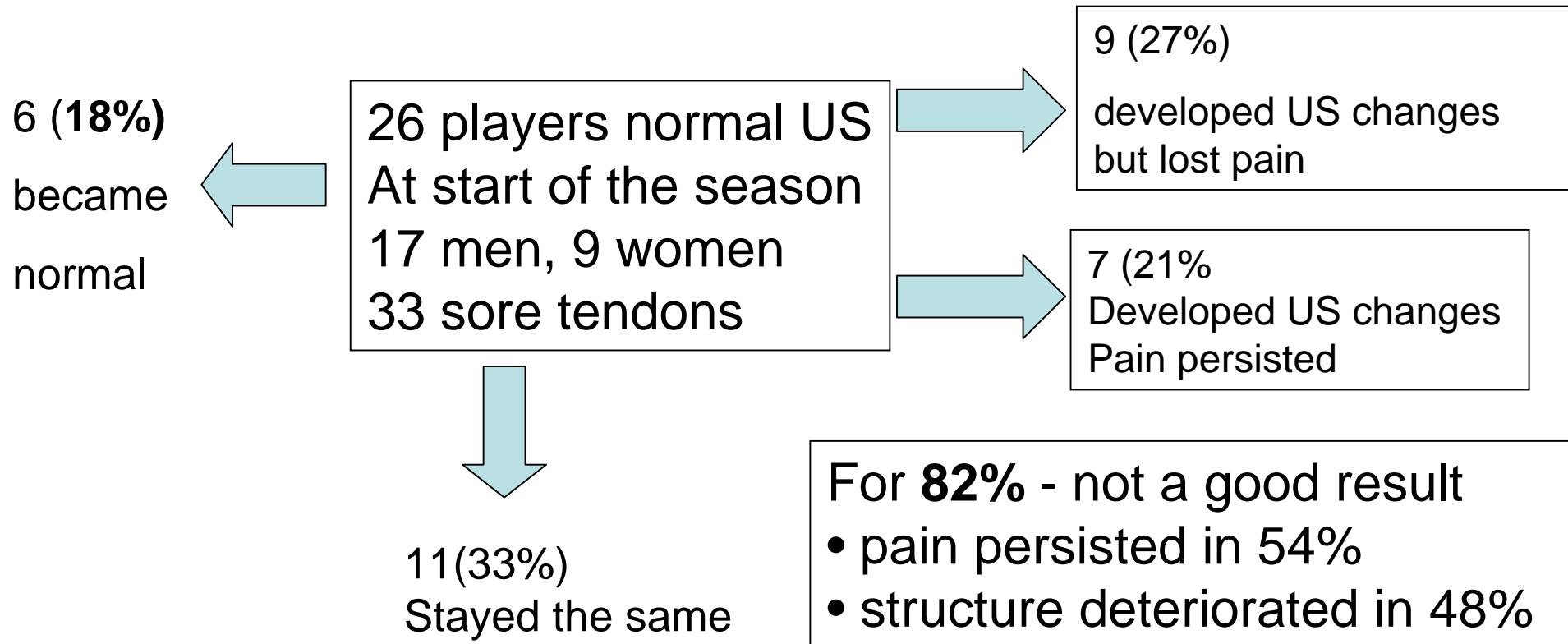
b) Technical, sales, and administrative support

4. Length of time with employer: More than 5 years

5. **70% UE, 25% LE**

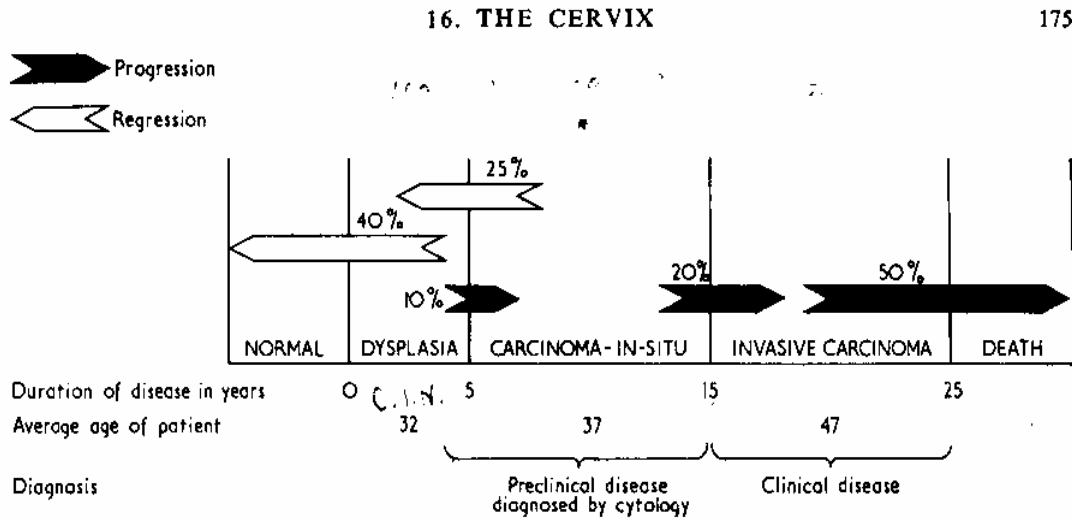
Painful tendons with normal imaging

Is this a true tendon entity?



Can U.S. predict symptoms?

I have likened it to a cervical changes



16/14. Diagram showing the 'life cycle' of unstable cervical epithelium.

