Clinical reasoning and treatment strategies

Additional scientific considerations on musculoskeletal medicine

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Recommended literature

"A practical approach to musculoskeletal medicine ; assessment, diagnosis and treatment" Elaine Atkins et al., 5th edition, 2024, Elsevier

"A system of orthopaedic medicine" Ludwig Ombregt, 3rd edition, 2013, Churchill Livingstone, Elsevier



You can have results or excuses,

But you can’t have both!

What is pain?

"Pain is not just a sensory awareness of bodily harm, but is also an emotional experience that can be influenced by a number of psychosocial factors"

Definition by the International Association for the study of pain, IASP, 2021

3 biological pain mechanisms

- Nociceptive
- Nociplastic
- Neuropathic
- Can all be influenced by psychosocial and movement system factors

Chimenti et al., 2018 ; “A practical approach to musculoskeletal medicine”, Atkins et al., Elsevier, 2024, p4

Nociceptive pain

- Stimulation of nociceptors
- Sensory nerve cells respond to damaging stimuli
  - Sending nerve signals to spinal cord and brain
- Mechanism
  - Inflammation,
  - injury,
  - mechanical and chemical irritant

Examples of nociceptive pain

- Ankle sprain
- Degenerative arthropathy
- Rheumatoid arthritis



Nociceptive pain may originate from

- Visceral structures
- Somatic structures
  - Deep somatic pain: bones, ligaments, tendons, muscles, fascia and blood vessels
  - Superficial somatic pain: skin or other superficial tissues

Nociplastic pain – “central sensitisation”

“Pain that arises from altered nociception, despite no clear evidence of actual or threatened tissue damage causing the activation of peripheral nociceptors, or evidence for disease or lesion of the somsatosensory system causing the pain”

Definition by the International Association for the study of pain, IASP, 2021

Examples of nociplastic pain

- Persistent non-specific low back pain
- Fibromyalgia
- Migraine

"A practical approach to musculoskeletal medicine", Atkins et al., Elsevier, 2024, p5

Neuropathic pain

- Due to pathology or disease od the somatosensory system
- E.g. spinal nerve root compression, CTS,…

Multiple pain mechanisms may occur at the same time!

e.g. low back pain ; degenerative knee arthropathy

Referred pain?

"Visceral and somatic primary sensory neurons converge onto common spinal neurons, causing confusion in the ascending spinal pathways and leading to misinterpretation of the origin of the pain. The message from the primary lesion could be wrongly interpreted as coming from the area of pain referral"

Vecchiet and Giamberardino, 1997; Robinson, 2003; Galea, 2014; "A practical approach to musculoskeletal medicine", Atkins et al., Elsevier, 2024, p6

Cyriax suggested that the misinterpretation of pain occurs at the cortical level, where stimuli arriving at certain cortical cells from the skin can be localised accurately to that area.

When stimuli from other deeper tissues of the same segmental derivation reach those same cells, the sensory cortex makes assumptions on the basis of past experience and attributes the source of the pain to that same area of skin.

What about referred pain from bones?

Cortical bone: well localised pain

Cancellous part of the bone: may provoke referred pain

Take your time for the history

Physicians interrupted and took control of the interview after average 18 seconds (!) and by asking specific closed questions they halted the spontaneous flow of information.

If allowed to continue uninterrupted, and with no specific guidance, patients talked on average 2 minutes (!) (some even 1,5 minutes)

Beckman and Frankel, 1984; Blau, 1989; Wilkinson, 1989
"A practical approach to musculoskeletal medicine",
Atkins et al., Elsevier, 2024, p20

Tendon problems

- Was there a change of use?
- Usually gradual onset

Behaviour of connective tissue structures

If the structure is loaded quickly, it behaves more stiffy than the same tissue loaded at a slower rate (Threlkeld, 1992)

So…tendons are more easily deformed at low strain rates, where they absorb more energy but are less effective at transmitting loads

At high strain rates, they become stiffer and are less easily deformed but are more effective at moving large loads (Wang et al., 2006)

"A practical approach to musculoskeletal medicine", Atkins et al., Elsevier, 2024, p53

Morning pain?

- More joint stiffness in the morning > 1 hour
- Inflammatory arthropathy

Medical history: THREADSSFC

- Thyroid
- Heart
- Rheumatoid arthritis
- Epilepsy
- Asthma
- Diabetes
- Surgery
- Steroid intake
- Fracture
- Cancer

From “A practical approach to musculoskeletal medicine”, Atkins et al., Elsevier, 2024, p22

Psychosocial assessment - ABCDEFW

- Attitude
- Belief and behaviour ("pain means harm")
- Compensation (insurance issues)
- Diagnosis *(misunderstanding, different diagnoses)*
- Emotion (fear avoidance, stress)
- Family and friends
- Work (delayed return)

From "A practical approach to musculoskeletal medicine", Atkins et al., Elsevier, 2024, p23

Chronic pain?

Evidence suggests that psychosocial factors can have greater influance than biomedical or biomechanical factors in the transition from acute to persistent pain – associated with poor outcomes

Gatchel et al., 1995; Picavet et al., 2002; Waddell, 2004; Carragee et al., 2005; Chou et al., 2009; Pincus et al., 2013

Red flags…

- One red flag can be significant, but…
- Presence of concurrent red flags is more important

- Weight loss and history of malignancy and age 55+
- → sensitivity of nearly 100% for underlying malignancy

Greenhalgh and Selfe, 2010; Jarvick and Deyo, 2002

Infiltration with corticosteroids?

Can inhibit the function of the macrophage in the early inflammatory stage, resulting in a delay in fibre production, which is caused by the inhibition of vascular permeability and matrix synthesis by corticosteroid

Dingman, 1973; Leibovich and Ross, 1974; Fowler, 1989; Hashimoto et al., 2002
"A practical approach to musculoskeletal medicine", Atkins et al., Elsevier, 2024, p42

Dura mater and dural nerve root sleeve

Mobile in a non-pathological state and can accomdate normal movement

Adhesions may develop , compromising the mobility

Possibly clinical symptoms

Iannotti and Parker, 2012; Standring, 2015; Soames and Palastanga, 2018; “A practical approach to musculoskeletal medicine”, Atkins et al., Elsevier, 2024, p50

Tissue healing

After an initial, relatively short bleeding phase, the **inflammatory phase** prepares the area for healing

The **proliferation phase** rebuilds the structure

The **remodelling phase** provides the final form of the tissue

Hardy, 1989; Broughton et al., 2006; Watson, 2009
"A practical approach to musculoskeletal medicine", Atkins et al., Elsevier, 2024, p57

Acute phase – Inflammation

- About 3-5 days
- Macrophages clean up the debris
- At the end of this phase, biochemical factors decrease

Subacute phase – repair/proliferation

Proliferation phase

Fibroblasts create new tissue (as from 24h after the injury until 3w)

Now we need biomechanical stimulation

- Gradual movement

Bryant, 1977; Chamberlain, 1982; Fowler, 1989

Chronic phase – remodelling

Starts about 3w after injury (sometimes earlier,as from 8 days) and continues for 6 months or more, possibly years

- Collagen has a turnover of about 360 days
- Realignment of tissue ; build up forces in the right direction
- Gradual loading

Broughton et al., 2006

Muscle healing

- Reduced number of macrophages in muscle tissue is associated with reduced muscle regeneration

- The inflammation phase should not be “fought” by applying anti-inflammatory treatment too early (not in the first 3 days)→ poor healing

Chazaud, 2020; Shen et al., 2008; Liu et al., 2017; Campagnolo et al., 2010

Tendinopathy

- Sudden increase or decrease in activity may cause tendinopathy
  - Tendons can respond adversely to both **overuse** and **underuse**

- *“They don’t like rest, and they don’t like change”*

Rees et al., 2006; J. Cook, 2012

What is causing the pain? Complex!

- Inflammatory cells or signs of chemical inflammation are absent in chronic tendinopathy
  - Degenerative changes seem to be more important
- Neovascularisation could play a role
- A combination of mechanical, neural, vascular theories, central sensitisation…

Cook et al., 2016, 2000; Khan and Cook, 2000; Wang et al., 2006; Alfredson et al., 2002; Rees et al., 2006; Rudavsky and Cook, 2014

Tendinous problems?

- Minimal 15’ of continuous angle stretch per day

Tim Daelemans, principal FICO Osteopathy Academy, personal communication during course, sept 2024

Continuum of tendon pathology – 3 stages

Reactive tendinopathy

- Acute overload

Tendon disrespair

- Increased proteoglycans and collagen production
- Increased vascularity / neural in-growth

Degenerative tendinopathy

- Further degradation and acellularity

Cook and Purdam, 2009;
Leong et al., 2018

Some tendons may have discrete regions that are in different stages at the same time

- E.g. “Reactive-on-degenerative tendinopathy”

Cook et al., 2016
“A practical approach to musculoskeletal medicine”, Atkins et al., Elsevier, 2024, p67

Tendinopathy and deep friction massage?

“Transverse frictions, ESWT,…, and other physical treatments that stimulate cell activity, increase protrein production and restructure the matrix are appropiate for the degenerative stage. Progressive loading is also appropiate.”

Cook and Purdam, 2009; Ahmad et al., 2020
“A practical approach to musculoskeletal medicine”, Atkins et al., Elsevier, 2024, p67

Stretching?

“Increases compression where tendons pass over a bony prominence, especially when there is some tension in the muscle as well. It is probably better to address muscle length and compliance in the muscle-tendon unitby using massage techniques, rather than stretching”

Cook and Purdam, 2012
“A practical approach to musculoskeletal medicine”, Atkins et al., Elsevier, 2024, p67

General treatment principles in musculoskeletal medicine

Peace and Love

- **P**rotection
  - First days after injury
- **E**levation
- **A**void anti-inflammatories
- **C**ompression
  - Reduce swelling
- **E**ducation
  - Your body knows best – avoid unnecessary passive treatments

Dubois and Esculier, 2020
"A practical approach to musculoskeletal medicine", Atkins et al., Elsevier, 2024, p75

Peace and Love

- **L**oad
  - Let pain guide your gradual return to normal activities
- **O**ptimism
  - Condition your brain
- **V**ascularisation
  - Increase blood flow to reapairing tissues
- **E**xercise
  - Restore mobility, strength and proprioception

Ice?

Reduce bleeding and swelling → Questionnable?

Current advice

- Short period application (up to 10’)
- Remove it for about 20’
- Can be repeated once/twice more in the initial few hours after injury
- Further application 3-7 days

Bleakly et al., 2006, 2012; Dubois and Esculier, 2020; Timestra, 2012; MacAuley, 2001



Transverse frictions…

Some evidence for the use of frictions in tennis elbow and supraspinatus tendinopathy, mostly anecdotal

Tennis elbow

- Findings generally show that the addition of transverse friction massage to standard care improves patient outcomes in the short term ; quality of studies??
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Joseph et al., 2012; Baltaci et al., 2001; Smidt et al., 2002; Nagrale et al., 2009; Dasm, 2012; Viswas et al., 2012
“A practical approach to musculoskeletal medicine”, Atkins et al., Elsevier, 2024, p78

Mechanical signal is vital to tissue healing

Transverse frictions improve strength of contraction and increased range of motion (extensibility) in normal gastrocnemius muscle

Davidson et al., 1997, Gehlsen et al., 1998; Kelly, 1997; Iwatsuki et al., 2001

Anaesthetic effect of DF

Changes in local microenvironment of the tissues by Increased blood flow

- Removal of chemical irritants that sensitise or excite local nociceptors
- Decrease in local oedema and pressure

Pain modulation, gate control theory

Time required to produce analgesia during DF: 0,4’ – 5,1’ (mean 2,1’)

Post DF analgesic effect lasted 0,3’ to 48 hrs (mean 26 hrs)

De Bruijn, 1984

Gate control theory

"passage of sensory information is mediated at spinal cord level, especially nociceptive impulses. Pressure stimulates low-treshold mechanoreceptors, the A-beta fibres, that reduce the excitability of the nociceptor terminals by presynaptic inhibitation, effectively "closing the gate" on the pain.

The greater the mechanoreceptor stimulation, the greater the level of pain suppression"

Bowsher, 1994; Wells, 1994

"A practical approach to musculoskeletal medicine", Atkins et al., Elsevier, 2024, p79

Peripheral Grade A mobilisation?

"A passive, active or assisted /active mobilisation performed within the patient's pain-free range of movement, aiming to provide or maintain mobility"

Initially small amplitude, slow, pain-free, without force and repeated often

Saunders, 2000

"A practical approach to musculoskeletal medicine", Atkins et al., Elsevier, 2024, p83

When to use grade A?

In acute inflammatory stage: fascilitate phagocytic action of the macrophages

To apply moderate longitudinal stress to connective tissue structures ; better orientation of fibres (no real stretch)

To promote normal function

To prevent anomalous adhesion formation

To reduce a loose body or bony subluxation

“A practical approach to musculoskeletal medicine”, Atkins et al., Elsevier, 2024, p83-84

Peripheral Grade B mobilisation

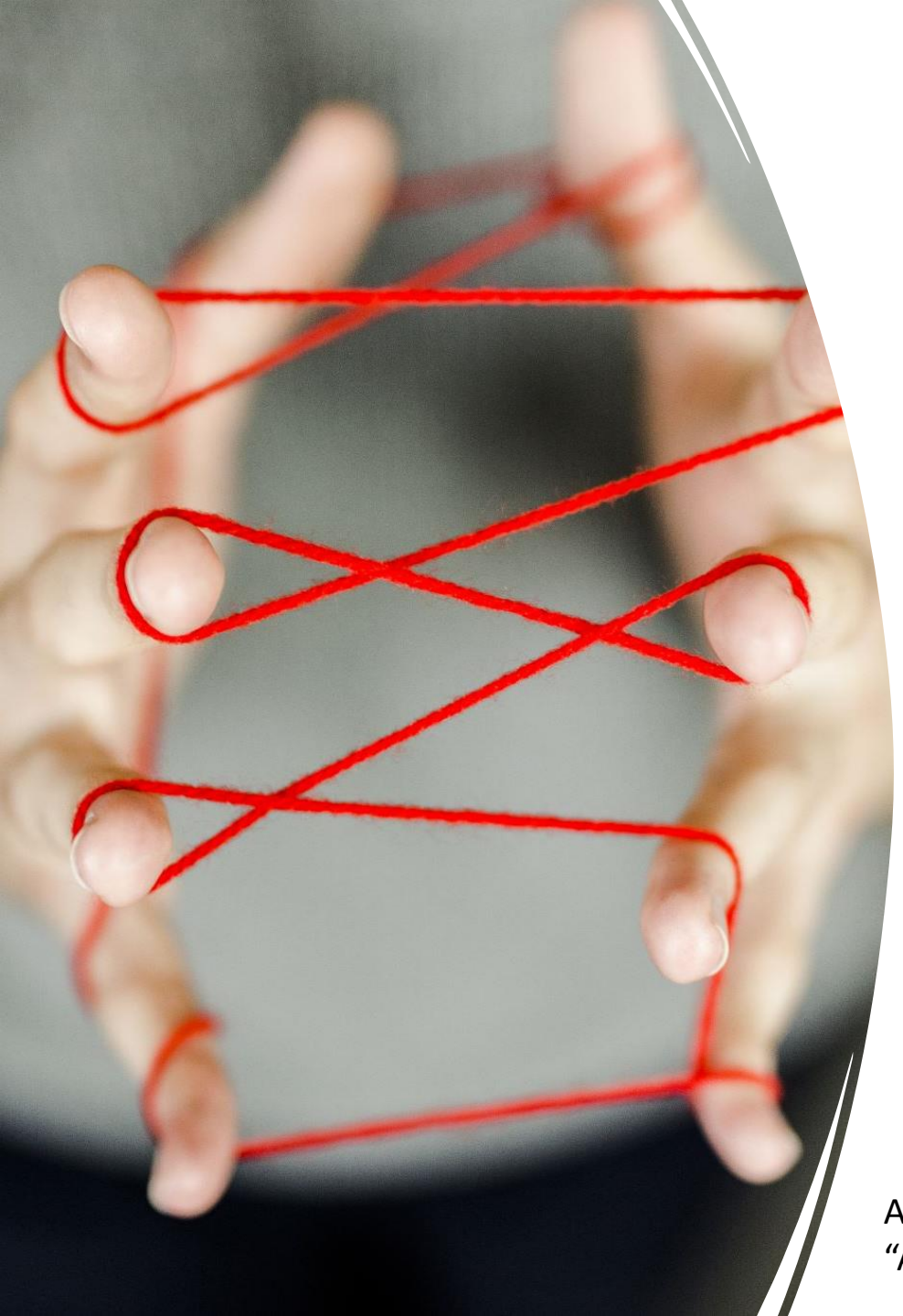
“is a mobilisation performed at the end of available range into the plastic range.”

“Specific, sustained stretching technique that aims to facilitate permanent elongation of connective tissue.”

“A practical approach to musculoskeletal medicine”, Atkins et al., Elsevier, 2024, p84

When to use grade B?

- To stretch capsular adhesions
- To reduce pain
- To improve function



Stretch capsular adhesions…

- The stretch (slow, sustained and repeated) is applied towards the end of the elastic limit into the plastic range to achieve personal lengthening
- The stretch applied uses the viscous flow phenomenon, which enables contracted scar tissue to creep or to lengthen gradually
- Patient should be warned about post-treatment soreness

Amis, 1985; Hardy and Woodall, 1998; Usuba et al., 2007
"A practical approach to musculoskeletal medicine", Atkins et al., Elsevier, 2024, p84

Duration and frequency of static stretch?

- Optimum dosis has yet to be determined
- A static stretch of 30’ seems to be sufficient (applied to the hamstrings to achieve an increase of ROM of knee extension)
- Maintain the stretch “as long as can be tolerated”, based on the patient’s feedback

Brandy and Irion, 1994; Brandy et al., 1997
“A practical approach to musculoskeletal medicine”, Atkins et al., Elsevier, 2024, p85

What about adding heat?

- Conclusion of a meta-analysis: heat combined with stretching is more effective than stretching alone
- Heat: 40°C-45°C (40°C is the temperature of a very hot bath)

- Home advice
  - Apply home exercise stretches after a hot bath or shower, or after the application of a heat pad

Usuba et al., 2007; Bleakley and Costello, 2013
"A practical approach to musculoskeletal medicine", Atkins et al., Elsevier, 2024, p85

Peripheral Grade C manipulation

- *“is a passive movement performed at the end of available range and is a minimal amplitude, high-velocity thrust”*

- When connective tissue is loaded more quickly, it behaves more stiffy than the same tissues loaded more slowly
  - The short-toe phase of the adhesions ensures that the slack is taken up more rapidly in the adhesions, than in the surrounding normal tissue, and that the minimal amplitude, high-velocity thrust cause macrofailure fo the adhesions while the normal tissue remains intact

- Home exercise to maintain the elongation!

Threlkeld, 1992

“A practical approach to musculoskeletal medicine”, Atkins et al., Elsevier, 2024, p86

Spinal grades of mobilisation?

"A practical approach to musculoskeletal medicine", Atkins et al., Elsevier, 2024, p87

Grade A

- Mobilisation mid-range

Grade B

- Mobilisation at the end of available range (not sustained, not into pain or muscle spasm)

Grade C

- Manipulation end-range, minimal amplitude-high-velocity



Injection therapy?

Provide a window of opportunity to allow progressive movement or loading, after a period of relative rest and protection, to gain the maximum benefit from the injection

"A practical approach to musculoskeletal medicine", Atkins et al., Elsevier, 2024, p89

Hyaluronic acid injections?

Necas et al., 2008; Henrotin et al., 2015; Kaux et al., 2015; Bannuru et al., 2001, 2014, 2016; Maheu et al., 2016; Smith et al., 2019
"A practical approach to musculoskeletal medicine", Atkins et al., Elsevier, 2024, p97

Safe an well-tolerated treatment of knee degenerative arthropathy and other joints (current literature and expert opinion)

In recent years it has also been used in tendon pathologies

But…international guidelines are not consistent…



Corticosteroids have a short-term effect (4-6 weeks) while HA has a longer effect (8-24 weeks) in the treatment of degenerative arthropathy

PRP injections could also be used in case of

- Chronic tendinopathy (tennis elbow, plantar fasciitis, achilles and patellar)
- Degenerative arthropathy of the knee
- Avascular necrosis of the femoral head
- Acute muscle tears, MCL tears and ankle sprains
- But…**literature is also not consistent! Efficacy has yet to be established**

Middleton et al., 2012; Lee, 2013; de Vos et al., 2010; Peerbooms et al., 2010; Gosens et al., 2011, Moraes et al., 2014; Keen et al., 2016 “A practical approach to musculoskeletal medicine”, Atkins et al., Elsevier, 2024, p99

Prolotherapy (sclerosant injections)

- The aim is to increase ligament or tendon mass and ligament-to-bone or tendon-to-bone strength
  - Cause an inflammatory reaction → stimulate the formation of new collagen fibres
  - The immature fibres laid down → contract and shorten by avoiding movement and stress during the repair and remodelling phases

- Hypertonic dextrose in local anaesthetic
- Occasionally phenol is injected in conjuction with dextrose and glycerol

"A practical approach to musculoskeletal medicine", Atkins et al., Elsevier, 2024, p100

Prolotherapy in achilles tendinopathy

- Closes down new vessels that have become established in degenerative tendinopathy, which are proposed as a cause of pain

Ohberg and Alfredson, 2003; Brukner et al., 2017
“A practical approach to musculoskeletal medicine”, Atkins et al., Elsevier, 2024, p427