A Pragmatic Evidence Informed Approach to Chronic Lateral Elbow Tendinopathy with Lessons for Other Sites

Bill Vicenzino

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What is Tennis Elbow?

Clinical presentation

Slater et al Pain (2005) 114: 118-30
What is Tennis Elbow?
Epidemiology of Tennis Elbow?

- Sex and age bias?
- 5-7 1st episode / 1000 patients in GMP (Verhaar 1992)
- 12 weeks absenteeism for 10-30% of sufferers
- 5-10% undergo surgery Nirschl 1979; Baker 2000
- High baseline pain & concurrent neck and shoulder pain is an indicator of poorer long-term outcome Smidt 2006; Lewis 2002; Haahr 2003; Solheim
- Prone to recurrence
# Differential Causes of Lateral Elbow Pain

**Common**
- Extensor tendinopathy
- Referred pain
  - Cervical spine
  - Upper thoracic spine
  - Neuro-myofascial

**Less common**
- Synovitis of the radiohumeral joint
- Radiohumeral bursitis
- Posterior interosseous nerve entrapment (radial tunnel syndrome)

**Not to be missed**
- Osteochondritis dissecans
  - Capitellum
  - Radius (in adolescents)

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### Table 22.1 Causes of lateral elbow pain

**Common**

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<td>Radius (in adolescents)</td>
</tr>
</tbody>
</table>

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http://www.optp.com/
The 3 components of EBP

Hush JM & Alison JA (2011) EBP: lost in translation? J Physiotherapy 57 (3)143-4
Short term gain -
long term pain

Aetiology

Alternative construct

Role of Phty & Exercise
Opinion piece

Stop injecting corticosteroid into patients with tennis elbow, they are much more likely to get better by themselves!

Hamish Osborne

Sport and Exercise Medicine, University of Otago, PO Box 913, New Zealand
Received 18 September 2009; accepted 28 September 2009

The management of tennis elbow

John Orchard adjunct associate professor, Alex Kountouris physiotherapist

1School of Public Health, University of Sydney, NSW 2006, Australia; 2Australian Cricket Team, Melbourne, Australia
...7/13 patients were relieved of pain from 1-5 months after the injection of hydrocortisone, only to have recurrence of symptoms...

THE USE OF HYDROCORTISONE ACETATE (COMPOUND F ACETATE) IN THE TREATMENT OF SOME COMMON ORTHOPAEDIC CONDITIONS

H. Herman Young, L. Emmerson Ward and Edward D. Henderson
www.the.lancet.com DOI:10.1016/S0140-6736(10)61160-9
www.the.lancet.com  DOI:10.1016/S0140-6736(10)61160-9
Wait and see policy: reassured that they will get better (n = 67)

Corticosteroid Injection: 
1 ml quantity of 1% lidocaine + 10 mg of triamcinolone acetonide in 1 ml (n = 65)

Physiotherapy: 
MWM & exercise: 8 x 30’ sessions over 6 weeks (n = 66)

Advice to all: ergonomics and self management …

Physiotherapy for tennis elbow

Bill Vicenzino

Evid. Based Med. 2007;12;37-38
doi:10.1136/ebm.12.2.37

Masterclass

Lateral epicondylalgia: a musculoskeletal physiotherapy perspective

B. Vicenzino

Department of Physiotherapy, University of Queensland, Brisbane, Australia

Original article

Effects of a novel manipulative physiotherapy technique on tennis elbow: a single case study

B. Vicenzino and A. Wright

Department of Physiotherapy, University of Queensland, Brisbane, Australia
MWM + exercise are beneficial:

NNT = 3
(RR: 2.44 [95CI: 1.55 to 3.85])

NNT = 2
(RR: 1.88 [95CI: 1.41 to 2.5])

MWM + exercise are beneficial:

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Recurrences</th>
<th>Not-per-protocol treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wait-and-See</td>
<td>6/64</td>
<td>34/62</td>
</tr>
<tr>
<td>Corticosteroid Injection</td>
<td>47/65</td>
<td>32/65</td>
</tr>
<tr>
<td>MWM/Exercise</td>
<td>5/64</td>
<td>13/63</td>
</tr>
</tbody>
</table>

Short term gain - long term pain:

Corticosteroid injection for tennis elbow - clear evidence of worse outcome in mid to long term with higher recurrence rates and less satisfaction.
Short term gain - long term pain

Aetiology

Alternative construct

Role of Phty & Exercise
Coombes B, Bisset L, Vicenzino B. A new integrative model of tennis elbow. BJSM Online First, published on December 2, 2008 as 10.1136/bjsm.2008.052738
B  Left forearm, from the left in the midprone position. Posterior interosseous nerve (extensor digitorum and part of extensor carpi ulnaris removed)

1  Biceps
2  Brachialis
3  Brachioradialis
4  Triceps
5  Extensor carpi radialis longus
6  Lateral epicondyle and common extensor origin
7  Anconeus
8  Supinator
9  Posterior interosseous nerve
10  Abductor pollicis longus
11  Extensor pollicis longus
12  Extensor carpi ulnaris
13  Extensor indicis
14  Extensor pollicis brevis
15  Extensor carpi radialis brevis

The posterior interosseous nerve passes between the superficial and deep parts of the supinator.
Abnormal appearance:
• Disordered arrangement of collagen fibres
• Increase in vascularity
• Mucoid degeneration of collagen fibres
• Thin frayed fibrils
• Presence of stainable ground substance
• Absence of classic inflammatory cells

(Coonrad & Hooper 1973, Verhaar et al 1993, Doran et al 1990)

Loss of continuity of collagen
Loss of reflectivity
Frank defect present

angiofibroblastic hyperplasia (Nirschl 1979)
Rounded tenocytes

Prom tenocytes
abn matrix

Abn tenocytes/matrix
Fascicle rupture

17 patients: 22 elbows (5 bilateral; 7 male; age 45 years; 18 months duration) v 11 controls (6 male; age 45 years)

US + Doppler study

Neovessels: TE = 21/22 (95%) v Controls = 2/22 (9%)

LA into neovessels reduces pain with extensor loading

Neovessels closely related to neural structures

Fig. 2 Patient clinically diagnosed to have Tennis elbow. Colour Doppler (CD) shows small vessels inside and outside the area with structural changes in the extensor origin (a). CD showing normal structure, without any vascularity, in the extensor origin in a pain-free elbow (b)
Short term gain - long term pain

Aetiology: does not support an anti-inflammatory treatment
Short term gain -
long term pain √

Aetiology √

Alternative construct

Role of Phty & Exercise
Coombes B, Bisset L, Vicenzino B. A new integrative model of tennis elbow. BJSM Online First, published on December 2, 2008 as 10.1136/bjsm.2008.052738
PFG or PFGS:

Pain free grip strength (force)

= to onset of pain

20 patients (mean duration 23.9 (7-72) months; mean age 36 (23-58) years; 11 male) & 9 normal (4 autopsy & 5 alive, 8 male, 36 (23-58) years old)

Morphological changes greater in LE

LE related changes:
- moth eaten fibres
- fibre necrosis
- high % fast-twitch oxidative (type 2A) fibre type

Morphological changes may contribute to decreased muscle performance in LE (along with pain)
N = 24 male + 16 female unilateral chronic lateral epicondylalgia (24 male; 49.5 years (32-66; mean duration: 7.7 ± 10 months) & 40 age-gender matched controls


Strength:

1. Metacarpophangeal extension/flexion ratio:

Control (0.56, n8) < recovered TE (0.87, n6) and TE (0.83, n7)
...no differences found for wrist F/E ratios.

2. Grip, Wrist F & E, Shoulder ABD, ER & IR
...all weaker in TE and recovered TE
...MCP E stronger in TE
ABSTRACT

Objective To evaluate whether deficits of elbow flexor and extensor muscle strength exist in lateral epicondylalgia (LE) in comparison with a healthy control population.

Design Cross-sectional study.

Participants 150 participants with unilateral LE were compared with 54 healthy control participants.

Main outcome measures Maximal isometric elbow flexion and extension strength were measured bilaterally using a purpose-built standing frame such that gripping was avoided.

Results The authors found significant side differences in elbow extensor (−6.54 N, 95% CI −11.43 to −1.65, p = 0.008, standardised mean difference (SMD) −0.45) and flexor muscle strength (−11.26 N, 95% CI −19.59 to −2.94, p = 0.009, SMD −0.46) between LE and control groups. Within the LE group, only elbow extensor muscle strength deficits between sides was significant (affected–unaffected: −2.94 N, 95% CI −5.44 to −0.44).

Conclusion Small significant deficits of elbow extensor and flexor muscle strength exist in the affected arm of unilateral LE in comparison with healthy controls. Notably, comparing elbow strength between the affected and unaffected sides in unilateral epicondylalgia is likely to underestimate these deficits.

Trial Registration Australian New Zealand Clinical Trials Register ACTRN12609000051246.
Mean Deficit: 11°
Lower 95CI: 7°
Upper 95CI: 14°

No effect of Age, Gender, Side

Speed of Movement

Subjects:
32 CLE (median duration = 31 months)
11 male, 21 female aged 43 yrs
32 gender matched controls

Results: Compared to normal the patients had:
19-36% slower reaction times for both arms
31-32% slower speed of movement for both arms
There was no difference between affected and unaffected arm

Conclusion:
Unclear mechanisms at play
May be indicative of altered central processing
What comes first the pain of tennis elbow or motor control deficit

<table>
<thead>
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<tbody>
<tr>
<td><strong>Deficit</strong></td>
<td>~30%</td>
<td>~15%</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>43</td>
<td>49</td>
</tr>
<tr>
<td><strong>Male:Female</strong></td>
<td>11:21</td>
<td>24:16</td>
</tr>
<tr>
<td><strong>Duration of LE</strong></td>
<td>31 months</td>
<td>4.5 months</td>
</tr>
</tbody>
</table>
Bilateral changes: scenario 1?

- 8 with LE and 14 normal
- Backhand stroke (single hand)
- Muscles sampled:
  - ECRB
  - ECRL
  - EDC
  - Pronator teres
  - FCR

Figure 2. The EMG activity for extensor carpi radialis brevis muscle in normal and injured subjects.

- Leading elbow = wrist extended and open racquet face near impact
- Greater activity in wrist extensors and pronator teres
- Motor dysfunction (control)
Motor system impairments

- morphological deficits
- sensori-motor (bilateral)
- strength imbalance
- global changes
Motor system impairments

Pain system(s) changes
Pain system(s) changes
Abstract: There is evidence suggesting an important role of nociceptive sensitization in lateral epicondylalgia (LE). Our aim was to explore somato-sensory changes in patients with unilateral LE to better understand this musculoskeletal condition. Twelve patients (6 female) with LE with a mean (SD) age 47 (10) years, and 16 controls (7 female), aged 41 (9) years were tested. The following somato-sensory parameters were assessed: pressure-pain threshold (PPT), heat- and cold-pain thresholds, thermal, cold- and vibration-detection thresholds. All these tests were bilaterally assessed over the lateral epicondyle (affected/unaffected in patients; dominant/nondominant in controls) and at the dorsal-lateral surface of the wrist in all patients and controls. The results showed that patients with unilateral LE not only exhibited substantial reductions in PPT on the affected side compared to the unaffected side (mean difference and 95% confidence intervals: 219 kPa [136.8 to 301.1 kPa] but also when compared to controls (581.1 kPa [340.5 to 821.7 kPa]), showing bilateral pressure-pain hyperalgesia. These differences represented an effect size (ie, standardized mean difference) of 1.23 and .94, respectively. In the same cohort, there were no such deficits in cold and heat pain, cold- and warm-detection thresholds, and vibration-detection thresholds, either between affected and unaffected sides in patients with LE or between patients and controls. Effect sizes for the sensory-detection tests were small, which were generally less than the pain tests. Our data imply that LE is largely characterized by peripheral and central mechanical pain hyperalgesia.

Perspective: This article reveals the presence of bilateral pressure-pain hypersensitivity in patients with unilateral LE. On the contrary, thermal and vibration tests were not significantly different from controls.
As an aside…

- Poorer health-related quality of life in severe LE relative to mild & moderate LE

- No differences in anxiety, depression & kinesiophobia between groups

Pain system(s) changes

- Mechanical hyperalgesia
- Deep tissue sensitivity
- Central sensitization
- Local neurotransmitters
Pain system(s) changes

Motor system impairments

- morphological deficits
- sensori-motor (bilateral)
- strength imbalance
- global changes
- mechanical hyperalgesia
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- central sensitization
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Pain system(s) changes
Sensori-motor (bilateral) deficits
Strength imbalance
Global changes
Motor system impairments
Local tendon pathology
Pain system(s) changes
Mechanical hyperalgesia
Deep tissue sensitivity
Central sensitization
Local neurotransmitters
Angiofibroblastic hyperplasia
Hypercellularity
Increased matrix protein
Neovascularisation
Collagen fibrils disarray
Increased matrix protein
Morphological deficits
Mechanical hyperalgesia
Deep tissue sensitivity
Central sensitization
Local neurotransmitters
Angiofibroblastic hyperplasia
Hypercellularity
Neovascularisation
Pain system(s) changes

Motor system impairments

Local tendon pathology

Pain system(s) changes

Global changes

Sensori-motor (bilateral)

Strength imbalance

Deep tissue sensitivity

Mechanical hyperalgesia

Central sensitization

Local neurotransmitters

Blood, Prolotherapy, Polydocinical, NO, Exercise

Angiofibroblastic hyperplasia

Hypercellularity

Increased matrix protein

Collagen fibrils disarray

Neovascularisation

Exercise, Exercise, Exercise, EPA, Polydocinical, MWM, steroid?
Short term gain - long term pain

Aetiology

Alternative construct: motor, sensorimotor and pain system impairments

Role of Phty & Exercise
Chapter 13
A recalcitrant case of aircraft engineer’s elbow

Leanne Bisset and Bill Vicenzino
Mobilisation with Movement

Pain Free Grip is affected in all patients with LE

PFG not MGS:
- Discriminates affected from unaffected and normal (Bisset et al 2006)
- Sensitive to change over time (Stafford et al 1987, 1994)
## Mobilisation with Movement

PFG is affected in all patients with LE

<table>
<thead>
<tr>
<th>Test position:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Elbow extension with palm facing treatment table = internal rotation of arm, pronation of forearm.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Most provocative position</th>
</tr>
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</table>

| 3. Note variation from 90° elbow flexion in sitting position |

PFG not MGS:
- Discriminates affected from unaffected and normal (Bisset et al 2006)
- Sensitive to change over time (Stafford et al 1987, 1994)
Mobilisation with Movement

PFG is affected in all patients with LE

Test procedure:
1. Always test unaffected side first
2. Perform 3 to 6 grip actions
3. Ask patient to memorize rate of gripping
4. Practitioner monitors rate of gripping action
5. Test affected after unaffected
6. Ask patient to grip at same rate as unaffected side
7. Practitioner monitors rate of force application
8. Perform 3 to 6 tests
9. Average the tests for both sides to arrive at the outcome measure.

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Mobilisation with Movement

PFG is affected in all patients with LE.

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Grip force in Newtons

200 N ▲ Maximum grip force = maximum amount of force that the patient can produce.

50 N ▲ Pain free grip force = amount of force to first onset of pain (pain threshold test).

0 N • •
Mobilisation with Movement

- PFG is affected in all patients with LE
- PFG not MGS:
  - Discriminates affected from unaffected and normal (Bisset et al 2006)
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<th>Grip force in Newtons</th>
<th>Aim of MWM: To substantially increase PFG towards MGS (+ ~10% if dominant side affected)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 N</td>
<td>...with each application of the MWM.</td>
</tr>
<tr>
<td>50 N</td>
<td></td>
</tr>
<tr>
<td>200 N</td>
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PFG is affected in all patients with LE

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Grip force in Newtons

- 200 N
- 50 N
- 0 N

How much = substantial?
Mobilisation with Movement

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</tr>
<tr>
<td>0 N</td>
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PFG is affected in all patients with LE

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How do we make a substantial improvement in force generation to pain onset?
Mobilisation with Movement

How do we make a substantial improvement in force generation to pain onset?

Grip force in Newtons

200 N

50 N

0 N
Mobilisation with Movement

Location of contact
- Joint (local or distant)
- Contact point on bone

Applied Force
- Direction (gross, subtle)
- Level (amount of force)
- Overpressure (OP)
- How applied (manual, belt, tape)

Grip force in Newtons

- 200 N
- 50 N
- 0 N

How do we make a substantial improvement in force generation to pain onset?
Mobilisation with Movement

Location of contact
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Applied Force
- **Direction (gross, subtle)**
- Level (amount of force)
- Overpressure (OP)
- How applied (manual, belt, tape)

Perpendicular to impaired action or movement direction:
- Transverse plane in 56% of all peripheral techniques in Mulligan book compared to 28% in Sagittal plane.
- Lateral in 44% of all peripheral techniques (~79% of all transverse plane MWM)

Grip force in Newtons

200 N

How do we make a substantial improvement in force generation to pain onset?

50 N

0 N
Mobilisation with Movement

Location of contact
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Applied Force
- Direction (gross, subtle)
- Level (amount of force)
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- How applied (manual, belt, tape)


5° posterior to directly lateral or lateral produces greater effect than 5° anterior of lateral
Mobilisation with Movement

How do we make a substantial improvement in force generation to pain onset?

Location of contact
- Joint (local or distant)
- Contact point on bone

Applied Force
- Direction (gross, subtle)
- **Level (amount of force)**
- Overpressure (OP)
- How applied (manual, belt, tape)


A threshold level of lateral glide force has to be met for the MWM to be beneficial in improving PFG.
Chapter 2
Mobilisation with Movement: the art and science of its application

Bill Vicenzino, Wayne Hing, Toby Hall and Darren Rivett
Mobilisation with Movement

Grip force in Newtons

200 N

50 N

0 N

How do we make a substantial improvement in force generation to pain onset?

Location of contact
  • Joint (local or distant)
  • Contact point on bone

Applied Force
  • Direction (gross, subtle)
  • Level (amount of force)
  • Overpressure (OP)
  • How applied (manual, belt, tape)
Initial Effects of Elbow Taping on Pain-Free Grip Strength and Pressure Pain Threshold

Study design: Single-blind, placebo control, randomized, crossover, experimental study with repeated measures.

Objective: To determine the initial effects of a taping technique on grip strength and pain in individuals with lateral epicondylalgia.

Background: Taping techniques are advocated for chronic musculoskeletal conditions such as lateral epicondylalgia, a prevalent disorder with significant impact on the individual and community. Little evidence exists supporting the effects of taping techniques on musculoskeletal pain.

Methods and Measures: Sixteen participants (mean age ± SD, 45.8 ± 10.2 years) with chronic lateral epicondylalgia (mean duration ± SD, 13.1 ± 9.9 months) participated in a placebo control study of an elbow taping technique. Outcome measures were pain-free grip strength and pressure pain threshold taken before, immediately after, and 30 minutes after application of tape.

Results: The taping technique significantly improved pain-free grip strength by 24% from baseline ($P = .028$). The treatment effect was greater than that for placebo and control conditions. Changes in pressure pain threshold (19%), although positive, were not statistically significant.

Conclusion: This preliminary study demonstrated an initial ameliorative effect of a taping technique for lateral epicondylalgia and suggests that it should be considered as an adjunct in the management of this condition. *J Orthop Sports Phys Ther* 2003;33:400-407.
Exercises
Concepts

- No pain during or after (DOMS?)
- Slow contraction (8 sec total)
- Endurance in first instance (15+ reps)
- 1st 2-3 weeks light load high reps
- Next 4-6 weeks endurance-strength (15-20/8-12 reps X 3 sets, short rest)
- May need in some to do high strength with hi loads low reps (4-6 reps X 3 sets, long rest)
Limited levels of evidence exist to suggest that eccentric exercise has a positive effect on clinical outcomes (P, function, patient satisfaction, RTW) when compared to various control interventions (concentric exercise, stretching, splinting, frictions and ultrasound).

Figure 4. Summary of findings. Pain VAS changes in the treatment of three tendinopathies, EE compared to CE (WMD ± 95% CI are shown). AT, Achilles tendinopathy; CE, concentric exercise; CI, confidence interval; EE, eccentric exercise; LET, lateral elbow tendinopathy; mm, millimetres; PT, patellar tendinopathy; VAS, visual analogue scale; WMD, weighted mean difference.

Figure 5 Summary of findings. RR of Satisfaction/Return to Activity in EE groups compared to controls (± 95% CI): (1) eccentric vs concentric - 12 weeks; (2) eccentric vs st. >6 months; (3) eccentric vs US >6 months. AT, Achilles tendinopathy; CI, confidence interval; EE, eccentric exercise; LET, lateral elbow tendinopathy; mm, millimetres; PT, patellar tendinopathy; RR, relative risk; st, stretching; US, ultrasound; VAS, visual analogue scale.
Eccentric or concentric?

or

...is it all about staging?

Eccentric exercise considerations:

(a) ~80% of unaffected and little pain

(b) Lower limb tendon v tennis elbow: pain during exercise tendon v enthesis
Enthesis organ v mid tendon

- Enthesis
- Fibrocartilage
- Sesamoid
- Superior tuberosity
- Periosteal fibrocartilage
- Kager’s fat pad
- Retrocalcaneal bursa

Brukner and Khan
New regimen for eccentric calf-muscle training in patients with chronic insertional Achilles tendinopathy: results of a pilot study

P Jonsson, H Alfredson, K Sundo, M Fahlström and J Cook

Br. J. Sports Med. 2008;42;746-749; originally published online 9 Jan 2008; doi:10.1136/bjsm.2007.039545
Exercise prevents recurrence & chronicity
RCT: 4 stage program of progressive slow, repetitive wrist/forearm stretching & strengthening, and occupational exercises; 6-8 weeks with weekly visits to physiotherapist

<table>
<thead>
<tr>
<th></th>
<th>Exercise (n=20)</th>
<th>US (n=19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men / women</td>
<td>8/12</td>
<td>6/13</td>
</tr>
<tr>
<td>Mean age (years)</td>
<td>43 (33-53)</td>
<td>41 (31-53)</td>
</tr>
<tr>
<td>Duration</td>
<td>9 &lt; 6 months</td>
<td>11 &lt; 6 months</td>
</tr>
<tr>
<td></td>
<td>11 &gt; 6 months</td>
<td>8 &gt; 6 months</td>
</tr>
<tr>
<td>Sick leave</td>
<td>6.3 weeks</td>
<td>7.1 weeks</td>
</tr>
<tr>
<td>Failed previous</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>treatment*</td>
<td></td>
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</tr>
</tbody>
</table>

* Immobilisation (4/4), injections (20/15), oral meds (18/18), percutaneous med (11/7), support (11/7), PT (12/7)

• Compared to the pulsed US, the exercise program produced significant improvements in:
  – Pain @ rest and under strain
  – Subjective ability to work & sick leave
  – Sleep disturbances
  – Isokinetic flexion torque and isometric grip

• No long term follow up in this study

Similar treatments (exercise versus US)
N = 30 (12 male, 18 female, mean age 42.3 years)
16 (12) exercise and 14 (11) US
Follow up time was a mean of 36 months

- After exercise there was:
  - Significantly less PT and GP treatment required
  - Fewer sick leave days
  - Less pain on VAS
- Operation: 5 in US group and 1 in Exercise group
- No spontaneous healing nor self limiting observed
- Exercise may prevent chronicity

Short term gain -
long term pain

Aetiology

Alternative construct

Role of Phty & Exercise