

Tendinopathies of the Lower Extremity: Basic Science & Clinical Practice

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HIP
KNEE
ACHILLES

SHOULDER
ELBOW
WRIST

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Tendinopathies in Sports Introduction

- ✓ Tendon problems represent a **major problem** in sports
- ✓ 30% of all injuries in runners were related to the Achilles tendon
Lysholm et al: AJSM '87
- ✓ Patellar tendinopathy (jumper's knee) most frequent knee injury
 - » 14% incidence in volleyball players
 - » 12% incidence in basketball players
Zwerver et al: AJSM '11

Tendon problems often become chronic – resistant to Rx

Tendinopathies in Sports Introduction

- ✓ Tendinopathy:
 - Clinical syndrome – often not always implies overuse tendon injuries
Ackermann & Renstrom: JSpts Health '12
 - ✓ Characterized by pain, diffuse or localized swelling & impaired function
Kahn et al: Clin J Spts Med '98
 - ✓ Pain is central factor in tendinopathies
Kongsgaard et al: SJMSS '11
Henriksen et al: BJSM '10

Tendinopathies in Sports Introduction

- ✓ **Tendinosis:**
- ✓ Histopathological finding which includes collagen disorganization, fiber separation, mucoid ground substance, hypercellularity, & nerve / vessel ingrowth – without signs of intra-tendinous inflammation
Magnusson et al: Nat Rev Rheumatol '10
- ✓ Due to complex nature of tendinopathy is a sign. challenge to Rx by clinicians
Kongsgaard & Landberg: SJMSS '11

Peritendinitis ← → Tendinosis

Tendinopathies in Sports Introduction

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Magnusson et al: Nat Rev Rheumatol '10
- ✓ **Theoretical Overuse injury is a result of mismatch:** *Landberg: SJMSS '07*

Mechanical Loading → Adaptation of Collagen

Eccentric Exercise & Tendinopathies

- Non-operative Rx with significant success
- Clinical studies illustrate 40-90% good outcomes after eccentric daily program of 6 to 12 weeks

Alfredson et al: *AJSM* '98
Ohberg et al: *BJSM* '04
Langberg et al: *SJMSS* '07
Jonsson et al: *BJSM* '09
Visnes et al: *BJSM* '07
Kongsgaard et al: *SJMSS* '09

***Best documented Non-Op Rx for Tendinopathy**
Ackermann & Renstrom *J Spts Health* '12



Stanish et al: *CORR* '86

- 200 patients with tendinitis treated with eccentric exercise Sx over 18 mos
- Once daily for 6 weeks of eccentric exercise
- 44% complete pain relief
- 43% marked improvement
- 9% virtually no change
- 2% were worse




TABLE I.

Begin with slow movement, little or no resistance	Stay at same level
No Pain?/?	Yes
Increase speed (moderate)	Stay at same level
No Pain?/?	Yes
Increase speed (fast)	Stay at same level
No Pain?/?	Yes
Increase resistance	Stay at same level
No Pain?/?	Yes

Langberg et al: *Scand J Med Sci Spts* '07

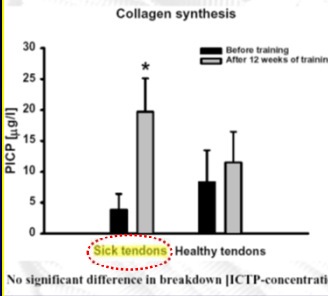
- 12 Danish elite soccer players with Achilles tendinosis & 6 healthy players
- 12 week heavy resistance eccentric (2xDay) program (3 sets of 15 reps at 20% BW)
- ✓ Collagen synthesis/formation injured area
- ✓ VAS pain level reduced from 44 to 13
- ✓ All players returned to play



Tissue turnover - collagen type I synthesis

high level soccer players

Collagen synthesis



VAS	Before	After
Tendinopathy	44 ± 9	13 ± 9 ^{3c}
Control	0 ± 0	0 ± 0

Langberg: *SJMSS* '07

Jonsson & Alfredson: *Br J Spts Med* '09

- Prospective randomized study athletes (mean age 25 yrs) with jumpers knee
- Compared *eccentric* to *concentric* exercise – decline single leg squat quadriceps training
- Performed 3 sets of 15, 7 days/wk for 12 wks
- ✓ Eccentric group: 9/10 satisfied VAS score from 73 to 23 ($p < 0.005$)
- ✓ Concentric group: 9/9 not satisfied, VAS 74 to 67 ($p < 0.34$)




Table 1. Baseline data of the 22 patients (11 tendons).

Parameter	Mean (SD)	Range
Age (years)	25.2 (2.1)	20-32
Height (cm)	178.5 (6.5)	165-190
Weight (kg)	78.5 (12.5)	60-100
Body mass index (kg/m ²)	24.5 (2.5)	19-30
Time since injury (months)	18.5 (12.5)	6-36
VAS (0-100)	73 (15)	30-100
Collagen synthesis (PICP, µg/l)	4.5 (2.5)	0-15
Collagen breakdown (ICTP, µg/l)	12.5 (5.5)	0-25

Kongsgaard et al: *Scand J Med Sci Spts* '09

- Randomized controlled single blind study
- Compared corticosteroid injection (CORT) to Heavy Slow Resistance eccentrics (HSR)
- ✓ HSR group elevated collagen turnover
- ✓ CORT group good short term results but *poor* long term results
- ✓ HSR group good short & long term results, subjective improvement, collagen synthesis

Eccentric Training with Stretching Programs

Dimitrios et al: Clin Rehabil '11

- Eccentric training with static stretching (N=22) produced superior results to eccentric alone (N=21) in patellar tendinopathy patients ($p < 0.0005$)

Witvrouw et al: AJSM '01

- **Prospective** risk factors for patellar tendinitis
- 138 asymptomatic young athletes (mean age 18 yrs)
- 19 developed patellar tendinitis
- ✓ **Risk factor: quadriceps & hamstring tightness ($p < 0.05$)**

Effects of Eccentric Exercise

- ✓ Tendon loading promotes collagen synthesis & collagen fiber cross linking – facilitation tendon remodeling

Magnusson et al: Nat Rev Rheumatol '10

- ✓ Eccentric produces more force by 150-300%

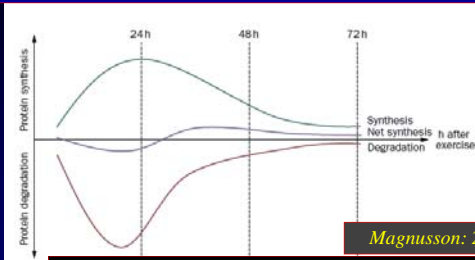
Komi et al: SJRM '74 Selinger: Eur J Appl Physiol '80

- ✓ Duration of exercise 3 months

Visnes et al: Br J Spts Med '07

- ✓ Same amount of time for tendon to form new fibroblasts *Ackermann & Renstrom: JSH '12*
- ✓ Exercise may stimulate new tendon cells – fibroblasts that adapt to load

Collagen Synthesis & Degradation after Exercise



- Collagen expression peaks at 24 hrs post-exercise
- Net loss around 24-36 hrs post-exercise
- Followed by net of collagen synthesis 36-72 hrs ??

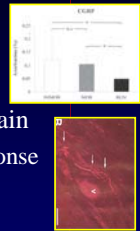
Effects of Eccentric Exercise

- ✓ **Exercise** exert mechanical effects on cells of nerve fibers & their receptors

- ✓ Seems to accelerate sensory n. retraction

Bring et al: J Orthop Res '07 & '09

- ✓ This may assist neuromodulation of pain
- ✓ Nerves alter the chemical milieu in response to load – either through release of antinoceptive substances (*opioids*) or by decreased production of *noceptive substances (substance P)* *Ackermann et al: Front Biosci '09*



Eccentrics & Tendinopathies

Effectiveness of Eccentrics

- *Langberg et al: Scand J Med Sci Spts '07*
- *Konsgaard et al: Scand J Med Sci Spts '09*
- *Jonsson et al: Br J Spts Med '09*
- *Norregaard et al: Scand J Med Sci Spts '07*
- *Magnusson et al: Nat Rev Rheumatol '10*
- *Knobloch et al: Scand J Med Sci Spts '07*
- *Fahlstrom et al: Knee Surg Spts Traum Arth '03*
- *Stanish et al: CORR '86*

Tendinopathies in Sports

How should we Rehab Tendons ??

Chronic (3-100 mos) Achilles overuse (n=15)



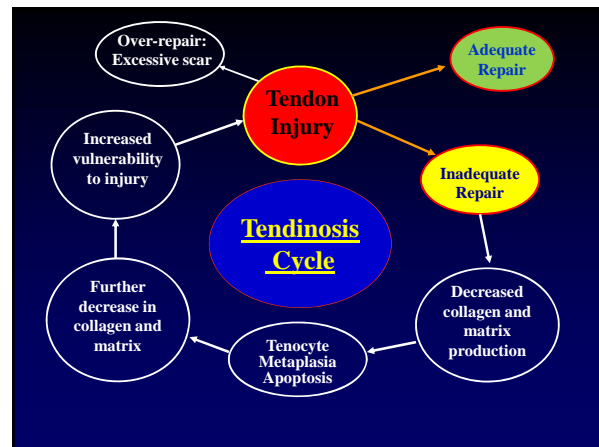
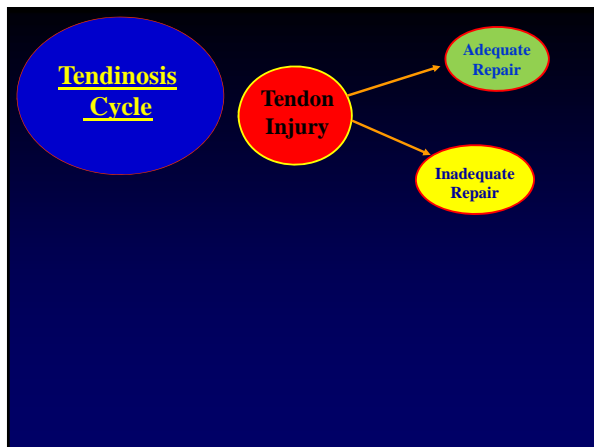
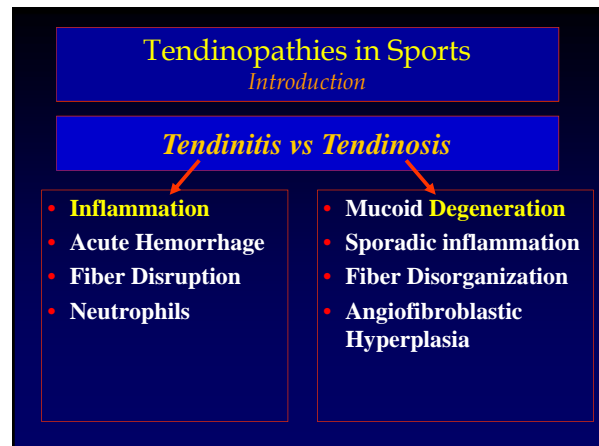
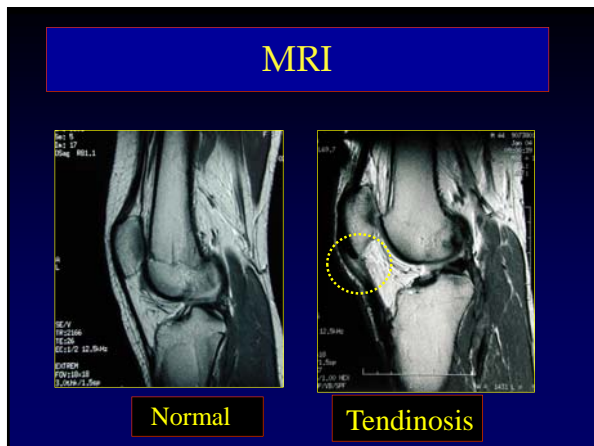
- Eccentric training with straight/bent knee
- 12 weeks, 7 days, 3x15 rep
- Increasing load

Pain was accepted during training.

- Running activity was allowed

All 15 were back to preinjury levels with full running activity

Alfredson: AJSM '98



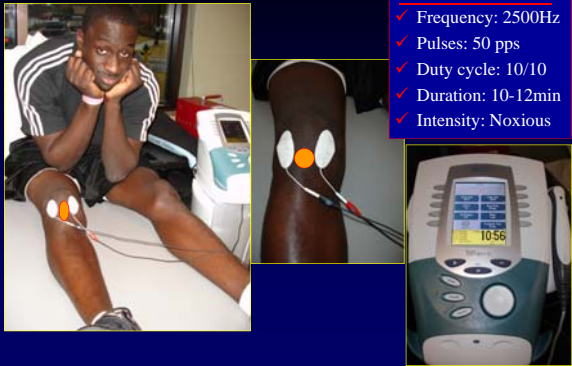
Blazina et al: Orthop Clin North Am '73

- I: Pain only after participation
- II: Pain with participation, but doesn't interfere with level
- III: Pain during / after participation, limits performance
- IV: Complete tendon rupture

Patellar Tendinosis

Treatment

- ✓ Heat
- ✓ Transverse massage
- ✓ Active warm-up
- ✓ Stretch (entire LE, esp quads)
- ✓ Pain stimulation*
- ✓ Strengthening program - eccentrics
- ✓ Stretch
- ✓ Laser
- ✓ HVS, compression, ice
- ✓ "level of acceptable pain" (5-6)



Specific Noxious Stim Parameters:

- ✓ Frequency: 2500Hz
- ✓ Pulses: 50 pps
- ✓ Duty cycle: 10/10
- ✓ Duration: 10-12min
- ✓ Intensity: Noxious


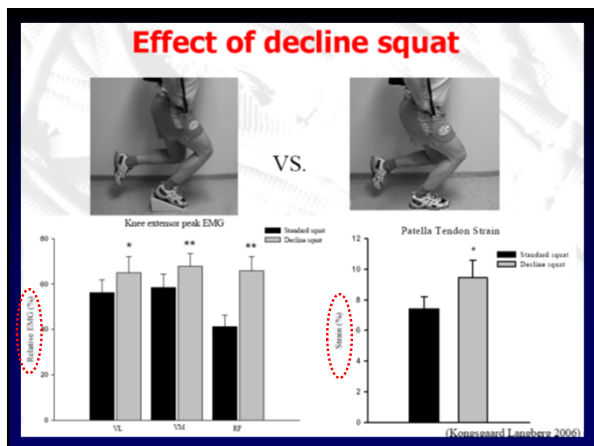


Patellar Tendinosis Eccentric Loading Program


II. Eccentrics (quadriceps)*
**use of pain stim*

Light -Moderate -Heavy Resistance
Slow resistance movements

- ✓ Eccentric Leg Press
- ✓ Eccentric leg extensions
- ✓ Front step downs
- ✓ Single leg decline squat
- ✓ Lateral step downs
- ✓ Single wall slides

Correct PF Biomechanics



Witvrouw et al: AJSM '01

- Intrinsic risk factors for patellar tendinitis (prospective study)
- 138 young adults (18 yrs) athletics
- Studied for 2 years
- 19 developed tendinitis
- Prospectively assessed anthropometric variables leg alignment, flexibility, & strength
- ✓ Positive correlation: *Quadriceps tightness*



Wilk, Arrigo, Andrews: 2015

- 24 patients with confirmed patellar tendinopathy by MRI (22 males)
- Average age 22.8 yrs (17-29 yrs)
- ✓ 91.6 % (22/24) returned to pre-injury level of sports
- Subjective reports:
 - » Minutes of play
 - » Quality of play
 - » Effectiveness (what % of 100% are you)

Rehab of Tendinopathies
Treatment



Rehab of Tendinopathies
Treatment



Tendinopathies in Sports
Conclusions

- ✓ Common lesion in sports (workplace)
- Difficult to treat – Challenging Lesion*
- ✓ Various Rx strategies for tendinopathies
- ✓ *Eccentric appears to stimulate healing response through collagen synthesis & remodeling – may require 12 weeks*
- ✓ **HSR (E/C)** effective for LE tendinopathies
- ✓ Pain is common with this lesion
- ✓ *Noxious pain stim* may assist & allow people to exercise with minimal pain

