Tendinopathy and Sports

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Department of Physical Therapy, University of Delaware

Goals and Objectives
- Review how tendon injury affects sports participation
- Challenge the concept of using pain and symptoms as the sole outcome for determining the ability to return to play
- Promote treating minor symptoms of tendinopathy early with "load control" instead of ignoring or just treating the symptoms
- Consider changes in sports performance as a possible sign of tendon overuse
- Describe a Return to Play program for Achilles Tendinopathy that also can be used as a guideline for other tendinopathies

Return to Play - Tendinopathy

- What is the goal of treatment?
  - Having no symptoms or return to previous performance level

Schematic illustration of pain and tissue damage in overuse tendinopathy (Leadbetter 1992)

Tendon’s importance for athletic performance

- The tendon saves energy
- The tendon improves explosive performance
- Sports utilize the tendon to improve performance

Tendon injury and performance

Pain
- The main symptom
- Experimental Achilles tendon pain causes changes in motor response (Hannksen et al. BJSM 2001)
- Indications of nervous system sensitization in persistent tendinopathies (Plinsinga et al. JOSPT 2015)
Tendon injury and performance
Changes in mechanical properties and performance

In Symptomatic subjects
- Tendinopathic tendons have lower tendon stiffness and elastic modulus (Arya et al JAP 2010, Child et al AJSM 2010)
- Altered Achilles tendon viscoelastic properties affect explosive performance in athletes (Wang et al SJMSS 2012)
- Altered stretch-shortening cycle behavior during submaximal hopping (Debenham et al JSMS 2014)
- Triceps surae activation is altered in runners with Achilles tendinopathy (Wyndow et al JKE 2013)

In Asymptomatic subjects (tendinosis and previous tendinopathy)
- Asymptomatic runners (previous Achilles tendinopathy) exhibit changes in knee kinetics during running, indicating permanent changes in knee biomechanics (Williams et al JOSP 2008)
- Achilles tendinosis result in a more compliant tendon (Chang & Kulig 2015)
- The compliant tendon elicit a series of neuromechanical adaptations (Chang & Kulig J Physiol 2015)

Schematic illustration of pain and tissue damage in oversue tendinopathy (Leadbetter 1992)

The problem starts before the “injury”
- Insidious onset – listen to early symptoms indications
- Training errors contributing in 60-80% of those with Achilles tendinopathy (Järvinen et al 2005, Kvist 1991)
- Greater mileage and running years in injured runners (Haglund-Åkerlid et al 1993)

Athletes balance on the edge of overuse to perform at an ultimate level
Treat “minor” symptoms of tendinopathy early with “load control” instead of ignoring or just treating the symptoms.

Change in performance could be early indication of tendon overuse
Elite Athletes
- Are they perpetual tendon over-loaders?
- Low levels of pain related fear?
**Tendon injury and performance**

**Pilot data**
- Mechanical properties evaluated with elastography in patients with Achilles tendinopathy
- Total work done on the heel rise test correlated significantly with the shear modulus on the symptomatic side ($r=0.78$)

**Return to Play - Tendinopathy**
Irrespective of treatment path or injury we end up with the same question

- How do we most efficiently Return an Athlete to Play?
  - How quickly should the athlete return?
  - For how long should the athlete be able to participate?
  - Performance state?
  - Symptomatic state?

**Achilles tendinopathy**

**Reinjury/Recurrence Rates**
- Return to sports after 12 weeks of treatment – 10–86% (Magnussen et al. 2009)
- Return to sport at 1 year – 55–99%
- Reinjury rates of Achilles tendinopathy in football players 27–44% (Gajhede-Knudsen et al. BJSM 2013, Hägglund et al. AJSM 2007)
- Recurrence common and reinjury risk high in elite football players with short recovery periods (Gajhede-Knudsen et al. BJSM 2013)

**Continued sports participation**
- No improvements in symptoms from the patellar tendon with eccentric exercise during the season for elite volleyball players

(Visnes et al 2005)
**PAIN-MONITORING MODEL**

Numerical Pain Rating Scale (NPRS)

<table>
<thead>
<tr>
<th>Safe zone</th>
<th>Acceptable zone</th>
<th>High risk zone</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>2</td>
<td>5</td>
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</table>

No pain | Worst pain imaginable

1. The pain is allowed to reach 5 on the NPRS during the activity.
2. The pain after completion of the activity is allowed to reach 5 on the NPRS.
3. The pain the morning after the activity should not exceed a 5 on the NPRS.
4. Pain and stiffness is not allowed to increase from week to week.

**Exercise – Comprehensive treatment protocol**

Exercise program
- Concentric and eccentric loading
- Divided into 4 phases
- Increasing speed of movement

**Home exercise**

**Training Diary**

<table>
<thead>
<tr>
<th>Week 1</th>
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<th>Physical activity</th>
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<tr>
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**Achilles tendinopathy rehabilitation**

Continued Sports Activity, Using a Pain-Monitoring Model, During Rehabilitation in Patients With Achilles Tendinopathy

A Randomized Controlled Study

Karin Grävare Silbernagel, MD, PhD, Bo Eriksson, MD, PhD, and Jan Karlsson, MD, PhD.

Exercise – Comprehensive treatment protocol

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Department of Physical Therapy
Return-to-Sport Program – Achilles Tendinopathy
Factors to consider when planning return to sports
• Tendon healing
• Tendon recovery
• Pain and Symptoms
• Impairments
• Load on the Achilles tendon
• Perceived rate of exertion

Silbernagel & Crossley JOSPT 2015

Tendon Healing
• Consider what stage of tendon injury-healing the athlete is in
• Full tendon healing can take up to 12 months (Kannus et al. SJMSS 1997)
• Mechanical loading is needed for tendon healing (Kjaer 2004, Kjaer et al. 2005)
• Age, hormonal levels, medication and genetics affect healing

Tendon recovery
• Achilles tendon loaded 6-12 times body weight with running
• If recovery between training sessions are inadequate it might lead to further injury instead of recovery
• Tendinopathy a result of collagen degradation occurring to a greater degree than collagen synthesis
• In humans, net increase in collagen synthesis first after 37-78 hours after a bout of exercise

Clinical implication
Plan for 3 recovery days between heavy Achilles tendon-loading activities

Tendon recovery


Overloading

Underloading

“Adequate loading”
**Pain and Symptoms**
- Allow for pain during the rehabilitation
- During the Return to play stage the pain might be absent during activity so important to assess the following day

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<tr>
<td>High risk zone</td>
<td>4, 5, 6, 7, 8, 9, 10</td>
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1. The pain is allowed to reach 0 on the NPRS during the activity.
2. The pain after completion of the activity is allowed to reach 0 on the NPRS.
3. The pain the morning after the activity should not exceed 2 on the NPRS.
4. Pain and stiffness is not allowed to increase from week to week.

**Progression of tendon load**
- Return to play is gradual progression in load
- Load on a tendon can be increased by load or speed of movement
- Walking loads the Achilles tendon 3.5 x body weight
- Achilles tendon loaded 6-12 x body weight with running
- Increased speed of running increases the load

**Progression of the load**
- Strike pattern (Almonroeder et al. 2013)
  - Rearfoot strike pattern loads the Achilles tendon less than forefoot or midfoot
  - Using forefoot or midfoot strike pattern added an additional load of 48 x body weight for each 1.6 km
- High breaking force during running a risk factor (Lorimer et al. 2014)
  - Using shorter step length could be beneficial
- Stiffer running surfaces was related to decreased injury risk

**How to individualize the load?**

<table>
<thead>
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<th>The athlete's rating of perceived exertion of the Achilles tendon</th>
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<tbody>
<tr>
<td>The Classification Schema</td>
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</table>
62 year old runner
Email 2 years after initiation of program
At start of program unable to run

"Been a very good summer. The best pain free, injury free summer in ten years. I did nine races this summer, eight sprint triathlons and one Olympic. Generally faster races than last year. Yesterday ran over ten miles with zero issues. One of the sprints I missed a transition area and ran barefoot for 5k in just over eight minute miles. Most of my races I am in the 8.45s range but did one in 8.12s and the 8.05s I mentioned. This is significantly faster."

Principles of Tendon Return-to-Sport program

- Progressively increase the demand on the tendon by controlling intensity, duration and frequency of Achilles tendon loading
- Continue with the rehabilitation exercises (tendon loading) during the return to sport phase (and continue for at least a year)
- Education – Easiest to educate about this phase when the athlete has a lot of symptoms
- Training diaries
- Initiate program early when athlete can perform activities of daily living with pain no higher than 2/10

Take home message

- Full recovery of tendon “function” important for performance and does not directly relate to symptoms
- Treat minor symptoms of tendinopathy early with “load control” instead of ignoring
- Consider changes in sports performance as a possible sign of tendon overuse
- Use the Return to Play program as a model to individualize for each patient

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Thank you!
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References:


