

# Power training (including Plyometrics) for Tendinopathies

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# Disclosure Statement:

- There is nothing to disclose

# Tendon basics related to athletes

## Achilles:

- The achilles tendon is exposed to loads of six to twelve times body weight (BW) when a person is running and jumping.<sup>1</sup>
- Hopping has been found to put the tendon under five times body weight load (BWL).<sup>1</sup>
- Even when walking the achilles tendon is subjected to three and a half times BWL but during cycling that number goes down to almost the same as BW.<sup>1</sup>
- Forefoot and mid foot striking patterns added an additional load of **48 times BW** for each mile ran.<sup>1</sup>

# Tendon basics related to athletes

## Patellar:

- Horizontal jumping has been found to put more load on the tendon and require greater posterior ground reaction forces than vertical jumping when landing.<sup>2</sup>
- The patellar tendon has been found to be subjected to over six times BWL during horizontal jumping and over five times BWL during vertical jumping.<sup>2</sup>

# Tendon basics related to athletes

## Proximal hamstring:

- The velocities of the LEs are very high before foot ground impact during sprinting.<sup>3</sup>
- Of note during the swing-stance transition moment the hamstrings, which counteract both external hip flexion and knee extension moments, support forces as high as eight times BWL!<sup>3</sup>

# Tendinopathies

- At this point you're aware that symptom reduction is feasible for tendinopathies via exercise therapy (particularly isometric, eccentric, and heavy slow resistance exercises)
- We have evidence that suggests even after a one year follow up of people who have had **\*\*\*full pain recovery\*\*\*** from Achilles Tendinopathy, as high as 75% of those individuals have reduced muscle–tendon function particularly during jumping.<sup>4</sup>
- It has been noted that re-injury for soccer players dealing with Achilles tendinopathy was more common following short recovery periods and in those who received no help/rehabilitation for the return-to-sport phase, compared with those who were given a standardized progressive exercise program that included resistance training during the return-to-sport phase.<sup>1</sup>
- Based on the current evidence available recovery from proximal hamstring tendinopathy can take 3-6 months and greater than 6 months for patellar tendinopathy.<sup>5</sup>
- A review on patient satisfaction in regards to exercise therapy for these conditions report generally positive perspectives particularly when the course of care is actually longer!<sup>6</sup>

# This brings up a question:

If

- 1) the forces put on tendons are so high during sports related activities such as jumping and running,
- 2) the function of athletes who are dealing with tendinopathies is typically not restored fully even with a significant reduction of pain,
- 3) patients with tendinopathies who do better generally are the ones who have longer rather than shorter courses of care including plyometric and return to sports oriented rehabilitation

then why wouldn't we logically consider that return to sport oriented/specific training should also be included as a standard in this process?

# More related to this topic

- The Dutch CPG for Achilles Tendinopathy recommend that plyometric and return to sport oriented training should be included in the later stages of tendinopathy rehabilitation.
- The University of Delaware's guideline for Patellar Tendinopathy includes a recommendation of a phase involving return to activity including plyometric activities that replicate training demands.
- Ohio State University's Tendinopathy guideline recommends an energy storage loading phase (including plyometrics) and return to sports training for the rehabilitation.
- Multiple other guidelines, reviews, and articles for LE tendinopathies recommend including sports specific training and plyometrics.<sup>1,5,6,11,12</sup>
- It should be initiated at a point when the patient has minimal to no symptoms (sources vary ranging from <5/10 to <3/10 on the NRS) and has developed adequate strength for their sport. For example Malliaras et al. 2015 suggest for jumping athletes with Patellar Tendinopathy one strength measure would be 4 sets of 8 reps of SL leg press at ~ 150% BW.<sup>8,9,10,12</sup>
- In regards to Achilles Tendinopathy sources have reported initiation criteria to include: minimal to no symptoms (ranging from <5/10 to <3/10 on NRS depending on the source), 20 dual leg jumps with minimal symptoms, and  $\geq 90\%$  LSI based on isokinetic/isometric dynamometer based testing.<sup>1,10,12</sup>



Okay, but what does that look like?



# Based on the available evidence

That would include progressions of jumping and explosive movements (essentially power training) which become increasingly sports specific to replicate the demands of the patient's sport.<sup>1,5,6,8,9,10,11,12</sup>

This may include...

# Track Drills (aka gentle plyometrics):



# Track options may include:

- A, B, or C skips
- Pogos and Broad Jumps
- Switches
- Bounding variations
- Sprints
- Resisted running variations (including sled and band resisted sprints)

# Other Jumping Drills working on shock absorption and jumping tolerance:



# Jumping options may include:

- Drop landing and drop jumps
- Rotational jumps
- Box jump variations
- Resisted jump variations
- Band assisted jumps

# Medicine Ball (Med Ball) Drills:

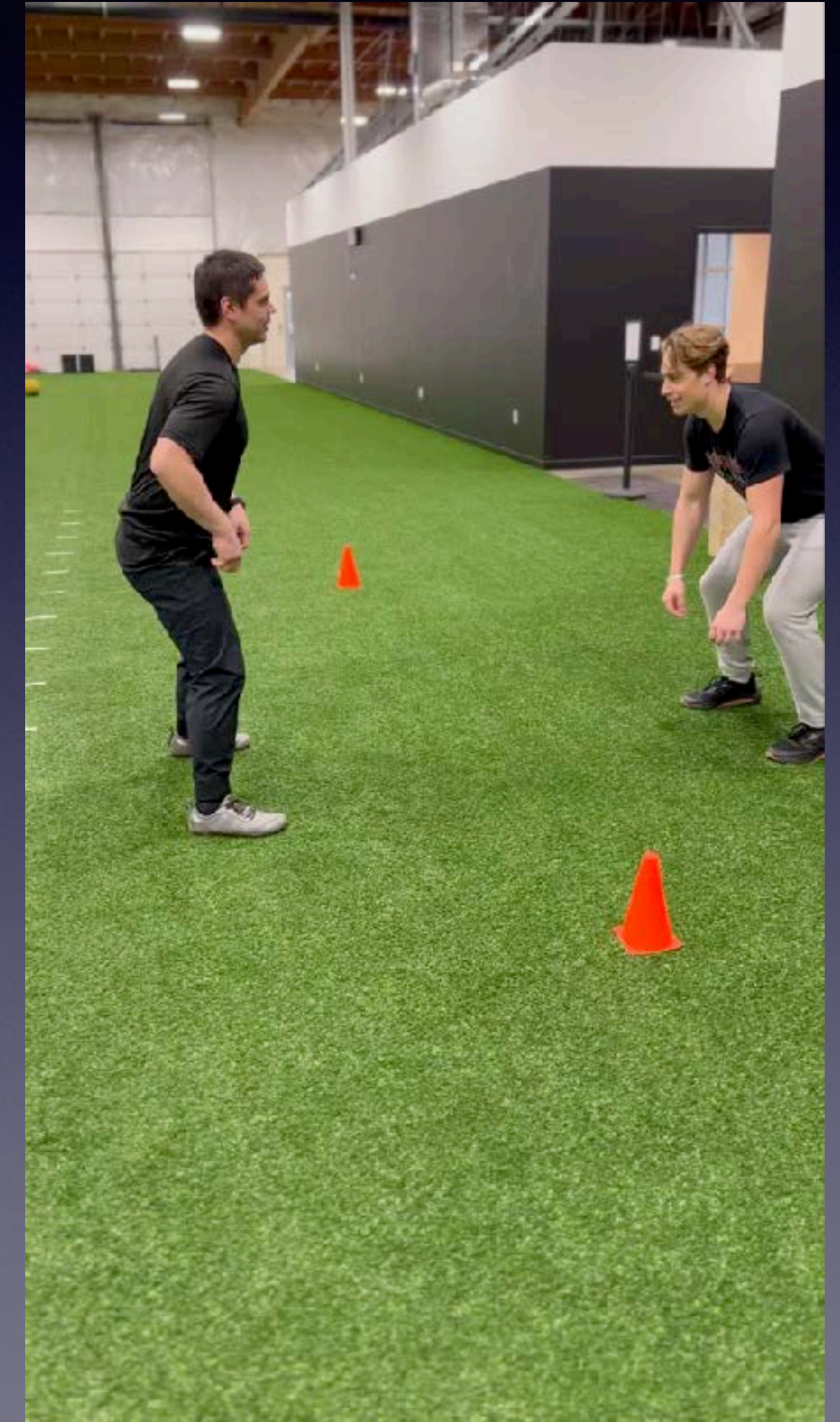


# Med Ball options may include:

- Overhead toss variations
- Backward toss variations
- Rotational throwing variations
- Med ball slam variations
- Combined toss and movement drill variations



# Different Reactive and Change of Direction Drills:



# Change of directions options may include:

- Rotational jump to run variations
- Drills involving curvilinear to straight line running
- Mirroring drills
- Sudden cutting and change of direction drills (including with sudden visual and cognitive stimuli)

# Explosive Resisted Movements:



# Explosive lifting options may include:

- Kettlebell swings, cleans, and jerks
- Olympic barbell drills including variations of the pull, jerk, clean, and snatch
- Banded barbell and trap bar drills emphasizing explosiveness
- Explosive Jammer arm drills

# Should this type of training also be included in post-operative LE rehabilitation?

- In regards to athletes, the answer is yes in most cases, two examples:
  1. ACL Reconstruction: often started when patients reach  $\geq 80\%$  quadriceps limb symmetry index (LSI) and at some point between months 3-6 of the rehabilitation process.<sup>13,14</sup> Other criteria to start that has been recommended includes 1.5xBW squat,  $\geq 85\%$  limb symmetry in terms of single leg squats,  $\geq 85\%$  ability to perform unilateral hop testing, and of course no reports of pain.<sup>15,16</sup>
  2. Achilles Tendon Repair: some guidelines suggest starting between weeks 13 and 16 citing no pain, 95% symmetry of DF & PF ROM compared to non-surgical LE, 95% calf circumference symmetry at 10 cm distal to tibial tubercle compared to non-surgical LE, 25 single leg heel raises (with heel height comparable to the uninvolved limb), Squat and lunge to 70° knee flexion without weight shift as criteria to initiate.<sup>17,18</sup>

Other sources, that are definitely far more conservative, suggest this phase starts at month 6+.<sup>19,20</sup>

# Summary

- Power training, especially sports-specific training, should be included in LE Tendinopathy rehabilitation for athletes just like it would after major surgical procedures such as ACL Reconstruction and Achilles Tendon Repair.
- This includes \*gradually progressing\* plyometric activities (skipping, hopping, jumping, running, and cutting in a variety of ways) and explosive resistance training (medicine ball and kettlebell/dumbbell/barbell based moderate to high velocity training).
- Criteria to start is based on reaching a certain point of symptom reduction in addition to adequate strength specific based on either functional activities (such as a very heavy SL leg press on the affected limb or repeated hopping with minimal pain) and isokinetic/isometric dynamometer based limb symmetry measures.

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