Treatment of tendinopathy often encompasses only rehabilitation, where the athlete is removed from training and competition and the tendon is progressively loaded through a rehabilitation program. This is costly in terms of time - for elite athletes time they may not have!

Keeping someone in training and competition with substantial tendon pain is more challenging, as control over the loads on the tendon is the remit of the coach and athlete. So, what are the key parts of managing tendinopathy in these athletes?

There are three key aspects of a plan: first the use of isometrics for immediate relief of tendon pain, second using other helpful exercises and adjunct therapies, third management of load on the tendon.

**ISOMETRIC EXERCISE FOR COMPETING ATHLETES**

Traditionally, isometric exercises are the first form of strengthening exercise used after injury or immobilization. One study showed a single resistance training bout of isometrics reduces tendon pain immediately for at least 45 minutes post-intervention and increases maximal voluntary isometric contraction. From a clinical perspective, wouldn’t it be great if isometric exercise trumped traditional pain-relieving methods and more importantly allowed you to do it in-season? In the era of evidence-based practice, we should always ask: “What about the evidence for this intervention?”

**Do isometric exercises reduce pain or pain perception?**

Evidence suggests that the magnitude of effect for isometric exercise-induced hypoalgesia in healthy individuals is moderate to large and the effect depends on the contraction location, intensity, or duration. Moreover, the effect size is larger for contractions held for longer durations, as high-threshold motor units need to be recruited to get the desired response. So far, so good! For patellar tendinopathy, 4-5 repetitions of 45 second holds at 70% of maximal voluntary contraction, have been shown to be effective. Interestingly, the relevance of isometric exercise for acute pain relief has been criticized based on conflicting evidence among a few studies in tendinopathy patients. Until now, ten studies have evaluated pain relief from isometric exercises in tendinopathies: one non-controlled prospective study in runners with Achilles tendinopathy, one randomised controlled trial (RCT) in patients with lateral epicondylalgia, one RCT in patients with plantar fasciopathy, one RCT in patients with rotator cuff tendinopathy, two randomized crossover trials, one randomized trial with repeated measures design evaluating different durations of isometric exercise in patients with patellar tendinopathy, one in-season prospective cohort study and two in-season prospective RCTs in jumping athletes with patellar tendinopathy. At a glance, variable results have been reported with some individual patients reporting increased pain with the isometric contractions and others finding significant benefit. However, variable levels of resistance and hold times were used, and the effect of these on pain relief is unclear.
Is it smoke and mirrors? – Maybe no, maybe yes

As physical therapists, we have a possible dilemma: is the literature overstating a claim? To our clinical knowledge, there is no single management approach (in our profession) that does or doesn’t work on all patients with a specific diagnosis. At this point, the idea of 95% confidence intervals become very important in terms of “success rate” of an intervention in other words “responders” to isometric exercises. Pearson et al. examined among other outcomes, the immediate effects of long- and short-duration isometric contractions on patellar tendon pain. The individual data presented indicates that 6 and 5 out of 8 patients with patellar tendinopathy responded in long- and short-duration isometric loading on pain on single-leg decline squat. By calculating the 95% confidence intervals, the range for the responders lies between 45-100% and 28-97% respectively. These calculations are affected by the sample size and the “nature” of the sample. Inferential statistics conform with assumptions and... Hey, wait a minute, we are clinicians, not statisticians. Every treatment session adopting a new or an old management approach is an “experiment”, you make a hypothesis and consequently test this hypothesis, something like research. We often treat patients that are the “typical patient” and occasionally patients that are better or worse than these “typical patients”. As a result, if you replicate the “experiment” you shouldn’t expect 75% or 62.5% of patients to respond to isometric loading, rather a range of responses that are expressed by the width of 95% confidence intervals. The evidence so far suggests this may be as low as 3 out of 10. Does it make sense? Yes, but what makes a patient “the typical patient”?

The “typical patient” is reflected by the interplay of several domains, such as clinical tests for diagnosis, concomitant issues, adequate application of management approaches in the clinical context, their profile across the psychosocial spectrum, the beliefs and the attitude of the therapist and many more. Currently, we decide on treatment strategies according to patients’ patho-anatomic diagnosis of some tissue pathology. Too often a diagnosis of tendinopathy is made based on imaging abnormality and pain on palpation; neither of these can diagnose tendon pain. These are often the inclusion criteria for research studies... thus research participants whose pain may be from another structure are failing to improve with isometric exercise. We do this despite the lack of good evidence that pathology is associated with symptoms. Many other factors contribute significantly to pain and disability. These factors include the patient’s fear and other beliefs, their levels of stress and sleep, their previous experience of treatment and injury to name just a few. Perhaps it’s not so surprising then that two patients with the same “pathology” might present with different levels of pain when these and other factors vary. Therefore, clustering patients based on a single domain (pathology) leads to a variety of treatment responses.

Hit and miss or trial and error for tendinopathy. Why not, if we do no harm?

Isometric exercises have been proposed as an interim step in tendinopathy management or as potential pain-relieving approach while continuing sport activities.
Three prospective studies\textsuperscript{10-12}, (including two RCTs) evaluated if isometric and isotonic exercises relieved pain in competing athletes with patellar tendinopathy. Isometric exercises delivered were either:

- 5 sets of 45 seconds single-leg isometric contractions at 80\% of maximal voluntary contraction with a knee joint angle of 60°, or
- 5 repetitions of a 30-second double-leg squat (as deep as possible) using a rigid belt.

Despite the protocol differences, the median pain score was decreased in the isometric groups from pre- to post intervention for every intervention session\textsuperscript{11} and over the 4-week intervention period\textsuperscript{10-12}. But the isotonic group also improved! What might the rationale be for using isometric exercises if they are not superior to isotonic exercises for acute patellar tendon pain relief? We will not give you the answer! You have to decide... you have to “hit and miss”. Clinical decision making is a process of applying knowledge and skills to a clinical situation, mainly based on reflection and metacognition. You might ask the question: “Is that fair enough?” The key point is that exercise in the acute stage, whether isometric or isotonic, is likely to have some benefit.

EXERCISE IN COMPETING ATHLETES

Besides isometric exercises to assist with pain management before training and games, it is essential to maintain other exercises to ensure that base strength and endurance are maintained. There is little evidence for exercise-based management of in-season athletes as randomized studies in this population are difficult, if not impossible, to do\textsuperscript{16}.

Tendon pain results in unloading, decreasing the strength, power and endurance in the entire kinetic chain. The athlete is exposed to energy storage and release loads as part of their ongoing training. The emphasis of exercise is therefore to maintain strength and endurance across the affected leg and on the healthy side.

The affected muscle tendon unit

Tendon pain can result in substantial strength deficits to the point of muscle wasting. Heavy (for that muscle), slow resistance training is essential and must be done as an isolated exercise on each leg. For example, the leg extension machine for patellar tendinopathy, standing and seated calf raises for the Achilles tendon, and hamstring curls for hamstring tendinopathy will focus on the affected muscle. Repetitions of around 8 and sets of 4 (i.e. around 30 repetitions overall) seem to offer the best strength option, with partial recovery between sets. The load must be sufficient, introducing muscle fatigue at the end of the sets that will make another quality set impossible.

Introducing these exercises in the weekly athlete training program can be challenging, as the strength program must adequately load the muscle. Strength exercises after training to allow for recovery for the next training session may be the best option; at least two strength sessions a week are necessary, and a third session will be helpful. Importantly the effect of cross-training means that exercising the same muscle on the unaffected side can promote strength in the affected side\textsuperscript{18}. Strength exercises are therefore done on each side and the load varied to ensure that the muscle is maximally loaded.

The kinetic chain

The rest of the kinetic chain also requires a program. For all lower limb tendinopathies, the calf muscle complex is a major absorber of landing loads and is an essential target for strength and endurance\textsuperscript{13}. It can therefore reduce the load on the affected muscle tendon unit. For tendons other than the Achilles, the calf muscle can be loaded fully, and specific exercises for the soleus (seated) and the gastrocnemius (standing) are required and must be completed on each side independently.

Hip strength is also required but is less affected in tendons below the hip (patellar and Achilles)\textsuperscript{19}.

Adjuncts to exercise

Any additional intervention that allows for maintenance of strength exercises can be used; muscle massage and contrast baths after strength work to allow better muscle recovery are encouraged. Interventions to the tendon may be provocative and should not be used unless the athlete reports substantial benefit over time.

LOAD MODIFICATION IN COMPETING ATHLETES

Combined with exercise-based rehabilitation, load modification is critical in managing tendinopathy. While many modalities and exercise protocols have been studied, ‘load management’ remains a vague concept and difficult to standardize in competing athletes across different sports.

So... what is training load and how is it related to tendinopathy?

Training load is defined by the combination of what an athlete is doing (external workload; i.e.: time, distance or power metrics) and how she’s reacting to that stimulus (internal workload; i.e.: heart rate, blood lactate or RPE)\textsuperscript{20}. Tendinopathy management tends to focus on external load modification.

Although high training loads are necessary in competitive sports, staying on the right side of the fine line between

Load plays a major role in tendinopathy but is just one of many potential injury risk factors in competitive sports.
Load spikes are the typical injury mechanism in tendinopathy. These spikes highlight a mismatch between tendon’s load capacity and load placed on the tendon. Tendons are especially sensitive to rapid load spikes, as they are known to have a delayed and slow response to load. Therefore, monitoring load throughout the season appears essential for preventing and managing tendinopathy in competing athletes.

**Then... what should we look at and how can we change it?**

Decreasing training load has traditionally been the first step for reducing mechanical demands on the tendon. This may address the problem in the short term but can also impair long-term tendon adaptation to the high training demands needed for performance.

One practical way of monitoring load changes in competing athletes is the acute:chronic workload ratio (ACWR), which expresses the proportion between the most recent load (i.e., last week’s load) and the chronic workload (i.e., rolling average of the last 4 weeks). Spikes in acute load have been associated with greater injury risk in several team sports and after injury, but nevertheless many methodological variables can affect the ACWR-injury relationship across different sports and injury types.

Although monitoring training load may have a place in tendon management, specific and one-off loads may also stress the tendon regardless of the overall training workload metrics. Addressing factors like training surface, athlete’s technical proficiency or potential sites of tendon compression (i.e. shoes or training equipment) may have more impact than short-term training load modifications or out of season training-exercise programs. Nevertheless, athletes need to be aware that even if addressing the key factor, there’s no quick tendon fix and any tangible improvement can take weeks or months.

Load plays a major role in tendinopathy but is just one of many potential injury risk factors in competitive sports. Knowledge of the intricacies of each sport is essential to identify the factors that impact on each specific case. Coaches and athletes are usually the ones providing the most valuable information, and their opinions and perception about training-related factors are critical.

**But... how does this translate into practice?**

The dichotomy with competing athletes is clear: on one hand we need to protect the tendon by avoiding high loads, but on the other hand the athlete needs to train hard to perform, and the better long-term adaptations in the tendon will occur with consistent exposure to high loads. So how do we do it?

1. **Progression** is the key in tendinopathy. Progressive training loads should be planned to avoid (if possible!) load spikes and long periods of rest. However, training and playing loads cannot always be tailor-made for an injured athlete (even less in team sports). It is often difficult to control factors that are intrinsic to the sport (e.g., tight competition calendars, contractual obligations or the pressure to perform on a certain date). Every detail must therefore be considered to build an achievable and progressive loading plan.

2. **Short-term gain = long-term pain.** For competitive athletes, the next competition is often the most important competition. It is usually possible to compete with most cases of tendinopathy. Therefore, one of the most common mistakes is for the athlete to compete and then to compensate with decreasing training load between competitions. This may be positive in the short-term (as the athlete is able to compete with less pain) but will cause de-training and decrease tendon capacity in the long term.

3. **Set priorities and adjust expectations.** Everyone needs to be on the same page, so sit down with the athlete, the coach and evaluate the competition calendar. Tendinopathy symptoms will probably remain for months, so important competitions and windows of opportunity for specific work need to be identified in advance.

4. **Monitor tendon response to load and identify patterns and harmful loads:** 'every time I do hurdles, I have pain the day after', 'if I leave 3 days between track sessions it feels much better' or 'if I run with spike shoes it gets sore for 2 days'. Small changes can have a significant impact.

5. **Expect the unexpected.** Our understanding of tendinopathy is still limited. While some tendons may benefit from rest, others will feel much better after very high intensity training. We should reflect and learn from each individual athlete with tendinopathy.

Planning training and competition loads that suit the individual athlete and coach, ensuring that training loads and specific exercise interventions are complementary to competition and addressing tendon pain without risking tendon integrity are the ideal way to manage tendinopathy in competing athletes.

**References**

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