Achilles tendinopathy: new insights in cause of pain, diagnosis and management
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Chapter 2

Outcome measures and assessment tools

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INTRODUCTION

Tallon and co-workers\textsuperscript{75} published a review of the outcome after surgery in patients with chronic Achilles tendinopathy and pointed at the deficiencies in outcome assessment and criteria. They recommended the use of outcome measures that were condition-specific, reliable, sensitive, and correlated with clinical severity.

OUTCOME SCORES – QUESTIONNAIRES

Many research studies have not used specific outcome measures validated for Achilles tendinopathy. Instead, many studies use patient-reported pain (on a Visual Analogue Scale) with tendon loading activity as a main outcome measure to determine the success of treatment. Sometimes, the investigators have graded the success of treatment based on patient-reported improvements\textsuperscript{1,41,45,51,76}.

To minimize the response bias, which can affect the patients’ reports of pain and symptoms, it is important to use outcome assessments in which the investigator has a minimal influence on the scoring\textsuperscript{12,75}. In many of the above-mentioned studies, it is difficult to judge how much the investigator could have influenced the results. Many studies include questionnaires relating to symptoms, physical activity, other treatments and previous injuries, but they are rarely specific standardized questionnaires. The lack of standardized outcome measures for Achilles tendinopathy caused previously difficulties when comparing treatment studies\textsuperscript{75}.

A performance test protocol and scoring scale for the evaluation of ankle injuries by Kaikkonen and co-workers has been used in a follow-up study of patients with Achilles tendinopathy\textsuperscript{25,49,50}. It includes both objective and subjective measurements and has been shown to have good reliability in healthy individuals and to be able to distinguish patients with ankle ligament injury from healthy individuals. However, its validity on patients with Achilles tendinopathy has not been evaluated.

Stanish and co-workers\textsuperscript{73} designed a system for tendon symptom classification (Table 1). This classification system has not been evaluated for reliability and validity, but it has been used as an outcome measure after surgery in patients with ‘achillodynia’\textsuperscript{56}.

The VISA-A questionnaire

In 2001, Robinson and co-workers\textsuperscript{55} developed a questionnaire as an index of the clinical severity of Achilles tendinopathy, the Victorian Institute of Sports Assessment – Achilles questionnaire (VISA-A). This questionnaire is based on a similar questionnaire for patellar tendinopathy\textsuperscript{79,80}. The VISA-A questionnaire is the first outcome measure designed specifically for Achilles tendinopathy. It has also been evaluated and shown to have good reliability
A factor analysis of the Swedish version of the VISA-A questionnaire (VISA-A-S) revealed that the questionnaire evaluated the two factors pain/symptoms and physical activity\(^{72}\). The VISA-A-S questionnaire also has been shown to have a large effect size indicating that it is responsive to clinically relevant changes\(^{71}\). The high responsiveness (as indicated by an effect size of 2.1) also indicates that the VISA-A-S questionnaire can be useful as an outcome measure in scientific studies.

When reviewing the literature we found that the VISA-A questionnaire had been used as an outcome measure in 19 studies on treatment for patients with Achilles tendinopathy\(^{9-11,15-17,39, 40, 53, 54, 57-59,65,69-71,77,78}\). Furthermore, the VISA-A questionnaire had been translated to Italian and Swedish, and these versions were also shown to be reliable and valid\(^{38,72}\).

The VISA-A is a self-administered questionnaire and provides an index of the clinical severity, which is easily followed over time, for patients with Achilles tendinopathy. The score ranges between 0-100, and a lower score indicates worse symptoms and greater limitation on physical activity. It can be used to compare different populations with Achilles tendinopathy and to facilitate comparisons between studies. In the clinic, the VISA-A questionnaire can be used to assess the clinical severity of the patient’s symptoms and provide a guideline for treatment, as well as for monitoring the effect of treatment. This score might be less valid for sedentary persons suffering from Achilles tendinopathy.

### The Foot and Ankle Outcome Score

The Foot and Ankle Outcome Score (FAOS) is a questionnaire that assesses patients’ symptoms, function and foot- and ankle-related quality of life\(^{60}\). The FAOS content is based on the Knee injury and Osteoarthritis Outcome Score (KOOS) and has been shown to have good content validity and reliability in patients with ankle injury\(^{60}\). It has, however, not been validated for patients with Achilles tendinopathy. When used as an outcome measure for patients with Achilles tendinopathy, it has been shown to be responsive to changes over time with treatment \(^{60,28,61}\).
FUNCTIONAL ASSESSMENT

Achilles tendinopathy appears to cause difficulties with physical activities in the active population, but exactly how it affects the lower leg muscle-tendon functions is not fully understood. Muscular strength, power, muscular endurance, flexibility and motor control are important in physical performance. The improvements of these factors are therefore often prescribed in rehabilitation and injury prevention programs for tendon injuries.

Strength

Strength measurements with dynamometry have been performed in patients with Achilles tendinopathy, in both etiological and prospective treatment studies. Isokinetic dynamometry has been used to test ankle plantarflexion and dorsiflexion strength both concentrically and eccentrically at various angular velocities such as 30°/s, 50°/s, 60°/s, 120°/s, 180°/s, and 225°/s. Paavola and co-workers measured the isometric strength of the lower limb in an isometric leg press dynamometer. Testa and co-workers measured maximum isometric muscle activation, as well as isometric muscular endurance, in patients with Achilles tendinopathy.

The various body positions described in the literature and used in the clinical setting to measure plantarflexion and dorsiflexion strength are supine with the knee and hip extended, sitting with the hip in 100-110 degrees of flexion and the knee in either 40 degrees or 90 degrees of flexion and a closed-chain position in which the measurement pad was placed on the knee. The reliability of isokinetic and isometric dynamometry is generally high, and the various testing positions for plantarflexion and dorsiflexion have good test-retest reliability. A test for measuring muscular strength and power of the ankle plantarflexion in a regular weight-training machine has also been shown to be reliable and valid for patients with Achilles tendinopathy. In this test, muscle power development, i.e. the ability to produce a high force quickly, was evaluated both concentrically and eccentrically-concentrically. The reason for evaluating muscle power was because power is considered to be more important for both sports performance and injury protection, than the ability to produce a high force. Patients with Achilles tendinopathy had a significant deficit on their injured side (or most symptomatic side) compared with their uninjured (or least symptomatic side) in both concentric and eccentric-concentric plantarflexion while standing.

It is, however, important to remember that strength tests are valid for measuring improvements in strength, but they are only moderately correlated to functional performance and need to be complemented with other types of functional assessment.

Endurance test

Muscular endurance testing is another type of muscle function measurement. In a heel-rise test (also called heel-raise, heel-drop or toe-raise), repetitive plantarflexion of the ankle is
performed on standing until fatigued. It is the most commonly used test for measuring the muscular endurance of the calf musculature. The normal number of heel-rise repetitions on one healthy leg is regarded to be approximately 25, but it can range from six to 70 in healthy individuals. The testing position for the subject is standing on one leg while maintaining a straight knee, support with the fingertips for balance and avoiding body sway forward. This test has been used in several research studies and has shown good reliability (ICC 0.78-0.84). The heel-rise test has been used in evaluations of patients with Achilles tendon ruptures, as part of a scoring scale used for patients with Achilles tendinopathy and in prospective studies of Achilles tendinopathy. Even though heel-rises are often prescribed during the rehabilitation of Achilles tendinopathy, they are not commonly used to evaluate the effect of treatment. One study found no significant deficit on their injured side (or most symptomatic side) compared with their uninjured (or least symptomatic side) on the toe-raise test. Since the treatment for Achilles tendinopathy include toe-raises, the test is useful to evaluate the effect of treatment and improvements in heel-rise endurance with treatment has been found in patients with Achilles tendinopathy.

**Jump tests**

Various jump tests are often used to evaluate function in patients with lower extremity injuries, as well as to evaluate functional performance in athletes. High loads occur on the Achilles tendon during activities during which the so-called stretch-shortening cycle (SSC) is utilized. The SSC is a combination of an eccentric muscle action (with lengthening of the muscle and tendon) immediately followed by a concentric muscle action (shortening of the muscle-tendon complex). The concentric force production will be higher when preceded by an eccentric muscle action compared with a pure concentric muscle action. Achilles tendon elasticity is important to store and release energy during the SSC, and thereby improves the economy and performance of motion. Changes in lower leg functions such as muscle-tendon strength, endurance, flexibility and motor control could all affect the various mechanisms in the SSC, and these changes might be etiological factors for the development of Achilles tendinopathy.

Jump tests such as counter-movement jumps (CMJ), squat jump (SJ) and hopping have been used to evaluate the loading of the Achilles tendon. CMJ and SJ are vertical jumps where the jump height is used for evaluation. In the CMJ, the starting position is upright whereas for the SJ the starting position is with the knees bent. Hopping is a continuous rhythmical jump, similar to jumping rope and here the contact times and flight times are usually evaluated. A drop counter-movement jump (Drop CMJ) is performed jumping down from a box/step and directly on landing performing maximal vertical jump. This type of jump is often used in training to improve jumping ability in athletes and it also places high
demands on the ability to utilize the SSC. One study on patients with Achilles tendinopathy found significant deficit in hopping and Drop CMJ on their injured side (or most symptomatic side) compared to their uninjured (or least symptomatic side) but this was not found on the CMJ\textsuperscript{69,70}. Another often used jump test is the one-legged hop for distance and it has also been used in a prospective study to identify intrinsic risk factors for Achilles tendon overuse injury\textsuperscript{42}. Even though Achilles tendinopathy is thought to be related to running and jumping, there are only a few prospective treatment studies that have evaluated the patient’s recovery in terms of jumping ability.

**CONCLUSION**

Thorough history taking and clinical examination are essential in diagnosing Achilles tendinopathy. Although our findings suggest that imaging adds little information of use for expert sports medicine clinicians in diagnosing tendinopathy, it is useful in preoperative planning and possibly for less experienced clinicians, who are unsure of their diagnoses and unfamiliar with subjective outcome measures.

Achilles tendinopathy causes not only pain, symptoms and difficulty with physical activity but also impairments in various aspects of lower leg function. It is therefore important to continuously evaluate the patients’ progress with both validated subjective scoring systems, such as the VISA-A questionnaire, and with various validated functional tests. Also the patients’ reported subjective pain and ability to return to previous physical activity and sports are important outcome measures. Proper evaluations with validated tests are not only for scientific purposes, but also of importance to the practitioner and the patient to follow the progress with treatment and rehabilitation.
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