LOWER EXTREMITY REVIEW

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Strategies for rehab after Achilles tendon surgery

At the Palo Alto Foundation Medical Group, rehabilitation following operative repair of Achilles tendon ruptures is based on three key evidence-based criteria for return to activity and selective use of an anti-gravity treadmill to accelerate that return.

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Achilles tendon surgery for both acute ruptures and chronic tendinopathy is common. Unfortunately, standardized protocols for rehabilitation and rating systems to assess postoperative outcomes are not universally employed, which has led to variability in published outcomes.

Many researchers have found persistent atrophy and weakness of the involved limb, particularly in athletes attempting to return to sports. Olsson et al found that 2 cm of calf atrophy persisted two years post-Achilles rupture repair, while Kangas et al found significant tendon elongation with variable postoperative regimens.[1,2] This atrophy is likely due to persistent weakness and loss of function. Elongation leads to loss of propulsion. This can be an issue even for nonathletic patients who simply want to do activities of daily living "on time," i.e., returning to tasks such as walking, driving, shopping, and work.

Because of these issues, the Achilles rehabilitation criteria my colleagues and I use at the Palo Alto Foundation Medical Group include regaining calf strength, range of motion, and girth. We described these criteria in a 2011 paper in the *Journal of Foot & Ankle Surgery*.[3] In this study we reviewed 219 patients who had surgery between 1990 and 2003 and calculated their return-to-activity (RTA) time frames. Patients who were unable to meet all three criteria were statistically unlikely to return to activities within the typical RTA time frame for their given procedure (Table 1).

Table 1:
Time frames for various Achilles procedures

Surgical Procedure	Return to Activity (weeks)	Number of surgeries (n=219)
Peritenolysis	6.5 ±2.8	30
Debridement	14 ±4.7	43
Excision of insertional calcification with tenodesis	17.7 ±5.9	73
Retrocalcaneal exostectomy with tenodesis	20.5 ±10.7	39
Repair of acute rupture	21.8 ±4	27
Repair of chronic rupture	31.6 ±7.8	7

Source: Saxena A, Ewen B, Maffulli N. Rehabilitation of the operated Achilles tendon. J Foot Ankle Surg 2011;50(1):37-40.

I coined the term “decreased desired activity” (DDA) level, along with RTA, in a 2000 *JFAS*article.[4] DDA is often a significant issue for patients with a number of conditions, including those not involving the Achilles tendon, but this is not documented often. Furthermore, when looking at any study that compares outcomes for different interventional approaches, for example, surgical versus nonsurgical treatment or open versus percutaneous techniques, one has to take into account patients’ activity levels (i.e., sedentary, active, or athletic) as well as their activity-related goals.[4] Studies often lack this information.

Investigators should control for activity level in studies of surgical procedures, along with numbers of surgeons and surgical technique. In studies of the Achilles tendon specifically, controlled variables should include immobilization protocols, nonweightbearing status, sex, age, and activity level. For an athlete, for example, achieving freedom from pain during activities of daily living (ADLs) but being unable to return to sport would be considered a poor result.

One of the greatest sources of frustration for patients and practitioners is the length of time required for complete healing and RTA after Achilles tendon surgery. Our *JFAS* article documented timeframes for various Achilles procedures[3] (Table 1). When considering surgical rehabilitation of any body part, one must know the typical RTA, along with restrictions, such as immobilization time (Table 2), and take note of the wide time ranges. Previous studies also show women often take longer to return to activity than men.[5-7]

Most of the evidence for Achilles rehabilitation comes from studies of nonoperative management of Achilles tendinopathy, e.g., eccentric strengthening.[8-12] This form of strengthening, described by Alfredson in 1998,[13] has not been critically studied in the postoperative setting. Don et al showed postoperative deficits even at two years after complete Achilles rupture repair.[14] It is critical for patients to re-establish concentric strengthening, as has been verified by many authors, particularly in the rehabilitative field.[15-17]

Eccentric training may be easier for postoperative patients (since they lack the strength to unilaterally heel-raise on the operative limb), but should be avoided as these maneuvers are likely to damage healing tissue in the immediate postoperative time frame, defined as ≥3 months after surgery.[1,2,6,20]Note that peritenolysis does not involve incisions into the tendon, so it’s appropriate to include some introduction to eccentric exercise after patients achieve pain-free concentric

exercise.[3,5,6,19-20] Early weightbearing and range of motion play a role in Achilles repair, however, wound protection is the more critical factor in the first three weeks after surgery.[1,2,22,24]

We are also studying ways of speeding up RTA by using an Alter-G treadmill (AGTM), as described in a pilot study published in the September/October 2011 issue of *JFAS*.[21] This treadmill, which provides buoyancy similar to that of swimming pool/aquatic therapy training, can allow for strengthening without full weightbearing. The AGTM reduces a patient's bodyweight as much as 80% by blowing air in a vacuum-sealed air chamber up to the patient's waist (see figure, next page). This "de-weights" the patient's lower extremity much like a waist-high swimming pool, but avoids the need for a pool/tank and means patients don't have to change clothes and aren't affected by weather conditions, proximity to an appropriate facility, and other issues.

Because the patient is able to engage the neuromuscular system sooner with a lightened bodyweight this may speed up RTA timeframes.[21] Earlier weightbearing in general has been shown to be helpful for most lower extremity injuries as long as physiological detriment does not occur.[16,19,20] Maffulli and colleagues found no detriment to early weightbearing at one versus three weeks post-Achilles repair.[22, 23]

Altered outcomes

Table 2:
Typical postoperative immobilization

Surgical Procedure	Nonweightbearing in BK cast/boot (weeks)	Weightbearing in boot (weeks after nonweightbearing)
Peritenolysis	1.5	0.5-1 (discontinue 2 wks postop)
Debridement	2	2-4 (discontinue 6 wks postop)
Excision of insertional calcification with tenodesis	4	6 (discontinue 10 wks postop) night-splint to avoid dorsiflexion until 4 wks
Retrocalcaneal exostectomy with tenodesis	4	6 (discontinue 10 wks postop) night-splint to avoid dorsiflexion until 4 wks
Repair of acute rupture	2-3	3-5 (discontinue 6-8 wks postop) night-splint to avoid dorsiflexion until 4 wks
Repair of chronic rupture	3-4	4-8 (discontinue 8-12 wks postop) night-splint to avoid dorsiflexion until 6 wks

Note: All patients except those who undergo peritenolysis have their foot in an equinus/plantar flexed position while nonweightbearing and then utilize a 1-inch heel lift that is progressively lowered during the weightbearing phase.

Our pilot study found that use of an AGTM resulted in faster RTA for patients. The pilot study included two similar cohorts of eight Achilles tendon surgery patients. Each group utilized the same rehabilitation protocols, including formal physical therapy sessions twice a week for six weeks; one group also utilized the AGTM as part of their rehabilitation. This group's RTA was faster than that of the group not using the AGTM, but this difference was not statistically significant (P=.27), most likely because of the small sample size. We excluded elite athletes (because they participate in therapy more frequently than individuals) and older (>60 yrs) and younger (<20 yrs) patients. We also found

that a patient being able to run at 85% of bodyweight was an acceptable criterion for releasing the patient to run at full bodyweight.

Our typical postoperative Achilles rehabilitation schedule for specific repair types is: At week one, patients may use a stationary bicycle with a boot or cast, placing their heel on the pedal only after resolution of postoperative pain and swelling. At week two (for
Achilles peritenolysis and debridement), week three (for Achilles rupture repair), or week four (for Achilles insertional repair and tendon transfer) patients begin nonweightbearing ankle range of motion (ROM) and strengthening (inversion, eversion, and plantar flexion) with surgical tubing or towel; dorsiflexion is performed initially with only Achilles peritenolysis patients. (Dorsiflexion gains with other Achilles tendon procedures are eventually made by using other strengthening regimens such as one-quarter squats.)

Clinicians and patients should be aware that wound complications can manifest four weeks postsurgery and beyond. In a 2008 study of 219 Achilles tendon surgeries, we found that suture granulomas can occur in a delayed fashion and that, overall, 7.3% of patients experienced wound complications.[24] Suture reactions can occur with both absorbable and nonabsorbable sutures and may resolve with local wound care or require incision and drainage/excision.

Alter-G treadmill

Physical therapists typically do an initial evaluation at week two for Achilles peritenolysis, week four for debridement, weeks six through eight for rupture repair, and weeks eight through 10 for Achilles insertional repair and tendon transfers. Following all procedures except Achilles peritenolysis (since the tendon itself is unaffected) patients wear a 1-inch heel lift for the first two to four weeks of weightbearing to avoid a drastic change from the equinus or plantar flexed positions that are required during the nonweightbearing postoperative period. Patients are weaned out of their heel lifts

over subsequent weeks, and sometimes months, based on how well they ambulate without the lifts. Overly aggressive cessation, however, may lead to tendon overlengthening.[25]

In addition, bilateral heel lifts of equal height are recommended to avoid imbalances, even in patients with unilateral repairs. Although Maffulli and colleagues did not find any detriment, such as rerupture or overlengthening, with early weightbearing, even as soon as one week post-Achilles repair, we tend to use the more conservative period of two to three weeks of nonweightbearing. Note that initially the repaired tendon will be smaller than the nonoperated side, but will subsequently experience hypertrophy as weightbearing and strengthening progress.

Time frames for starting formal physical therapy (PT) tend to correlate with those for phasing the patient out of the cast boot. Note that a patient should not bear weight out of the boot until they are weightbearing pain-free in the boot. Having patients begin a home program utilizing a stationary bike and strengthening exercises before the start of formal PT maximizes patients' insurance coverage by improving the cost-benefit ratio.

PT protocols

The first PT visit typically includes evaluation of lower extremity ROM and of deficits such as weakness in gait and heel raise, pain, and swelling. Therapy includes ankle-joint mobilization; cross-friction massage of the incision site and posterior ankle; seated calf stretch; introduction of single-limb proprioception (balancing on the affected limb); bilateral concentric heel raises (first seated, then in a pool or with an AGTM or supported bilaterally on land); home instruction; and cryotherapy using an ice water bath for twice a day for 15 minutes (gel packs are not used as they can cause cold injuries).[18] The typical therapy session lasts 45 minutes or more.

Table 3:
Sample concentric heel-raise progression with knee straight (performed on successive days if pain-free):

3 sets of 10 repetitions, single-legged, pain-free
4 sets of 10 repetitions, single-legged, pain-free
5 sets of 10 repetitions, single-legged, pain-free
3 sets of 15 repetitions, single-legged, pain-free
4 sets of 15 repetitions, single-legged, pain-free
5 sets of 15 repetitions, single-legged, pain-free
3 sets of 20 repetitions, single-legged, pain-free
4 sets of 20 repetitions, single-legged, pain-free
5 sets of 20 repetitions, single-legged, pain-free
3 sets of 25 repetitions, single-legged, pain-free
4 sets of 25 repetitions, single-legged, pain-free
5 sets of 25 repetitions, single-legged, pain-free

Source: Saxena A, Ewen B, Maffulli N. Rehabilitation of the operated Achilles tendon. J Foot Ankle Surg 2011;50(1):37-40.

In subsequent weeks, therapy consists of soft-tissue massage to the calf muscle and posterior ankle tendons; mobilization of the ankle and subtalar joints; gluteal/core strengthening (one-quarter squats); stationary biking without a boot; modalities such as therapeutic ultrasound and electrical

stimulation, if needed; unilateral concentric strengthening of the lower leg at 50% to 70% of bodyweight using the AGTM; and walking for 10 minutes on AGTM at 50% to 70% of bodyweight.

Over time, patients use progressively more difficult single-limb strengthening exercises (Table 3). Initially, heel raises are done with the knee straight; patients progress to performing them with the knee bent and with variations in foot position, (e.g., internally and externally rotated). Patients move to walking at 70% of bodyweight for 10 minutes and increase their home program strengthening. The rehabilitation strategy outlined in Table 3 (pain-free at a certain bodyweight or number of repetitions) allows patients to progress from double-limb to single-limb heel raises (starting with 3 sets of 10 reps, progressing to 5 sets of 25 reps).

With the AGTM strengthening can progress from 70% to 90% of bodyweight and to walking up to two miles at 70% of bodyweight. Depending on patients' individual progress, exercises can include dynamic balancing; step downs; calf eccentrics (if patient is pain-free); lunges; Bosu ball squats; single-leg heel raises (full bodyweight); and leg presses. Objective measurements using our criteria can be assessed as a patient approaches the typical RTA for the procedure.

Our 2011 study showed patients must meet the following three criteria to ensure a safe return to activity:

1. Able to perform five sets of 25 single-leg heel raises with the knee straight, with 15 seconds rest between sets. The patient should avoid compensation (such as pushing down against a supporting table or using hip flexion to raise the heel).

2. Have an operative limb calf circumference within 5 mm of the uninjured limb, as measured 10 cm distal to the tibial tuberosity (shorter patients or children can be measured at 7 cm distal).

3. Have ankle dorsiflexion and plantar flexion (total) ROM on the operative limb within 5° of the uninjured limb.

These criteria are easier to document than other measures, such as the VISA-A score (Victorian Institute of Sport Assessment-Achilles) validated by Robinson et al.[26] Although not all rehabilitation programs have access to an AGTM, we have also found that once a patient can run on the AGTM at 85% of bodyweight for 10 minutes, it is safe to release them to run outside.[19] Before releasing patients for outdoor running we generally begin a walk/run program (two minutes of walking alternated with two minutes of running) followed by progression to the AGTM to 75% to 85% of bodyweight for 10 minutes. Other sport-specific training is also introduced before release, though throwing while balancing for ball sports can be initiated as soon as patients can bear their full body weight comfortably.[27] Patients are typically discharged after four to six weeks of therapy with a home program of strengthening, proprioceptive exercises, stretching, and cryotherapy, which they are instructed to maintain until they can return to their full activity level.

Further study of accepted patient rehabilitation protocols after Achilles tendon surgery is needed. Other modalities besides the AGTM, such as soundwave or radial pressure waves, may help with

rehabilitation in the postoperative setting, and this is currently being studied with rotator cuff surgery.[28]

At our Palo Alto center we have now used our assessment criteria for the rehabilitation of almost 400 patients who have undergone Achilles repair and feel confident in its efficacy and in its ease of use. Larger, prospective, randomized studies are needed, however. We hope our studies will stimulate more review and research to improve patient outcomes.

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