Rehabilitation – How can the load building be controlled after an Achilles tendon rupture?

1. Background information – Achilles tendon rupture
The Achilles tendon (AT) is the strongest tendon of our body. It connects the gastrocnemius, soleus and the plantaris muscle to the heel bone [1] and functions as a transducer of force and an energy buffer. Rupture of the AT results from augmented forces or degeneration [10]. Since it is the most common tendon rupture of our body [1], it is important to understand which rehabilitation options are available. The purpose of this summary is to create a brief review of different papers that focus on the different treatment possibilities for AT repair. In addition we would like to outline the factors we think may be associated with the healing of the tendon and what kind of approaches exist today.

2. Treatment after Rupture
The rupture of the Achilles tendon can either be treated operatively or non-operatively [13]. The opinions regarding the treatment of choice are diverse. Depending on the patient’s medical history and location of the AT rupture the treatment varies. Ruptures of the tendon at border to the fleshy calf muscle or patients with risk factors for wound healing (diabetes mellitus, tobacco use, steroid use and obesity) are treated conservatively [4, 14]. On the contrary when the rupture occurs at the bony insertion close to the heel, surgery is recommended (according to discussion with local orthopaedic surgeon). Operative repair of a ruptured AT can be accomplished with a variety of techniques, ranging from open repair, minimally invasive technique, to endoscopic-assisted repair. Open surgery increases the risk for infections, while minimal invasive and percutaneous surgery lower this risk and further improve aesthetics [3, 6, 15]. Open surgical repair of acute Achilles tendon ruptures significantly reduces the risk of re-ruptures when compared with non-operative management [20]. However, the study by Willits favours accelerated functional rehabilitation and non-operative treatment for acute Achilles tendon ruptures. In this study all measured outcomes of non-operative treatment were acceptable and clinically similar to those for operative treatment [21].

3. Rehabilitation programs
Rehabilitation is an important aspect in the treatment of Achilles tendon ruptures aiming for an early restoration of the pre-injury activity level [5]. With functional rehabilitation it was even possible to achieve similar re-rupture rates but lower complication rates following non-operative treatment than after operative treatment [8]. Additionally, rehabilitation should try to minimize atrophy of the gastro-soleus complex which could lead to gait abnormalities [12].

3.1 Immobilization
Depending on the severity of the rupture and on the preferences of the patient and doctor, an immobilizing cast should be worn either after the surgery or directly after the rupture. The position of immobilization depends on the gap or the overlap between the two ends of the tendon. This has to be determined by an ultrasound scan, where the knee and the foot have to be flexed and extended. Choosing the best immobilization-position is important for the healing process [9].

After keeping the foot in this optimal position, a stabilization by functional orthoses in 20° to 30° degrees plantar flexion follows. Some rehabilitation protocols report a decline in the plantar flexion angle to the neutral position during immobilization [9, 1], allowing more freedom until the cast or boot can be removed [9].

3.2 Functional Rehabilitation
Instead of immobilization there are several different functional rehabilitation protocols. The early functional rehabilitation attempts differ in the allowed range of flexion, whether daily movement is permitted, the amount of weight-bearing, the type of orthotic that is used and how long it has to be worn [12].

The aim of functional rehabilitation is the earlier restoration of pre-injury activity level [5], prevention of atrophy of the gastro-soleus complex and consequently gait abnormalities [12]. These potential benefits have to be weighted against the bigger possibility of re-rupture and tendon elongation caused by overloading the Achilles tendon.

3.2.1 Controlled early mobilization
Mobilization can either be achieved with a dynamic brace, allowing movement of the ankle, or with a fixed but removable brace, where the patient has to remove the brace to do mobilization exercises [1].

Early mobilization rehabilitation protocols were assessed in different reviews. Brumman et al. (2014) showed, that immediate free plantar flexion but restriction of the dorsiflexion at 0°, showed a significantly shorter time for returning to work and sport. Another review showed almost no advantages of early mobilization compared to
3.2.2 Controlled early weight-bearing
Protocols with early weight-bearing include full weight bearing while the ankle is immobilized in different positions. The immobilization with protective equipment like orthoses is crucial and the foot position gets shifted from plantar flexion to the neutral position within 3.5 weeks on average [8]. Barfod and Einstein (2014) showed in their studies that early weight-bearing is safe and improves quality of life during treatment [1]. In another review, significantly higher patient satisfaction and earlier return to pre-injury activity was observed with early weight-bearing [5].

3.2.3 Controlled early mobilization and weight bearing
Rehabilitation with early weight-bearing and early mobilization, also called combined functional treatment, shows very promising results. Brumann et al. (2014) showed higher satisfaction, less rehabilitation resources, earlier return to pre-injury activities and better functional results with combined functional treatment compared to immobilization. Early weight-bearing together with mobilization was also found to result in a higher possibility of normal ankle range of motion, less minor complications like abnormal sensation and less Achilles tendon elongation after treatment [8]. The higher patient satisfaction was probably achieved by the minimized disability in daily living [16] because of less use of crutches and a greater heel-raise ability [8].

Until now, studies with more progressive rehabilitation protocols always showed superior results without increasing complication rate [5]. Therefore even more accelerated protocols with as early weight-bearing and mobilization as possible should be evaluated to define the best combined functional treatment [5].

4. Outcome measures/assessments
Often an isokinetic dynamometer is used to measure the rehabilitation-process [1, 13, 17]. Outcome measures are the tendon stiffness, peak passive torque, energy stored during loading (= absorbed energy by the plantar flexor-muscle-tendon complex), torque relaxation (= shock absorbing quality) and the dissipation coefficient (= energy released compared to energy stored) [1]. In addition, the calf muscle strength and endurance [2, 3, 5, 7, 8, 13, 16, 17, 18], the assessment of the range of motion (ROM) in the ankle [16, 17] and the change in tendon elongation over time [16, 18] are recorded comparing the affected vs. healthy foot. During the rehabilitation process the change in the amount of calf muscle atrophy [8, 11, 16, 17, 19], the re-rupture rate [2, 7, 8, 9, 17, 19] and minor/major complications such as infections or deep venous thrombosis [8, 11, 18], and diverse physical activity levels [2, 11, 18] can be reported. The interpretation of X-Ray, MRI and ultrasonography pictures of the tendon as well as electromyography can also be part of the outcome measures [1, 9, 10].

Frequently used scores/scales for assessing Achilles tendon rehabilitation are: Leipipälahti score [10, 12, 13, 17], Achilles tendon Total Rupture Score (ATRS) [2, 3, 5, 9, 18], Achilles Repair Score (ARS) [9], Physical Activity Scale [11], Foot and Ankle Outcome Score [2, 17], Short Form-36/Rand-26 Questionnaire [1, 11, 16]. They include either observing of several parameters, like the ones mentioned before, different rating of the rehabilitation process by the patient himself, or both [1, 18, 19].

5. Conclusion
As Suchak et. al. [19] mentioned in their meta-analysis (2006), the optimal postoperative rehabilitation protocol is unknown. Therefore different opinions on whether to follow a mobilization, early weight-bearing or immobilization rehabilitation protocol coexist. Some studies clearly support early mobilization [18, 11], while others do not really see a difference, especially in the long-term [19]. Suchak et. al did the first meta-analysis of randomized studies, comparing the traditional immobilization protocol with an early functional protocol and stated that patient satisfaction can be improved with an early functional protocol without increasing the occurrence of re-ruptures, infections or minor complications [19].

Due to all of the facts and the big amount of information found in the literature we conclude that there exists no ‘best way’ to treat an Achilles tendon rupture. In general we think that it might be preferable to start with mobilization of the ankle and weight-bearing as soon as possible after the injury. Furthermore in our opinion the rehabilitation program depends extremely on the location of the rupture, the doctors’ interpretation of the injury as well as on the possibilities of the therapist. It is also important to know details about the patients’ characteristics concerning further diseases that could impair the rehabilitation process and to adapt the program to his plans for the future.
6. Literaturverzeichnis