Achilles tendon rupture: the evaluation and outcome of percutaneous and minimally invasive repair.

Akademisk avhandling

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av

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- I. Carmont MR, Silbernagel KG, Nilsson-Helander K, Mei-Dan O, Karlsson J, Maffulli N. Cross cultural adaptation of the Achilles tendon Total Rupture Score with reliability, validity and responsiveness evaluation. *Knee Surg Sports Traumatol Arthrosc* 2013;21(6):1356-1360.
- II. Carmont MR, Heaver C, Pradhan A, Mei-Dan O, Gravare Silbernagel K, Surgical Repair of the ruptured Achilles tendon: the cost effectiveness of open versus percutaneous repair. *Knee Surg Sports Traumatol Arthrosc* 2013;21(6):1361-1368.
- III. Carmont MR, Silbernagel KG, Edge A, Mei-Dan O, Karlsson J, Maffulli N. Functional Outcome of Percutaneous Achilles Repair: improvements in Achilles Tendon Total Rupture Score during the first year. *Orthop J Sports Med* 2013;1(1):325967113494584
- IV. Carmont MR, Silbernagel KG, Mathy, Mulji Y, Karlsson J, Maffulli N. Reliability of Achilles Tendon Resting Angle and Calf Circumference measurement techniques. *Foot Ankle Surg.* 2013;19(4):245-249.
- V. Carmont MR, Silbernagel KG, Brorsson A, Olsson N, Maffulli N, Karlsson J. The Achilles tendon resting angle as an indirect measure of Achilles tendon length following rupture, repair and rehabilitation. *Sports Med Arthro Rehab Tech* 2015;2:49-55.
- VI. Carmont MR, Zellers JA, Brorsson A, Olsson N, Nilsson-Helander K, Karlsson J, Grävare Silbernagel K. The functional outcome of Achilles tendon minimally invasive repair using 4- and 6-strand nonabsorbable suture. *Orthop J Sports Med* 2017 5(8):2325967117723347
- VII. Carmont MR, Kuiper JH, Grävare Silbernagel K, Karlsson J, Nilsson-Helander K. Tendon end separation with loading in Achilles tendon repair model: comparison of non-absorbable vs absorbable suture. *J Exp Orthop* 2017 4(1):26

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Abstract

Acute Achilles tendon rupture is common and has increasing incidence. This is thought to be due to increasing activity and sports participation in middle age. Sustaining an Achilles tendon rupture means a long rehabilitation period and many patients do not achieve full recovery of strength and function. One of the reasons for this reduced function is considered to be due to tendon elongation. The reasons for the lack of recovery has been discussed in earlier studies comparing operative and non-operative treatments. Operative treatment can be divided into open, minimally-invasive and percutaneous technique. Proponents for operative treatment consider open technique to prevent tendon elongation and reduce the re-rupture rate compared with non-operative treatment. Percutaneous repair is considered to lead to an increasing incidence of iatrogenic nerve damage and reduced repair strength compared with open repair but is considered to be advantageous because of lower risk of infections and wound problems.

The purpose of this dissertation was to evaluate and optimise the results of percutaneous and minimally-invasive technique for an Achilles tendon rupture. Moreover, evaluation instruments were developed and an already existing validated questionnaire was culturally adapted in English to be used in the United Kingdom. Achilles Tendon Resting Angle (ATRA) is an indirect measure of tendon elongation. The method has been developed and validated in one of the studies in the dissertation. ATRA has subsequently been used to evaluate the clinical outcomes. The ATRA angle increases after an Achilles tendon rupture, then decreases after operative intervention to finally increase again during the first rehabilitation phase. The ATRA angle was shown to correlate with patient-reported symptoms and function as measured by heel rise height one year after injury. Thus, ATRA can provide an indication of function achieved after treatment of an Achilles tendon rupture.

Achilles Tendon Total Rupture Score (ATRS) is a validated patient-reported questionnaire for evaluating limitations and physical activity after an Achilles tendon rupture. ATRS was originally developed for a Swedish population but has now been translated and culturally adapted to an English population in one of the studies. ATRS has also been used for evaluating patient-reported outcomes.

Percutaneous and minimally-invasive operative techniques have been evaluated in 169 patients treated for an Achilles tendon rupture. Percutaneous technique was found to be more cost-effective in comparison to open procedure, with similar results regarding function and patient-reported symptoms. Minimally invasive repairs produced similar outcome to percutaneous repair but with a lower complication rate. Based on these results, minimally invasive repair is recommended for the operative treatment of an acute Achilles tendon rupture.

In order to compare the strength of different suture materials after repair of the Achilles tendon, a cadaveric study was performed, in which the tendon was cyclically loaded. The result from this study shows that repair with non-absorbable suture has better strength in comparison to an absorbable one.

However, there is still a lack of knowledge of why a patient suffering from an Achilles tendon rupture does not fully recover. Further studies involving how treatment and rehabilitation can be optimised is of value.

Keywords: Achilles tendon rupture, percutaneous, minimally-invasive, outcome, Achilles tendon Total Rupture Score, Achilles Tendon Resting Angle, Heel-Rise Height