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A PROSPECTIVE ANALYSIS OF INTRINSIC AND EXTRINSIC RISK FACTORS ON THE DEVELOPMENT OF ACHILLES TENDON PAIN IN RUNNERS

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SUMMARY

Between 27% and 70% of all runners suffer from an overuse injury every year [1], whereby circa 15% develop Achilles tendon pain (AT) [2]. Retrospective studies have identified training errors, kinematic abnormalities or muscular imbalances as potential risk factors for AT, but evidence has not been provided so far due to retrospective study designs or missing control groups [1,2,3]. The goal of this prospective study is to evaluate whether recreational runners who develop AT already show differences in anthropometric, biomechanical and training related variables in a non-injured state and, consequently, to clarify the principle of cause and effect.

269 uninjured recreational runners were recruited and passed the initial examination, including a clinical examination and biomechanical procedures such as three dimensional kinematics and isometric strength measurements. 142 subjects handed in their training data on a weekly basis, and 45 runners generated overuse symptomatic during their maximal time of participation of one year. 10 subjects developed AT and showed alterations in knee and ankle joint kinematics in a non-injured state compared to a matched control population. Prior to AT, runners showed a change in their training concepts with an increase in training intensity and a shift from slow endurance runs fast endurance runs and competitions. Additional exercises besides running also increased just before AT occurred for the first time. It is proposed that a more forward-shifted touchdown in combination with higher impact forces due to faster training sessions lead to greater stress on the Achilles tendon and consequently to Achilles tendon pain.

INTRODUCTION

Running has become increasingly popular over the last decades, but besides the positive effects on the cardiovascular system, running is often accompanied by the occurrence of overuse symptoms. Between 27% and 70% of all runners suffer from an overuse injury every year [1], whereby circa 15% develop Achilles tendon pain (AT) [2]. The generation of overuse injuries, in general, and the development of AT, in particular, appears to be multifactorial with diverse intrinsic and extrinsic risk factors [1, 2].

A distinct definition of risk factors for AT has not been achieved, since most studies are carried out retrospectively,

meaning the clarification of cause or effect is not possible [3]. Training errors, kinematic abnormalities or muscular imbalances are often cited as risk factors, but evidence has not been provided so far due to the lack of prospective studies of intrinsic and extrinsic risk factors [2, 3].

The goal of this prospective study is to evaluate whether recreational runners who develop AT already show differences in anthropometric, biomechanical and training related variables in a uninjured state compared to healthy runners.

METHODS

Healthy recreational runners were included in the prospective study starting with an initial examination, including standardized clinical examinations and biomechanical testing procedures, such as three dimensional kinematics and isometric strength measurements. After the initial examination, all subjects had to hand in weekly training diaries containing information about their individual training behavior over a maximal period of one year. If any pain occurred due to training, a second examination equivalent to the initial examination and including additional diagnostics of the current symptoms became necessary.

Three-dimensional kinematics of the lower extremities were recorded according to ISB-recommendations [4]. Hip, knee and ankle joint excursions were quantified by calculating Cardan angles [5]. Mean angular displacements and discrete parameters were calculated from 10 valid trials of barefoot running.

Isometric strength measurements were conducted for the upper body, back extension, and abdominal flexion, and for the lower extremities, unilateral and bilateral hip abduction and adduction, as well as unilateral knee flexion and extension.

Individual training diaries were submitted on a weekly basis and included information on e.g. training frequency, running distance, time, distance profile, running surface, additional exercises etc. For the prospective analysis, training data from the last four weeks prior to the occurrence of AT were compared with data from the rest of the participation period using dependent t-tests.

Anthropometric data, lower extremity kinematics and maximal strength were analyzed for the injured leg of the injured runners and a randomly selected leg of a uninjured runner using independent t-tests.

269 uninjured recreational runners were recruited and passed the initial examination. During their time of participation 127 runners (47%) had to be excluded due to missing feedback, other injuries or personal reasons so that 142 runners (53%) were included in the study. 96 of the 142 runners remained uninjured and serve as controls (CO). 45 runners (31%) generated an overuse injury, with ten runners suffering from Achilles tendon pain.

Since literature shows sex-related influences and an effect of anthropometric differences on biomechanical results, the subjects were matched according to gender, BMI, height, weight and age. Consequently, two groups of ten runners were included in the data analysis, each containing two females and eight males (see Table 1)

Table 1: Distribution of the two groups of runners: controls (CO) and runners suffering from Achilles tendon pain (AT)

group	sex [m/f]	BMI [kg/m ²]	height [cm]	weight [kg]	age [years]
CO	8 / 2	23 (2)	177 (5)	72 (8)	40 (7)
AT	8 / 2	23 (3)	177 (4)	72 (8)	45 (5)

RESULTS AND DISCUSSION

All presented results are based on uninjured runners who either developed AT or remained uninjured during their participation in the study.

No differences were found for clinically relevant parameters between the two groups of runners. Runners who developed AT showed significantly reduced knee flexor strength and a lower knee flexors/extensor ratio compared to the healthy controls. Further, runners with AT showed differences in sagittal knee and ankle joint kinematics as well as in tibial rotation with more extended knee and ankle joints and a more internally rotated tibia at touchdown. They also had lower maximal knee flexion, ankle dorsiflexion and greater maximal tibial internal rotation compared to CO.

During the last four weeks before AT occurred, these runners reported changes in their training habits, with a shift from slow training sessions towards a significantly increased percentage of competitions and fast endurance training sessions accompanied by an increase in training intensity. They also reported an increase in additional weekly exercise besides their usual running training.

CONCLUSIONS

The generation of Achilles tendon pain in runners is multi-factorial, since runners developing Achilles tendon pain already show differences in their lower extremity kinematics, muscular strength, and training habits.

More extended knee and ankle joints lead to a more forward-shifted touchdown and higher stress on the Achilles tendon during the weight bearing situation at the beginning of the stance phase. This abnormality in combination with higher impacts on the foot due to faster training sessions may promote the occurrence of Achilles tendon pain. Additionally, single endurance running sessions, such as competitions, or additional exercising, such as hiking, might trigger events leading to injury. Therefore, to prevent the occurrence of AT, a cautious increase in training intensity or in additional exercises is necessary.

The principle of cause and effect for the occurrence of Achilles tendon pain in recreational runners could not be conclusively clarified, since the population size is still too small, but three-dimensional kinematics and changes in training have been identified as potential risk factors.

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