

IN VIVO ESTIMATION OF SUBTALAR JOINT AXIS AND RELATIONSHIP TO ACHILLES TENDON OVERUSE IN RUNNERS

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INTRODUCTION

Many studies have been published concerning overuse and acute injuries of the lower extremity with respect to individual risk factors [1]. Based on the studies by Isman [2] and others it has been speculated that inclination and deviation of subtalar joint axes (STA) could be used to estimate the risk to chronic or acute injury. The most important problem of measurement in vivo is that there are constraints due to the critical ankle anatomy [2, 4]. In this novel approach a method has been used to determine a set of parameters, describing the axes of rear foot movement with respect to the tibia. The aim of the study was to measure STA of runners with and without chronic symptoms of Achilles tendon (AT).

METHODS

The measurement system is based on the zebris® ultrasonic system which has been adapted for joint axes estimations. For direct control of the movement analysis system, the zebris® software development kit has been used. By postulating a pure rotational movement around the STA, the system could be reduced to only one Marker which was fixed to the rear foot complex (Fig. 1). As a first step of the procedure the tibia-co-ordinate system has been determined with the ankle joint in neutral position during upright stance. Then (in sitting position) the ankle has been moved to maximum dorsiflexion. The investigator supported this position and moved the ankle from inversion to eversion 6 times. A set of 6 finite axes between the end positions was calculated real time and then averaged in order to minimize errors from data capturing. Data had been accepted only if the standard deviation was lower than 10°.

A total of 614 axes were calculated from 307 high level runners with minimum of 25 km running per week and at least 3 years running experience. Mean age was $38,5 \pm 17$ years, mean height was $1,74 \pm 0,25$ m and mean weight was $68,4 \pm 16$ kg.

RESULTS AND DISCUSSION

Data of this study revealed an average inclination of 42° and an average deviation of 11° from 614 ankles. Significant differences have been found between deviation angles from ankles with Achilles tendon problems compared to those without AT problems (Table 1). Compared to data of Isman et al. [2] it seems that the average deviation of the STA is smaller and therefore more parallel to the longitudinal axis of the foot, which is also in line with the findings of Lewis [4]. However, the range of data and standard deviations are

actually higher than published in previous studies. In recent studies different approaches have been proposed to estimate individual joint anatomy in terms of joint axes orientation, using motion analysis systems [1] in vitro studies [2] or Magnetic Resonance Imaging (MRI) [4], which creates more accuracy.

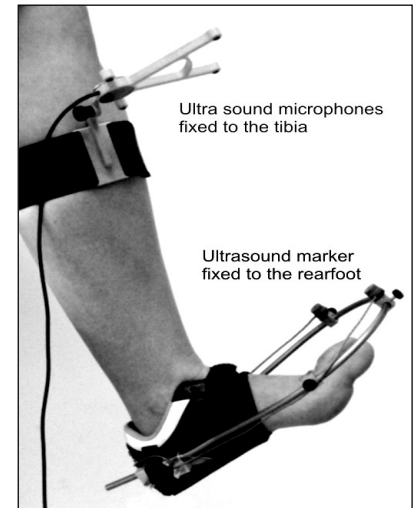


Figure 1:

Ultra sound based measurement system applied to a left lower leg.

CONCLUSIONS

This method can be used to estimate a functional joint axis which is closely related to STA orientation. This might be useful, especially to investigate large sample sizes in order to detect individual risk factors to chronic AT overuse in running.

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Table 1: Results (mean \pm s. d.) from this study 307 subjects compared to previous studies.

STA axis (deg)	results of this study			data from references	
	AT problems	No AT problems	All data	2	4
	N = 519	N = 95	N = 614	N = 47	N = 25
Inclination	44 \pm 16	42 \pm 17	42 \pm 11	41 \pm 9	33 \pm 11
Deviation	18 \pm 23	10 \pm 23	11 \pm 23	23 \pm 11	18 \pm 10