CLASSIFICATION OF PTS-SYNDROME IN FEMALE RUNNERS

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INTRODUCTION

The objective clinical and biomechanical classification of overuse injuries in general and of the patella tendon (PTS) in particular is a problem in biomechanics and medicine which has not been satisfactorily solved. Over the years, many authors (Stefanyshyn 2003, Malinzak 2001, Ferber 2003) assumed that PTS is caused by different biomechanical variables, such as the extent and velocity of initial and total pronation as well as the extent and velocity of internal rotation of the tibia and femur. Although epidemiological studies show that PTS is among the major complaints in running (especially in females), very little research has been done to study the direct relationship between overuse (running) injuries, such as PTS, and biomechanical and clinical variables. This might be the reason why it is still unclear how to effectively treat PTS (orthotics, physiotherapy), and which specific running shoes might help prevent PTS. Moreover objective biomechanical data of PTS patients could provide important information in the development of running shoes, as well as in the understanding of overuse injuries in general.

METHODS

19 healthy male (CO_m), 18 healthy female (CO_f) and 16 female runners with patella tendon syndrome (PTS) were clinically and biomecanically analyzed. Clinical measures included range of motion (ROM) of the knee and ankle joints, mobility of the patella, size of the q-angle and description of static and dynamic leg and foot axes. In addition, strength and flexibility of the main lower extremity muscles were tested. The biomecanical measurements included 3-D kinematics of the lower extremity (6 camera Vicon System, 250 Hz), as well as plantar pressure distribution (emed-xt, 100Hz, 4 sensores/cm^2) in barefoot running (overground) at 12km/h. 3-D kinematics was based on a 9 segment lower extremity model (21 reflective markers at the pelvis, thigh, shank and foot) to describe segmental frontal plane (internal/external rotation, ab-/adduction) and sagittal plane (flexion/extension) movements. Pressure distribution evaluations were based on general dynamic roll-over patterns (e.g. spatial path of center of pressure (COP), coordinates of COP at time of maximum loading, velocity of COP in medio-lateral & a-p direction) in addition to loading patterns of specific anatomical regions of the foot (e.g. peak forces, force time integral (FTI), maximum slope). Statistical analysis was based on descriptive statistics as well as on ANOVA ($\alpha = 0.05$) and Tukey Kramer´s Test ($\alpha = 0.05$).

RESULTS

PTS patients show more adduction movement of the femur compared to the pelvis (“medial collaps”), as well as increased internal rotation of the femur compared to both healthy groups ($PTS > CO_f > CO_m$). Furthermore, PTS show increased internal rotation of the tibia compared to both healthy groups ($PTS > CO_f > CO_m$). No differences could be found for eversion/inversion movement of the ankle joint. No differences between the groups could be observed for all pressure distribution variables (COP values as well as loading patterns in different anatomical regions). Clinical analysis showed that PTS have a more mobile patella, greater laxity of the ligamentum collaterale, as well as a larger ROM at the ankle and knee joint.

DISCUSSION

The biomechanical findings with 3-D kinematics support the assumptions in previous studies that internal rotation of the femur and the tibia are predisposing factors for the development of overuse injuries at the patella. Interestingly, pronation movement seems not to be involved in the developmental process, as the results for eversion/ inversion movement of the ankle joint as well as for the pressure distribution measurements showed no differences between the groups. Overall, women showed more internal rotation of the femur and tibia and more adduction at the hip compared to men. In addition to the clinical findings this might be the reason why women develop PTS problems more often than men.

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