HIP ABDUCTOR FATIGUE IN DISTANCE RUNNING – DOES MAXIMUM STRENGTH MATTER?

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INTRODUCTION
On average, female runners with patellofemoral pain have weaker hip abductors than healthy, matched controls [1], as well as compared to their unaffected limb [2]. Females with patellofemoral pain also appear to run with greater hip adduction compared to uninjured females [3]. This led to the hypothesis that hip abduction strength was significantly correlated to hip adduction during running. However, a 6-8 week hip strengthening program does not appear to significantly change running kinematics [4], calling into question the relationship between strength and kinematics.

To date, studies investigating this relationship have either been longitudinal or cross-sectional in nature. Investigating kinematic differences after an immediate change in hip strength would help better define this relationship. Therefore, the purpose of this study was to investigate the immediate effect of hip abductor fatigue on running kinematics in healthy runners.

METHODS
To date, 6 out of 16 runners included in this study have been analyzed, 3 females and 3 males (age: 31.0 ± 8.0 years). Thirty-nine reflective markers were placed on these runners who ran continuous overground laps in the laboratory while whole-body kinematic data were collected at 200 Hz using a 10-camera motion capture system (Motion Analysis Corp.).

Isometric hip abduction strength was measured sidelying in 0-degrees of abduction on a Biodex System 3 Dynamometer (Biodex Medical Systems) at 4 time points: before the first bout of running, immediately before the fatigue protocol, immediately after the fatigue protocol, and after the second bout of running. For each test, subjects pushed maximally for 5-seconds. Maximal torque was normalized by bodyweight for analysis.

For the fatigue protocol, subjects again laid sidelying on the Biodex Dynamometer. Subjects were instructed to maximally push in the direction of abduction while the dynamometer passively rotated up and down through a 30° range of motion at 30° per second for 2 minutes. A previous validation study in the Motion Analysis Laboratory demonstrated that this fatigue protocol decreased hip abduction strength by 27% immediately, and that hip abduction strength remained 10% lower than baseline 10 minutes after the fatigue protocol.

Immediately after fatigue, subjects again ran continuous laps in the laboratory while whole-body kinematics were collected.

Paired t-tests compared angular excursion and peak angles of the knee, hip, pelvis, and trunk before and after hip abductor fatigue. For all tests, the family-wise alpha-level was set to .05.

RESULTS AND DISCUSSION
Immediately after the hip abductor fatigue protocol, normalized hip abduction strength was 37% ± 13% lower than immediately before the test (pre-fatigue: 1.68 ± .26 Nm/kg; post-fatigue: 1.09 ± .20 Nm/kg), p = .02. After the second bout of running, hip abduction strength remained 8% ± 1% lower than baseline (post-run: 1.56 ± .11 Nm/kg).

Angular excursion of the knee, hip, pelvis, and trunk did not significantly change after fatigue. Peak ipsilateral trunk lean was significantly greater after the fatigue protocol (pre-fatigue: 3.2° ± 1.8°; post-fatigue: 3.8° ± 2.0°), p = .01. No differences were seen in any other kinematic variable.

Increased peak ipsilateral trunk lean may be a compensation to decrease the force needed from the hip abductors by decreasing the moment arm of the body’s center of mass. Hip adduction and internal rotation were not changed after hip abductor fatigue, which may suggest that the body prefers to compensate superiorly at the trunk in order to not sacrifice the runner’s ingrained motor pattern of the lower extremities. More data from this study is needed to support this hypothesis.

CONCLUSIONS
Despite a significant reduction in hip abduction strength that remained after the second bout of running, no changes were seen in hip adduction or hip internal rotation during running. Greater peak ipsilateral trunk lean during running was seen in runners after hip abductor fatigue, which may suggest a superiorly-directed compensation pattern.

REFERENCES

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