INTRODUCTION

Weak hip muscles, particularly the hip abductors, have been suggested as contributing factors for several common running-related injuries [1,3]. It has also been reported that injured runners display abnormal hip kinematics compared to healthy controls [2], and that there are correlations between reduced hip strength and excessive hip internal rotation [3] or hip adduction [1].

Some studies, however, have reported that strengthening these weak muscles did not alter running mechanics [4], which calls into question the relationship between hip strength and running mechanics. Therefore, one purpose of this study was to further investigate this relationship between hip strength and hip kinematics in healthy runners.

In addition, anecdotal evidence from our lab suggests that some runners shift their trunk laterally during stance phase (Figure 1). In theory, this may be an attempt to compensate for weak hip abductors by reducing the load on those muscles. To date, little is known on the relationship between hip strength and trunk kinematics in runners. Therefore, a second purpose of this study was to examine the relationship between hip strength and frontal plane trunk motion.

METHODS

Subjects for this study were part of a larger, ongoing study on running biomechanics and injuries at the University of Oregon Motion Analysis Laboratory. Inclusion criteria for this study were running over 20 miles per week, being injury-free at the time of testing, and completing all components of the protocol required for this study. Based on these criteria, 58 runners were included for analysis (age: 30.20 ± 11.02 years).

Reflective markers were placed on subjects who ran continuous laps of ~25 meters in the laboratory at their normal training run paces. Whole body kinematic data were collected at 200 Hz using a 10-camera motion capture system (Motion Analysis Corp.) Three AMTI (Advanced Mechanical Technology, Inc.) force plates located in series along the capture region recorded ground reaction forces at 1000 Hz.

After the running protocol, hip abduction strength was measured bilaterally using a Biodex System 3 dynamometer (Biodex Medical Systems, Shirley NY). For this test, subjects pushed against the dynamometer with maximal force three times for five seconds while standing with the hip at 10-degrees of abduction. Mean torque was calculated for each limb and normalized by body mass for analysis.

Limbs with hip abduction strength that is 1.5 standard deviations above the overall mean were considered “strong”, while limbs 1.5 standard
deviations below the mean were considered “weak” for this study [5]. For each variable, differences were examined using a 2-tailed t-test. Significance level of $p < .05$ was used for all tests.

RESULTS AND DISCUSSION

Eight runners were identified as having strong hip abductors (age: $22.5 \pm 4.9$ years; weekly mileage: $44.4 \pm 9.4$ miles) while four runners were identified as having weak hip abductors (age: $32.8 \pm 13.0$ years; weekly mileage: $40.0 \pm 4.1$ miles). There were no significant differences between groups with respect to demographic data ($p > .05$).

Results indicate that individuals with strong hip abductors display significantly less contralateral pelvic drop and hip internal rotation compared to individuals with weak abductors ($p < .05$). No significant differences were found between groups for hip adduction ($p > .05$) (Figure 2; Table 1).

These findings support previous research that suggested a relationship between hip abduction strength and hip kinematics [1,3].

In addition, no significant differences were found between groups in regards to frontal plane trunk lean ($p > .05$) (Figure 2; Table 1). This result contradicted our hypothesis that excessive frontal plane trunk motion may be an attempt to compensate for weak hip abductors. More studies are needed to explain this phenomenon.

CONCLUSIONS

Runners with strong hip abductors display significantly less contralateral pelvic drop and hip internal rotation than runners with weak hip abductors. No significant differences were seen between groups for hip adduction or lateral trunk lean. Future studies should examine the effect of hip strengthening on hip kinematics in healthy runners. More research on the relationship between hip strength and trunk kinematics during running also appears warranted.

REFERENCES


Table 1: Comparison between strong and weak hip abductor groups for selected kinematic parameters

<table>
<thead>
<tr>
<th></th>
<th>Range of Motion (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Contralateral Pelvic Drop*</td>
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<tr>
<td>Strong Hip Abductors</td>
<td>$2.6 \pm 1.0$</td>
</tr>
<tr>
<td>Weak Hip Abductors</td>
<td>$5.0 \pm 0.4$</td>
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</table>

*indicates a significant difference between groups.

Figure 2. Comparison between strong and weak hip abductor groups for selected kinematic parameters.