The Relationship Between Hip Flexor Flexibility and Hip Mechanics During Running

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Introduction

- Greater musculoskeletal flexibility is generally associated with a lower risk for musculoskeletal injury (1).
- It is speculated that the same amount of thigh extension may be achieved differently depending on the tightness of the hip flexor muscles (Figure 1A, 1B).
- Increased anterior pelvic tilt has been proposed as a potential cause of lower back pain, since it may result in an exaggerated curvature (lordosis) of the lower back (2, 3) (Figure 1B).
- Clinically, flexibility is typically evaluated through the passive ROM test known as the Thomas Test.
- Currently, the effects of passive flexibility on running gait is unknown.

![Figure 1](image1.png)

Figure 1. Position of the thigh, pelvis, and spine during gait with either normal (A) or tight (B) hip flexors.

Methods: Procedure

Passive Flexibility Measurements
- Passive hip extension (θ) was assessed through the Thomas Test (Figure 2) using a digital inclinometer (Lafayette Instrument Company, Lafayette, USA).
- Subjects were assigned to three groups (tight, normal, flexible) using tertiles of the passive flexibility measurements from the Thomas Test.

Gait Measurements
- Participants ran on a treadmill at a speed based on their personal walk to run transition speed.
- 3D marker coordinate data were collected using a 10-camera motion capture system (Vicon Motion Systems, Oxford, UK).
- Filtering and joint angle calculations were performed using Visual 3D software (C-motion, Germantown, USA).

Statistical Analysis
- Peak thigh extension, hip extension and anterior pelvic during running were compared between the three groups (tight, normal, flexible) using one-way ANOVA.

![Figure 2](image2.png)

Figure 2. Administration of the Thomas Test where a negative value is indicated when the thigh drops below the horizontal.

![Figure 3](image3.png)

Figure 3. Reflective marker set and subsequent Vicon imaging (B).

Results

![Figure 4](image4.png)

Figure 4. Kinematic curves of hip extension, thigh extension, and pelvic tilt during stance phase between the three different groups.

Table: Passive Flexibility Measures

<table>
<thead>
<tr>
<th>Variable</th>
<th>Tight</th>
<th>Normal</th>
<th>Flexible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thigh Ext(°)</td>
<td>-26.8 (3.4)</td>
<td>-24.3 (3.5)</td>
<td>-26.4 (5.5)</td>
</tr>
<tr>
<td>Hip Ext(°)</td>
<td>-2.7 (8.1)</td>
<td>-2.7 (8.7)</td>
<td>-3.8 (8.8)</td>
</tr>
<tr>
<td>Ant Pelv Tilt(°)</td>
<td>-24 (7.1)</td>
<td>-22.6 (6.7)</td>
<td>-22.5 (6.7)</td>
</tr>
</tbody>
</table>

![Figure 5](image5.png)

Figure 5. There was no significant difference found between groups for thigh extension (p=0.579), hip extension, (p=0.969), or pelvic tilt (p=0.834).

![Figure 6](image6.png)

Figure 6. Average Thomas Test values for the tight (7.5°), normal (-1.2°), and flexible groups (-8.7°).

Summary

- There were no differences in hip extension, thigh extension, or pelvic tilt between groups, consistent with previous literature.
- Thigh extension during gait was greater than Thomas Test values. Pelvis angle may play a role in the amount of thigh extension, but it is not accounted for during the Thomas Test.
- Thomas Test may not predict restrictions in hip extension during running but it might still provide useful information.

References


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