Treadmill Running vs. Overground Running in Individuals with Patellofemoral Pain

Clinical Bottom Lines:
1. In healthy young individuals without knee pain treadmill running significantly decreases knee range of motion compared to overground running.¹
2. Individuals with patellofemoral knee pain (PFP) syndrome have significantly less range of motion than individuals without PFP when running on a treadmill.²
3. Treadmill running should minimize the level of knee pain more than overground running in individuals with PFP.

Citation:

Level of Evidence:
Level 3b: Small prospective cross-sectional study (n =20), within subjects design.

Clinical Question:
Does treadmill running minimize knee pain more than overground running in a thirty four year old male with a history of knee trauma?

The Study:
Purpose: This study focused on comparing the kinematic and kinetic parameters of subjects free of any musculoskeletal pathology when running on a treadmill vs. running overground.
Design: This was a quasi-experimental prospective study in which the results were compared within subjects. Each subject received both the control (overground) and experimental (treadmill) conditions in that order, at a single point in time.
Methods: Motion capture and ground reaction force data were collected for subjects as they ran overground at a self selected pace. On the same visit, data were then collected for the same subjects as they ran on an instrumented treadmill set to their average overground running pace. Within-subjects comparisons were used to compare kinematics and kinetics of overground vs. treadmill running.
Independent Variable: Running condition: treadmill running vs. overground running
Dependent Variables: Body segment orientation, joint angles, net joint moments and powers were measured using a 10-camera VICON 624 Motion Capture system on an overground ramp and instrumental treadmill.

The Study Patients:
A sample of convenience (n=20) including 10 males and 10 females were recruited from the local community by an unknown means. Each subject was a regular runner that ran/jogged a minimum of 15 miles/week on a regular basis. Subjects had to have no past history of musculoskeletal pathology or any running related injuries within the last two months. Each subject completed both conditions. My patient would not be eligible for this study because he has a history of knee pain and trauma.

Control Condition:
Overground running was considered to be the control condition. Overground data was collected using retroreflective markers as the subjects ran at their self-selected 10 km race pace on a 15m runway covered with a thin carpet material. Each subject used his/her personal running shoes.

**Experimental Condition:**
After completing the overground running protocol, each subject then ran on an instrumented treadmill. Marker placement was unchanged between conditions. The pace measured during the overground control run determined the running speed for the experimental run. Three to five sets of data were collected for the treadmill condition using retroreflective markers, as they performed a run on an instrumented treadmill. In this study the subjects were not similar to my patient given that they did not experience any knee pain during running.

**Evidence:**
Kinematic and kinetic measures showed a significant overall decrease in the range of motion about the knee when running on a treadmill vs. running overground.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Overground Mean Value</th>
<th>Treadmill Mean Value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum knee flexion</td>
<td>110.1</td>
<td>103.5</td>
<td>0.0005</td>
</tr>
<tr>
<td>Minimum knee flexion</td>
<td>8.3</td>
<td>10.2</td>
<td>0.0005</td>
</tr>
<tr>
<td>Knee flexion moment</td>
<td>2.33</td>
<td>1.70</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Knee varus moment</td>
<td>1.90</td>
<td>1.54</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Knee power generation</td>
<td>11.26</td>
<td>7.63</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

**Comments:**
1. This study sheds light on some very valuable information concerning a physiological comparison; however it is not applicable to the patient in my clinical question.
2. The subject recruitment in this article raises concern considering we had no knowledge of how it was done and there was a very limited number of test subjects.
3. An additional article by Dierks et al\(^2\) was used in order to make this study more applicable to the clinical question. Dierks et al\(^2\) focused on comparing lower extremity kinematics in runners with PFP versus runners without PFP during a prolonged run on a treadmill. The study found that individuals with PFP had significantly less range of motion than individuals without PFP when running on a treadmill. Combining the data from both articles suggests that treadmill running may minimize the level of knee pain more so than overground running in individuals with PFP, given that the decrease in range of minimizes the intensity of the knee pain.

**Appraised by:** Crystal Montoya, SPT

**Date appraised:** July 22, 2011