KNEE BIOMECHANICS OF SELECTED KNEE UNFRIENDLY MOVEMENT ELEMENTS IN 42-FORM TAI JI

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Background

Tai Ji, as a mind-body therapy, is a traditional Chinese martial art that includes natural postures, and gentle and smooth movements.

In recent years, Tai Ji has been shown to relieve pain and improve the quality of life for knee osteoarthritis (OA) patients. Tai Ji is also one of the recommended non-pharmacologic treatments for knee OA (1), but it is not clear if all Tai Ji movements would be suitable and beneficial for knee OA patients.

Furthermore, it is undetermined whether Tai Ji movements place similar or higher loads to the knee joint compared to other recommended aerobic exercises such as walking for knee OA population (2).

Purpose

The purpose of this study was to examine knee biomechanical characteristics of the selected knee unfriendly Tai Ji movement elements performed in high-pose position compared to slow walking. The knee unfriendly movement elements were defined as movements with a greater deep knee flexion.

Methods

Subjects:

- 17 healthy subjects
- age: 23.9 ± 2.7 yrs
- height: 1.73 ± 0.08 m
- mass: 69.0 ± 13.0 kg
- All the subjects have at least two weeks Tai Ji experience.

Protocol and Instrumentation

- 3 trials of walking at speed of 0.8 m/s
- 3 trials of identified knee unfriendly Tai Ji movement elements: lunge, pushdown, and kick in high pose, and pseudo-step (figure 1)
- Nine-camera motion analysis system (120 Hz, Vicon): 3D kinematics
- Three force platforms (1200 Hz, AMTI): GRF and moments

Data Analyses

3D kinematic and kinetics were analyzed by using Visual 3D software (C-Motion, Inc.). Moments were calculated as internal moments.

Statistical Analysis:

A one-way ANOVA was performed with post hoc paired samples t-tests with Bonferroni adjustments to determine differences between each elements and walking.

Results

Table 1: Peak knee ROM (degree) and moments (Nm/kg) of four Tai Ji movement elements and slow walking: mean ± SD

<table>
<thead>
<tr>
<th></th>
<th>Lunge</th>
<th>Pushdown</th>
<th>Kick</th>
<th>Pseudo-step</th>
<th>Walking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexion ROM</td>
<td>-29.5±6.0bcd</td>
<td>-24.3±8.8bcd</td>
<td>-11.1±5.8bcd</td>
<td>-45.0±13.0d</td>
<td>-47.8±7.0d</td>
</tr>
<tr>
<td>Peak extensor moment</td>
<td>1.04±0.21bcd</td>
<td>1.01±0.28bcd</td>
<td>0.48±0.41c</td>
<td>1.46±0.26d</td>
<td>0.38±0.19</td>
</tr>
<tr>
<td>Peak abduction moment</td>
<td>0.54±0.10bcd</td>
<td>0.43±0.14cd</td>
<td>0.44±0.13c</td>
<td>-0.61±0.16d</td>
<td>-0.45±0.10</td>
</tr>
</tbody>
</table>

Note: * - significant difference from Push Down, b - significant difference from Kick, c - significant different from Pseudo Step, d - significant different from walking

Conclusions

Higher peak knee extensor moment was found in most of the Tai Ji knee unfriendly movement elements compared to slow walking.

Tai Ji participants with knee OA and other knee pathological conditions are recommended to modify lunge and reduce the knee flexion angle of their movements to minimize knee joint loading when practicing Tai Ji.

The Tai Ji movement elements including pushdown and pseudo-step should be avoided in Tai Ji exercises designed for knee OA patients.

References
