INTRODUCTION

Anterior cruciate ligament (ACL) injury has been associated with progressive development of knee osteoarthritis (OA) (Daniel et al, 1994). ACL reconstruction is often performed to restore the joint stability. Current literature does not lend support to the efficacy of ACL reconstruction in retarding progression of OA after knee injury. Altered knee kinematics and loading pattern are believed to be responsible for premature OA. Knee kinematic changes were observed after ACL injury using dynamic MRI (Barrance et al, 2006). A recent study reported that rotational changes at the knee would cause cartilage thinning (Andriacchi et al, 2006). Some differences during level walking between ACL injured knees and healthy knees have been reported (Zheng et al, 2007). The purpose of this study is to study 3-D joint motion of ACL-deficient (ACL-D), ACL-reconstructed (ACL-R) and ACL-intact (ACL-I) knees during level walking, ascending and descending stairs.

METHODS

Twenty nine subjects were recruited in this study, including 15 healthy subjects, 6 subjects with unilateral ACL-R knee and 8 with unilateral ACL-D knees. Subjects at the time of test were 3 months to 2 years after injury or surgery. Both left and right knees were tested using an IRB approved protocol. An 11-camera motion analysis system (MAC, Santa Rosa, CA) was used to collect motion data using 89 reflective markers (Fig. 1) (Zheng et al, 2007). Three translations and rotations at the knee were determined using a modified point cluster technique with accuracy of 1.8° for rotation and 3.5 mm for translation (Gao and Zheng, 2007). Peak and valley values during the stance phase and swing phase were determined for each variable. Each test was repeated three times. Differences of three translations and three rotations between two knees were analyzed and compared between ACL-R and healthy group. Multivariate analysis of variance (MANOVA) was used to compare the differences (SPSS, Chicago, IL).

RESULTS AND DISCUSSION

Figure 2 shows the three rotations and three translations at the knee during level walking, ascending and descending stairs. There were significant differences of the knee flexion between the ACL-R and ACL-I and between the ACL-D and ACL-I. Subjects in the ACL-D and ACL-R groups had more knee flexion at the mid stance during level walking (Table 1). Subjects in the ACL-R group had greater peak knee flexion during the swing phase in all three daily activities. Tibiae in the ACL-R and ACL-D groups had significant less external rotation during the swing phase and at heel strike of three daily activities. Significant differences for the maximum valgus at the stance phase, the maximum varus and valgus at both the
stance and swing phases were also found for three daily activities.

Findings from this study allow us to identify the individuals who have abnormal joint motion. Future studies will be focused on how changes in knee joint kinematics in ACL-D and ACL-R groups lead to cartilage degenerative changes of the articular cartilage and how to apply appropriate interventions and treatment to prevent degenerative changes of the knee joint.

SUMMARY/CONCLUSIONS

Three dimensional knee joint motions in ACL-D, ACL-R and healthy groups were studied and significant differences of joint motion were found. Their long-term influences on the joint degenerative change need to be monitored and studied.

REFERENCES


Table 1 Rotations (deg) with significant differences among groups during level walking (mean± SD).

<table>
<thead>
<tr>
<th>Group</th>
<th>ACL-I</th>
<th>ACL-R</th>
<th>ACL-D</th>
<th>p</th>
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</thead>
<tbody>
<tr>
<td>Flexion at stance phase</td>
<td>2.4 ± 3.3</td>
<td>7.6 ± 4.4</td>
<td>12.4 ± 1.8</td>
<td>**, p&lt;0.01</td>
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<tr>
<td>Flexion at heel strike</td>
<td>0.1 ± 3.7</td>
<td>5.4 ± 4.0</td>
<td>6.9 ± 4.7</td>
<td>**, p&lt;0.01</td>
</tr>
<tr>
<td>External Rotation at swing phase</td>
<td>12.7 ± 3.7</td>
<td>8.5 ± 5.1</td>
<td>7.8 ± 4.3</td>
<td>*, p&lt;0.05</td>
</tr>
<tr>
<td>Valgus at stance phase</td>
<td>6.3 ± 2.8</td>
<td>5.5 ± 2.9</td>
<td>2.0 ± 2.6</td>
<td>*, p&lt;0.05</td>
</tr>
</tbody>
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