A COMBINED ACL/MCL INJURED KNEE PREDISPOSES THE MEDIAL MENISCUS TO INJURY DURING THE HEALING PROCESS

*Yagi, M (A-NIH); *Abramowitch, S D (A-NIH); *Tsuda, E (A-NIH); +*Woo, S L-Y (A-NIH)
+*Musculoskeletal Research Center, Department of Orthopaedic Surgery, University of Pittsburgh, Pittsburgh, PA. 210 Lothrop St.- E1641 BST P.O. Box 71199 Pittsburgh, PA 15213; 412-648-2000; Fax: 412-648-2001, ddecenzo@uoi.upmc.edu

Introduction:
The clinical outcomes of combined anterior cruciate ligament (ACL)/medial collateral ligament (MCL) injuries are unpredictable as there is a high incidence of associated medial meniscal tears (1). Although studies have reported the important contribution of the medial meniscus (MM) to knee stability during ACL injury (2,3), the forces in the MM following a combined ACL/MCL injury remain unknown. The objective of this study was to measure the force distribution between the MM, ACL graft and healing MCL after a combined ACL/MCL injury in a goat model. The changes in these forces between time-zero and 6 weeks of healing were also compared. It is hypothesized that as the in-situ force in the ACL graft decreases from time-zero to 6 weeks, the resultant force in the MM will increase under anterior tibial loading.

Material and Methods:
Five skeletally mature female Sannan breed goat knees were tested at time-zero following ACL reconstruction (0 week). An additional 5 goats were tested at 6 weeks with the right knee serving as the experimental group (6 weeks) and the contralateral knees as the control group (Control). To create a combined ACL/MCL injury, a surgical procedure was performed in which the ACL was transected and the MCL was ruptured using a “mop-end” tear technique (4). Then, a 6mm wide bone-patellar tendon-bone graft was used to reconstruct the ACL, but the MCL was not repaired. For the ACL reconstruction, the femoral bone plug was fixed using an interference screw (Tunneloc™, Arthrotek), while the tibial bone plug was fixed to the anteromedial cortex of the tibia using a spiked staple and suture post. Following surgery, the goats were allowed free cage activity for 6 weeks, at which time the goats were sacrificed and both knees were harvested.

A robotic/universal force moment testing system was used for biomechanical testing (5). This system is capable of measuring unconstrained knee kinematics in multiple degrees of freedom (DOF), the in-situ forces in ligaments, and the resultant forces in menisci in response to a 67 N anterior tibial load. In this study, knees were tested at 30° of knee flexion and the resulting kinematics for the 0 week, 6 weeks, and control groups were obtained. Kinematics were limited to 4 DOF due to the inherent internal-external rotational instability of the goat knee. The in-situ force in the ACL or ACL replacement graft, and the resultant forces in the MM were also obtained for the 0 week, 6 weeks and control groups. In addition, the in-situ force in the healing MCL was obtained at 6 weeks. All statistical comparisons were performed using unpaired t-tests. Significance was set at p<0.05.

Results:
Anterior tibial translation is shown in Table 1. The anterior tibial translations at 6 weeks were significantly larger than both those for the control and 0 week groups, but no differences were detected between the control and 0 week group.

The in-situ force in the ACL for the control group was 74 ± 6N, while that of the ACL replacement graft at 0 week and 6 weeks was 76 ± 11N, and 56 ± 10N, respectively (Figure 1). There was no significant difference between the control and 0 week groups. However, the in-situ force in the ACL graft of the 6 weeks group was significantly lower than that of the other two groups (p<0.05). The resultant force in the MM of the control, 0 week and 6 weeks groups were 7 ± 5N, 15 ± 9N and 22 ± 11N, respectively (Figure 1). No significant differences could be demonstrated between the control and 0 week groups, however, the resultant force in the MM at 6 weeks was significantly larger than that of the control group (p<0.05). The in-situ force in the healing MCL at 6 weeks was less than 1 N.

Discussion:
In a combined ACL/MCL injured knee at 6 weeks, anterior tibial translation significantly increased, possibly due to the effects of graft maturation and soft-tissue remodeling. Correspondingly, the resultant force in the MM was found to increase, while the in-situ force in the ACL graft decreased between 0 and 6 weeks. This data confirms our hypothesis. Additionally, the healing MCL is not functional in terms of restricting anterior tibial translation at 6 weeks. Thus, the MM indeed plays a more important role in response to anterior tibial loads and could be at a potential risk for injury. Based on this data, rehabilitation protocols during the early stages of healing should take into consideration the possibility that subsequent MM injury following a combined ACL/MCL injury may occur.

<table>
<thead>
<tr>
<th>ATT</th>
<th>Control</th>
<th>0 week</th>
<th>6 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.0 ± 0.9</td>
<td>5.4 ± 3.2</td>
<td>8.8 ± 1.3*</td>
</tr>
</tbody>
</table>

Means SD (mm)

Table 1: Anterior tibial translation in response to a 67 N anterior tibial load. (* indicates p<0.05 when compared to the control group)

Acknowledgements: The support of NIH grant AR 41820 is gratefully acknowledged.

Reference:
2) Jackson et al., J Orthop Res., 17: 810-816, 1999
5) Rady et al., J Biomech 29:, 1357-60, 1994

0044 Session 8 – Meniscus - Esplanade Ballroom 306-308, Sun 11:30 AM - 1:00 PM