INTRODUCTION:
The rupture pattern of anterior cruciate ligament (ACL) differs, such as complete tears to partial tears. It is reported that the rate of partial ACL tears ranges from 10% to 28% of all ACL rupture. However, it is difficult to diagnose partial tears preoperatively, because the manual examination and subjective classification proposed by the Lachman test, the pivot shift test, or other manual tests lack objectivity. To evaluate the knee laxity quantitatively, we developed a three dimensional electromagnetic measurement system (EMS) and applied this system to the Lachman test and the pivot shift test for quantitative evaluation. The purpose of this study was to investigate a motion analysis of the ACL deficient knees of both partial and complete tears that were confirmed by arthroscopic inspection. We hypothesize that the partial ACL rupture was detected by the quantitative evaluation of the Lachman test and the pivot shift test using this EMS in comparison with the complete tears preoperatively.

METHODS:
20 patients who confirmed the partial ACL tear arthroscopically and underwent ACL augmentation were picked from all ACL reconstructed patients in our institution (Group P). On the other hand, sex and age matched 20 patients who identified the complete tear were also extracted during the same period for comparison (Group C). There were no statistical differences between two groups in number, gender and age.

Patient profile is shown in Table 1:

<table>
<thead>
<tr>
<th>Patient profile</th>
<th>Partial tear (Group P)</th>
<th>Complete tear (Group C)</th>
<th>Statistical evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>20</td>
<td>20</td>
<td>N.S. (P&gt;0.05)</td>
</tr>
<tr>
<td>Gender (female / male)</td>
<td>10/10</td>
<td>10/10</td>
<td>N.S. (P&gt;0.05)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>27.6±10.5</td>
<td>24.7±10.1</td>
<td>N.S. (P&gt;0.05)</td>
</tr>
<tr>
<td>Injury side (AMB / PLB)</td>
<td>3/17</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Patient profile.

All the patients were evaluated under general anesthesia and recorded for the knee kinematics data by the EMS before reconstructed surgery. We evaluated the end point during the Lachman test, the side-to-side differences anterior laxity measured by the KT-1000 arthrometer, and the manual grade of the pivot shift test. Additionally, the side-to-side difference of anterior tibial translation during the Lachman test and the acceleration of the sudden reduction of the tibia during the pivot shift test were used by the EMS. This system can record the six-degrees-of-freedom of knee kinematics data at the sampling rate of 60 Hz. The statistical evaluation was carried out by means of Student t-test. Significance level was determined at 5%.

RESULTS:
The end points during the Lachman test were found in 9 patients (45%) of group P, however, no end points were found in group C. In the KT-1000 measurements, the mean side-to-side differences were 3.88 ± 2.47 mm in group P and 5.53 ± 2.21 mm in group C. There was significant difference among these two groups. In the pivot-shift test, one patient were evaluated as grade 0, seventeen patients were evaluated as grade 1-, two patients were evaluated as grade 2+ in group P. In group C, ten patients were evaluated as grade 1+, nine patients were evaluated as grade 2+, one patient was evaluated as grade 3+. Group C tended to have greater laxity than the group P. (Table 3)

According to the assessment using the EMS, in the quantitative Lachman test, mean side to side differences were 3.07 ± 2.17 mm in group P and 7.06 ± 3.07 mm in group C. In the quantitative measurement of the pivot shift test, the mean acceleration of the sudden reduction of the tibia in group P was -1072.80 ± 428.32 mm/s², while group C was -1549.11 ± 733.88 mm/s². Both of the quantitative data in group P were significantly smaller than group C. (Fig.1)

DISCUSSION:
Recently, in ACL reconstructive surgery, the importance of ACL remnant has been recognized in terms of its proprioceptive and biomechanical function and its vascularity, which may induce more rapid vascularization from the ACL remnant to the grafted tendon. Therefore, it is important to diagnose partial ACL rupture preoperatively. The quantitative measurement of the Lachman test and the pivot shift test demonstrated that the partial ACL tear was detected by the significantly lower instability in comparison with the complete ACL tear.

REFERENCES: