Accuracy of intra-operative fluoroscopic measurements for describing the femoral tunnel aperture positions in anatomical ACL reconstruction - *analysis using 3D quadrant method on automated 3D reconstructed model*

Jaeang Sim[1], Byung Hoon Lee[2], Jungmin Shin[3]
[1]Gachon University Gil Med Center, [2]Gachon University, Gil Medical Center, [3]Rheumatology

INTRODUCTION: Intraoperative fluoroscopy has been proposed as a feasible method to improve the accuracy of anatomical tunnel positioning. This study aimed 1) to introduce a new automated analysis program of 3D quadrant method to find accurate femoral tunnel position; 2) to analyze the accuracy of femoral tunnel positioning during anatomical DB-ACLR(double bundle anterior cruciate ligament reconstruction) with fluoroscopic assistance compared to conventional 3D-CT analysis.

METHODS:

A total of 32 patients who underwent DB-ACLR from 2010 to 2014 were evaluated retrospectively. Routine CT scan was evaluated at 5 days postoperatively in all patients. Femoral tunnel location was calculated using 3 methods included as the quadrant method on fluoroscopic radiographs, (modified) quadrant method on conventional 3D-CT images, and on automated 3D reconstructed model. For each knee, two independent observers conducted the measurements. Reliability of both measurement techniques of quadrant methods using fluoroscopic radiographs and conventional 3D-CT images was evaluated. The accuracy of tunnel location on grid of fluoroscopic radiograph and conventional 3D-CT was analyzed by measuring the degree of agreement compared to the coordinates on the automated 3D reconstructed model.

RESULTS:

Femoral tunnel location measured by quadrant method using automated 3D reconstructed model were 19.1 ± 4.8 % of depth and 22.3 ± 7.7 % of height in AM tunnels, 32.2 ± 6.0% of depth and 48.4 ± 7.7% of height in PL tunnels. Using fluoroscopy, 20.3 ± 5.0 % of depth and 26.8 ± 8.9 % of height in AM tunnels, 32.9 ± 5.4% of depth and 50.6 ± 7.9% of height in PL tunnels. Using conventional reconstructed 3D CT, 21.3 ± 4.6 % of depth and 26.0 ± 9.1 % of height in AM tunnels, 34.9 ± 7.1% of depth and 50.1 ± 8.0% of height in PL tunnels. When analyzed using Bland-Altman plot, Limit of Agreement (LOA) in the fluoroscopy group was more closer to equator than conventional 3D CT group in all cases except for the height of the AM tunnel, which slightly lower LOA.

DISCUSSION AND CONCLUSION:

Fluoroscopically identified tunnel aperture location is with higher accuracy and reproducibility than quadrant method using conventional 3D-CT image.