

BIOMECHANICAL EVALUATION OF KNEE JOINT STABILITY FOR VARIOUS POSTERIOR CRUCIATE LIGAMENT RECONSTRUCTION METHODS

Yoon Hyuk Kim, Kyungsoo Kim¹, Won Man Park, and Sang Hoon Kim

School of Advanced Technology, Kyung Hee University, Yongin, Korea

¹Institute of Natural Sciences, Kyung Hee University, Yongin, Korea

KEY WORDS: posterior cruciate ligament (PCL), reconstruction, stability.

INTRODUCTION: Recently, it has been reported that PCL injuries in the athletic population, especially in contact sports, occurred frequently by a fall on the flexed knee with a planar flexed foot and hyperflexion of the knee (Wind et al. 2004). However, the most effective PCL reconstruction method is not well understood even though PCL reconstruction has become popular with the advance of arthroscopic surgical techniques. The purpose of this study is to evaluate the stability recovery of the knee joint for various reconstruction methods, conventional single and double bundle reconstruction methods as well as double bundle augmentation methods by using the finite element analysis.

METHOD: A three-dimensional finite element (FE) model of the healthy lower extremity was developed based on CT images. The FE model consisted of femur, tibia, patella, cartilage, meniscus, and four major ligaments. The material properties of different bony and soft tissue models were adopted from previous studies. In addition to the intact model, PCL deficient, single bundle and double bundle reconstruction, and double bundle augmentation models were developed based on clinical approach using Achilles allograft. In order to have same total area of the ligaments, 6 mm diameter was used for double bundle reconstruction and augmentation models, and 8.5 mm diameter was used for single bundle reconstruction model. Then, 90N of posterior drawer test and 3Nm of torsion were performed to evaluate the translational and rotational stability of the knee and PCL stresses for various reconstruction methods.

RESULTS: The double bundle augmentation model showed similar translational stability comparing with the double bundle reconstruction model and higher than the single bundle reconstruction. However, for 3 Nm of torsion, the double bundle augmentation model showed the best rotational stability. For the PCL stresses, the augmentation model had lower stress values compared with other models in 90N of posterior drawer test.

DISCUSSION AND CONCLUSION: The results of this study showed that the double bundle augmentation model had advantages of rotational stability and ligament stresses, even though the posterior stability in the double bundle augmentation model showed no difference with that in the double bundle reconstruction model. From this finding, we think that the double bundle augmentation method would be beneficial for rotational stability and injury risk of the reconstructed ligament tissue.

REFERENCES:

Wind Jr, W.M., Bergfeld, J.A., Parker, R.D. (2004). Evaluation and treatment of posterior cruciate ligament injuries: Revisited. *American Journal of sports medicine*, 32(7), 1765-75.

Acknowledgement

This work was partly supported by the Korea Science and Engineering Foundation (KOSEF) grant funded by the Korea government (MOST) (No. R11-2007-028-02002-0) and by MOCIE through EIRC program.