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論　文　内　容　の　要　旨
Synopsis of Thesis

氏　名 Name	松尾　知彦
論文題名 Title	Tibiofemoral relationship following anatomic triple-bundle anterior cruciate ligament reconstruction （解剖学的三重束ACL再建術後における大腿骨ー脛骨の位置関係）

論文内容の要旨

<Purpose>

One of the aims of anterior cruciate ligament (ACL) reconstruction is to restore the normal tibiofemoral relationship. However, several studies indicated that an abnormal tibiofemoral relationship remained after single-bundle (SB) ACL reconstruction. Thanks to recent anatomical studies and improvement of surgical instruments, anatomic double-bundle (DB)/triple-bundle (TB) ACL reconstruction was developed to mimic the normal ACL fiber arrangement. Some studies reported normal knee kinematics after anatomic ACL reconstruction. In addition, good clinical outcomes of this technique were observed in some reports.

However, the time point at which the altered tibiofemoral relationship returns to normal after anatomic ACL reconstruction remains unclear. The objective of this study was to investigate the tibiofemoral relationship sequentially before and after anatomic TB ACL reconstruction using 3-dimensional (3D) computer models in the same patients. It was hypothesized that the tibia was over-constrained (posterior displacement and external rotation) immediately after surgery but then returned to the normal position with graft remodeling.

<Methods>

Nine patients with complete unilateral ACL rupture participated in this study. Anatomic TB ACL reconstruction was performed using autogenous semitendinosus tendon grafts. Computed tomography images were obtained before surgery as well as 3 weeks and 6 months afterward. During image acquisition, the patient's knees were fully extended in the supine position. Tube current/voltage for the hips, knees, and ankles was 80 mA/120 kV, 100 mA/120 kV, and 45 mA/120 kV, respectively, and scan length was 9 cm, 22 cm, and 6 cm, respectively. Slice thickness was 1.25 mm. The femoral head, distal femur, and proximal/distal tibia were segmented from CT images, and then 3D surface models were constructed. The anatomical femoral coordinate system was based on the center of the femoral head and the medial/lateral epicondyles. The anatomical tibial coordinate system was based on the center of the footprint of ACL/posterior cruciate ligament (PCL) and the center of the ankle. Anterior–posterior (AP) and medial–lateral (ML) displacement of the tibia relative to the femur were evaluated for each period, as were internal–external (IE) and varus–valgus (VV) rotation, followed by calculation of side-to-side differences in parameters. As the control group, 7 healthy volunteers were evaluated. The Wilcoxon signed rank test was used to detect statistically significant differences within the patient group, and the Wilcoxon rank sum test to compare the patient and control groups. Differences were considered statistically significant at $P < 0.05$.

<Results>

Within the patient group, compared with the state before surgery, AP and ML displacement significantly decreased 3 weeks after surgery; IE and VV rotation also decreased significantly. All parameters significantly increased from 3 weeks to 6 months after surgery.

Compared with the control group, AP displacement and IE rotation in the patient group were 1.4 ± 0.9 mm and $2.1 \pm 1.7°$, and were significantly greater than those in the control group (0.1 ± 1.0 mm and $0.1 \pm 2.0°$) before surgery. Three weeks after surgery, AP displacement and IE rotation in the patient group were -2.0 ± 1.2 mm and $-3.4 \pm 3.5°$, and were significantly lesser. ML displacement and VV rotation exhibited no significant difference between the patient and control groups before surgery or 3 weeks after surgery. Then there was no significant difference between the patient and control groups in AP/ML displacement or IE/VV rotation 6 months after anatomic TB ACL reconstruction.

<Conclusion>

The anteriorly located and internally rotated tibia in ACL-deficient knees was over-constrained (posterior displacement and external rotation) 3 weeks after anatomic TB ACL reconstruction, but returned to the normal position 6 months afterward. Therefore, anatomic tunnel placement, appropriate initial tension, and moderate rehabilitation can be the key for return to the normal tibiofemoral relationship after ACL reconstruction.

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論文審査の結果の要旨及び担当者

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論文審査の結果の要旨

前十字靭帯(anterior cruciate ligament、ACL)は大腿骨と脛骨を結ぶ靭帯であり、anteromedial bundle、intermediate bundle、posterolateral bundleの三本の線維束で構成されている。これら三本の線維束は相補的に脛骨の前方亜脱臼を制動していることが知られている。本研究では、解剖学的三重束ACL再建術前後における大腿骨ー脛骨の位置関係の変化を3D computer modelを用いて経時的に調べている。その結果、ACL損傷膝では前方転位及び内旋している脛骨が、術後3週では後方転位及び外旋し、術後6ヶ月では正常の位置に戻るということが明らかとなった。従来の非解剖学的な再建後に脛骨の前方転位が残存している報告は散見されるが、解剖学的再建後の脛骨位置を調べた報告は少なく、本研究は学位に値するものと認める。