Long term outcomes of ACL reconstruction in patients with excessive laxity

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A variety of factors affect outcomes of anterior cruciate ligament(ACL) reconstruction. Main cause of poor outcomes after ACL reconstruction is recurrent instability[1]. Recurrent instability was reported to occur by technical error[2,3], biologic failure[4], traumatic failure[5]. Untreated laxity from combined ligament injuries also causes instability of reconstructed ACL[6,7]. A majority of surgeons take into account considerations about these influential factors during ACL reconstruction and rehabilitation. However, most studies have not given attention to the inherent physiologic and structural characteristics of patients as factors affecting outcomes of ACL reconstruction. Some previous studies have dealt with the generalized joint laxity and hyperextension of the knee as an intrinsic factor contributing to ACL injury[8-10]. Only a few studies have considered the relationship between generalized joint laxity and outcomes of ACL reconstruction and revealed the negative effects of generalized joint laxity on surgical outcomes[11,12]. However, these studies dealt with outcomes after a short period of about two years after operation. To the best of our knowledge, there have been no previous studies on the long term effect of generalized joint laxity on outcomes of ACL reconstruction. The purpose of the present presentation is to compare the outcomes of ACL reconstruction between patients who had normal and generalized joint laxity, and investigate the effect of generalized joint laxity on ACL reconstruction outcomes for eight years. We also compare the five-year outcomes of ACL reconstruction in patients who had normal and generalized joint laxity according to the type of graft, and find an appropriate graft in ACL reconstruction for patients with generalized joint laxity. We hypothesize that generalized joint laxity would adversely affect outcomes of ACL reconstruction, patients who had generalized joint laxity would have worse outcomes over time and there would be an appropriate graft in ACL reconstruction for patients with generalized joint laxity.

We retrospectively review the medical records of 675 consecutive patients who underwent unilateral ACL reconstruction from January 2001 to December 2008 after obtaining approval by the institutional review board of our institution. The inclusion criteria were (1) an age of more than eighteen years, (2) a primary single-bundle ACL reconstruction, (3) an isolated ACL injury without a concomitant ligament injury, and (4) no osteoarthritis on plain radiographs (grade A on the IKDC radiographic assessment scale[13]). The exclusion criteria were (1) concomitant subtotal or total meniscectomy, (2) chondral lesion of more than Outerbridge grade II at arthroscopy[14], (3) malalignment of the lower extremity (the normal mechanical axis line passes 8 ± 7 mm medial to

the center of the knee joint line on standing hip-knee-ankle radiographs[15]), (4) previous surgery at the affected knee, and (5) previous injury of the contralateral knee. The included patients were classified according to the presence or absence of generalized joint laxity. Generalized joint laxity was assessed with the Beighton and Horan criteria using 9-point scoring system for all patients[16]. This criteria consists of nine components: passive dorsiflexion of both fifth fingers beyond 90°; passive opposition of both thumbs to the volar aspects of the ipsilateral forearms; hyperextension of both elbows beyond 10°; hyperextension of both knees beyond 10°; and forward flexion of the trunk with the knees fully extended and palms resting on the floor. One point was given for each component that the patient is able to demonstrate. The scores were tallied up and generalized joint laxity was defined as a score of ≥4 points (with a maximum of 9 points) on the basis of the cutoff most commonly cited in the literature[17].

This presentation consists of two topics. The first topic is to compare the outcomes of ACL reconstruction between patients who had normal and generalized joint laxity, and investigate the effect of generalized joint laxity on ACL reconstruction outcomes for eight years. The second topic is to compare the five-year outcomes of ACL reconstruction in patients who had normal and generalized joint laxity according to the type of graft including bone-patellar tendon-bone and hamstring autografts, and to find an appropriate graft in ACL reconstruction for patients with generalized joint laxity.

Regarding the first topic, total one hundred and sixty-three patients were included in the present study. These patients were followed up for minimum two years. One hundred and thirty patients were followed up for five years. One hundred and eight patients were followed up for eight years. The patients were divided into two groups according to the presence or absence of generalized joint laxity. According to the results, the primary finding was that patients who had generalized joint laxity including hyperextension of knee had less stability and poorer functional outcomes during eight year follow-up after ACL reconstruction compared with patients who had normal joint laxity. Comparisons between two groups were made at two years, five years and eight years. Although there was no significant difference in proportions of patients who underwent meniscectomy and sustained graft rupture, significant differences in anterior stability assessed with the Lachman test and SSD in the anterior translation measured with KT-2000 arthrometer between two groups were shown across all the time period. The rotational stability evaluated with the pivot-shift test differed significantly after five years from operation. Functional outcomes of the Lysholm knee score and IKDC subjective score also differed significantly continuously for eight years. Comparisons between serial outcomes measured at two years, five years and eight years

after operation within each patient group showed that there was no significant difference of stability, functional outcomes and radiologic result in patients with normal joint laxity. However, stability measured with the SSD in the anterior translation and functional outcomes assessed with the Lysholm knee score and the IKDC subjective score differed significantly in patients with generalized joint laxity.

Regarding the second topic, total two hundred and thirty-seven patients were included in the present study. These patients were followed up for minimum two years. One hundred and eighty-nine patients were followed up for five years. The included patients were classified according to the presence or absence of generalized joint laxity. And then patients were subdivided into two groups in each group on the basis of used type of graft: bone-patellar tendon-bone(BPTB) autograft and hamstring (semitendinosus-gracilis) autograft. Consequently, a total patients were organized into four groups: group A consisting of patients with normal joint laxity treated with BPTB graft; group B consisting of patients with normal joint laxity treated with hamstring graft; group C consisting of patients with generalized joint laxity treated with BPTB graft; group D consisting of patients with generalized joint laxity treated with hamstring graft. Comparisons between four groups were performed at two years and five years after operation. Stability including the Lachman test, the pivot-shift test and SSD in the anterior translation measured with KT-2000 arthrometer, functional outcomes including the Lysholm knee score, IKDC subjective score and IKDC objective grade differed significantly at two years and five years. Pairwise comparisons between outcomes of BPTB and hamstring grafts in patients with generalized joint laxity showed that the patients treated with BPTB graft had better functional outcomes of the Lysholm knee score and IKDC subjective score than patients treated with hamstring graft. Comparisons between serial outcomes measured at two years and five years within each patient group showed that there was significant differences of stability measured with the SSD in the anterior translation and functional outcomes assessed with the Lysholm knee score and the IKDC subjective score in patients with generalized joint laxity regardless of used graft type.

The inherent extensibility of connective tissue that is determined by the orientation of the soft tissue structures and the composition of connective tissues primarily affects the characteristics of generalized joint laxity[18]. The laxity of passive restraint including ligaments, tendons and joint capsule was assumed to affect the stability of reconstructed ACL. It has been also noted that a reconstructed ACL might sustain more severe consistent stress in patients with knee hyperextension than in those without hyperextension because of structural condition resulting from inability to stabilize the knee and absorb ground reaction force[12,19]. The increased possibility

of roof impingement of the reconstructed ACL graft in hyperextension could be a consideration as well.

In summary, generalized joint laxity as inherent physiologic characteristics of patient was related to a significant adverse effect on stability and functional outcomes of ACL reconstruction in eight years follow-up study. Generalized joint laxity could be considered one of the risk factors for poor outcomes after ACL reconstruction. In patients who have excessive joint laxity, the five-year outcomes of ACL reconstruction with bone-patellar tendon-bone grafts are better than those with hamstring grafts in terms of functional outcomes.

REFERENCES

1. Kamath GV, Redfern JC, Greis PE, Burks RT. Revision anterior cruciate ligament reconstruction. *Am J Sports Med* 2011;39:199-217.
2. Jaureguito JW, Paulos LE. Why grafts fail. *Clin Orthop Relat Res* 1996:25-41.
3. Johnson DL, Swenson TM, Irrgang JJ, Fu FH, Harner CD. Revision anterior cruciate ligament surgery: experience from Pittsburgh. *Clin Orthop Relat Res* 1996:100-109.
4. Getelman MH, Friedman MJ. Revision anterior cruciate ligament reconstruction surgery. *J Am Acad Orthop Surg* 1999;7:189-198.
5. Shelbourne KD, Gray T, Haro M. Incidence of subsequent injury to either knee within 5 years after anterior cruciate ligament reconstruction with patellar tendon autograft. *Am J Sports Med* 2009;37:246-251.
6. Corsetti JR, Jackson DW. Failure of anterior cruciate ligament reconstruction: the biologic basis. *Clin Orthop Relat Res* 1996:42-49.
7. Vergis A, Gillquist J. Graft failure in intra-articular anterior cruciate ligament reconstructions: a review of the literature. *Arthroscopy* 1995;11:312-321.
8. Myer GD, Ford KR, Paterno MV, Nick TG, Hewett TE. The effects of generalized joint laxity on risk of anterior cruciate ligament injury in young female athletes. *Am J Sports Med* 2008;36:1073-1080.
9. Uhorchak JM, Scoville CR, Williams GN, Arciero RA, St Pierre P, Taylor DC. Risk factors associated with noncontact injury of the anterior cruciate ligament: a prospective four-year evaluation of 859 West Point cadets. *Am J Sports Med* 2003;31:831-842.
10. Ramesh R, Von Arx O, Azzopardi T, Schranz PJ. The risk of anterior cruciate ligament rupture with generalised joint laxity. *J Bone Joint Surg Br* 2005;87:800-803.
11. Kim SJ, Kim TE, Lee DH, Oh KS. Anterior cruciate ligament reconstruction in patients who have excessive joint laxity. *J Bone Joint Surg Am* 2008;90:735-741.
12. Kim SJ, Moon HK, Kim SG, Chun YM, Oh KS. Does severity or specific joint laxity influence clinical outcomes of anterior cruciate ligament reconstruction? *Clin Orthop Relat Res* 2010;468:1136-1141.

13. Hefti F, Muller W, Jakob RP, Staubli HU. Evaluation of knee ligament injuries with the IKDC form. *Knee Surg Sports Traumatol Arthrosc* 1993;1:226-234.
14. Outerbridge RE. The etiology of chondromalacia patellae. *J Bone Joint Surg Br* 1961;43-b:752-757.
15. Paley D. Normal lower limb alignment and joint orientation. In: Paley D, Herzenberg JE, eds. *Principles of deformity correction*. Berlin Heidelberg: Springer, 2002;1-18.
16. Beighton P, Horan F. Orthopaedic aspects of the Ehlers-Danlos syndrome. *J Bone Joint Surg Br* 1969;51:444-453.
17. Seckin U, Tur BS, Yilmaz O, Yagci I, Bodur H, Arasil T. The prevalence of joint hypermobility among high school students. *Rheumatol Int* 2005;25:260-263.
18. Pearsall AW, Kovaleski JE, Heitman RJ, Gurchiek LR, Hollis JM. The relationships between instrumented measurements of ankle and knee ligamentous laxity and generalized joint laxity. *J Sports Med Phys Fitness* 2006;46:104-110.
19. Park HS, Wilson NA, Zhang LQ. Gender differences in passive knee biomechanical properties in tibial rotation. *J Orthop Res* 2008;26:937-944.