

CURRENT CONCEPTS REGARDING ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

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Abstract: Anterior cruciate ligament reconstruction is regarded as the standard procedure in patients suffering anterior cruciate ligament injuries, whereas the conservative approach often fails to alleviate all issues involved. Controversy still exists in literature regarding aspects of the reconstruction technique and this study aims to provide answers to some of the conflicting aspects that arise in today's literature. We assessed recent literature, with most of the studies dating from 2015 to 2017 and analyzed aspects such as graft choice, surgical technique, tunnel placement and time to intervention. Bone-patellar tendon-bone graft seems to be leading to osteoarthritis, while stability proved relatively deficient when single-bundle reconstruction was performed. Transtibial drilling technique reportedly presents inferior results. Surgery delay was correlated with meniscal injury. The aspects and recommendations in the studies reviewed were not always consonant. The best surgical approach is still debatable and further studies need to be done before reaching consensus in this matter.

Anterior cruciate ligament reconstruction is a routinely performed task by the orthopedic surgeon. Usually, the patients largely comprise of young, active people, not only professional athletes. A conservative approach often does not eliminate all the problems and sometimes recurrent symptoms persist, along with the potential progressive degenerative joint disease. Anterior cruciate ligament reconstruction (ACLR) is the preferred treatment option, widely regarded as the golden standard for this type of injuries.(1,2)

There are certain controversies that arise involving certain aspects of the reconstruction technique and studies in literature report dissonant results. Whether it is about hamstring technique (HS) or bone-patellar tendon-bone technique (BPTB), about single- or double-bundle reconstruction, about the type of graft used or even the time until the intervention (early or late), this study aims to provide answers to these conflicting aspects of today's approach of the ACL injuries.(3)

Graft choice

The first question was to answer which is better: reconstruction using the hamstring technique or the bone-patellar tendon-bone one. We found a number of studies that focused on the long-term difference in the functional outcome between the two aforementioned techniques. In a 15-year follow-up of a randomized control trial, Webster et al found no significant overall differences between the HS and BPTB. Initially, there was reported at up to 3-year follow-up a loss of extension range of motion for BPTB. This was consistent with other findings in the literature and, nonetheless, the issue had resolved at the 15-year follow-up.(4) The same issue was found by in a similar study. Leys affirmed that the extension deficit was significantly higher at the 15-year follow-up in the same category of patients. Moreover, between 10 and 15 years, a decline in performance of the single-legged hop test was reported for those who received a patellar tendon graft, all signs indicating this was probably due to osteoarthritis.(5) In another

follow-up study, Sajovic discovered that those who received patellar tendon graft were more prone to osteoarthritis 11 years after the surgical intervention, contrary to other studies in the literature.(6)

Surgical technique

To measure the different possible outcomes between the single-bundle (SB) and double bundle (DB) groups of patients, Mayr, in a prospective randomized study, performed the IKDC 2000 Objective Scores, knee laxity measurements and radiographic evaluation and concluded that there are no differences between single- or double-bundle anatomic reconstructions 2 years after surgery.(7) Emphasizing the importance of the pivot-shift test for determining the difference in rotatory laxity preoperatively and postoperatively in the SB and DB groups, Ahldén concluded that there is no difference between SB and DB groups 2 years after surgery, both in terms of laxity objectively demonstrated with the pivot-shift test and other objective outcome variables; the study also suggests that there are different outcomes in similar studies because of the subjectivity of the pivot-shift test, making it challenging to compare different results.(8) Further empowering these results, Jeong-Ku Ha stated that there are no statistically different outcomes between the two groups in terms of subjective knee scores, static stability, functional performance tests, pivot shift test, and isokinetic muscle strengths, although suggesting that a 2-year follow-up is not enough to clearly validate these findings.(9) In another randomized controlled trial, which presented mid- to long-term results of SB and DB ACLR using the transtibial approach, DB reconstruction was significantly better than SB reconstruction in terms of anterior and rotational stability during the 3- to 12-year follow-up, proven by the objective use of Lachman and pivot-shift tests and also in terms of sport activity level, better and longer maintained in the DB group, in which the Tegner score was also superior.(10) In a prospective randomized comparison of knee stability and joint

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degeneration for single- and double-bundle ACL reconstruction, Sun also showed that double-bundle ACL reconstruction can achieve better anterior and rotational stability and also maintains a lower rate of arthritic progression and tunnel expansion 3 years after surgery, in line with other in vivo and clinical studies and suggests that DB ACL reconstruction can lower the incidence of osteoarthritis by closely restoring contact area and pressure.(11) Morey reported in a similar study that there is a statistical difference between SB and DB, with better IKDC, Lysholm and Cincinnati scores in favor of the DB group, although his patients were mostly non-athletes.(12)

Tunnel placement

Another technical aspect that needs to be taken into consideration is the ACL reconstruction drilling technique/either by the transtibial (TT) or anteromedial (AM) drilling techniques. A retrospective comparative study on non-athletic patients that underwent primary ACLR demonstrated that the femoral tunnels drilled through the AM portal were positioned more horizontally and anatomically, although the difference was not statistically significant and there was no clinical superiority for the AM technique compared to the TT approach at the short-term follow-up.(13) Another study published in 2016 presented similar outcomes in terms of tunnel placement, as AM drilling technique proved better than TT approach in creating femoral tunnels within anatomical range, according to the radiological evaluation method of Illingworth and the patients in the AM group began jogging and returned to normal life significantly sooner than those in the TT group, but there were no superior clinical outcomes.(14) Studies also concluded that the risk of impingement is lower if AM technique is used, eliminating the need of notchplasty.(15,16) Ozel found that in patients treated by the TT approach, there was a statistically significant relationship between femoral tunnel widening and both anterior knee stability and clinical outcomes, whereas this relationship was not found in the AM group of patients, recommending that the anatomical femoral tunnel placement should be performed detrimental to the transtibial placement.(17) Although it was proven in Wang's study that the AM technique showed better results than the TT approach in terms of anterior-posterior stability of the knee during the swing phase as well as the axial rotational stability at midstance, there were concerns raised about the fact that the AM ACLR can lead to extension deficits during the late stance phase.(18) In Franceschi's study on athletes, femoral drilling using AM technique also provided superior results in comparison with the TT approach in regard with improved anterior-posterior laxity and stability of the knee and while patients in the AM group were more likely to return to the level of activity before the surgery, no statistically significant differences were found at the 5-year follow-up regarding Lysholm and IKDC scores and the occurrence of degenerative changes on radiography.(19) Using 3D Computed Tomography, Takeda reported in a comparative study that the average values for the anatomical footprint reported in previous studies were obtained for the anteromedial (AMB) and posterolateral (PLB) bundles through the far AM portal and that the angles for the femoral and the tibial tunnels in the AM group were significantly different from those in the TT group concluding that the anteromedial portal technique may decrease the risk of tunnel aperture coalition between the AMB and PLB tunnels.(20) The same two techniques were assessed comparatively via conventional MRI in a study and although the position of the femoral tunnel aperture was more posterior, Telos score was better and the average Lysholm test was 3 points higher in the AM group, no statistically significant differences were found in the IKDC score or Tegner activity scale between the AM and TT groups.(16) One study by

Rezazadeh points out the importance of the need of an experienced surgeon and the performing of a well-done technique, since they found no statistically significant difference between AM reconstruction technique and the TT approach regarding the IKDC rating, the Lysholm score and Tegner scale.(21)

Time to intervention

There is an ongoing debate concerning the time until ACL reconstruction, since there are a lot of discrepancies between the results published in the literature. Both the early intervention and the late one have proven to have positive aspects as well as drawbacks. There are a lot of factors that need assessment prior to the decision for intervention, among them being the swelling, edema, range of motion (ROM) and even the orthopedist's preference, patient's support system.(22) A reason for the lack of an universal recommendation for the time until procedure may be the absence of a general consensus regarding the definitions of early and late interventions, Evans also reporting that a third definition for ACLR may help in defining timeframes, thus allowing some clarification on this matter.(23) Krutsch recommends that early intervention should be of election, since his findings in a study published in European Society of Sports Traumatology, Knee Surgery, Arthroscopy (ESSKA) journal show a statistically higher number of repairable meniscal injuries in ACLR within the first months after trauma compared to the operation being done at 7 to 12 months after the trauma.(24) Another study reported lower chances of meniscal repair, increased rate of meniscal and articular cartilage lesions in patients that underwent ACL reconstruction more than a year after the surgery and the pain that was experienced by the patients was significantly associated with these intra-articular lesions.(25) A study that defined "early intervention" as ACL reconstruction performed in the first 3 weeks after injury and "delayed intervention" as the reconstruction done after 3 months reported that the patients in the early intervention group showed a higher possibility of meniscal repair, although there were no other statistically significant differences in terms of functional scores, muscle power and posture control, ROM and incidences of meniscal or cartilage injuries.(26) Similar results were discovered by de Campos who concluded that increased time between injury and ACL reconstruction increased the chances that other intra-articular lesions of the knee would occur, with higher chances of injury to the medial meniscus after 6 months and to the cartilage after 24 months when compared with the period of up to 2 months.(27) These are in line with Gupta's findings which showed a correlation between the ACLR delay beyond 6 months after injury and damage to the medial meniscus, recommending that the reconstruction should be made in the first 3 months after the injury.(28) Regarding highly active patients and competitive athletes, the time until intervention can be as little as 48 hours, as Herbst stated in a study that there was no significant difference regarding the range of motion (ROM) between surgery that took time within 48 h and a delayed surgery in the inflammation-free interval, also mentioning that early ACLR is more cost-effective than a delayed operation after an early preoperative rehabilitation and thus the delay of return to sports is avoided.(29) In contrast, a study performed over a 5-year period did not find any statistically significant economic value for an early intervention compared with a strategy of rehabilitation with the option of delayed ACLR when needed, highlighting the risk of overtreatment after acute ACL injury and the importance of the fast detection of patients that can benefit from any of the mentioned strategies, although a long-term follow-up beyond 5 years is needed to assess the risk of the development of osteoarthritis.(30) Age seems to be a key factor

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influencing the outcome of ACLR timing, since a study found that the correlation between increased time from injury to ACL reconstruction and higher prevalence of medial compartment injury may not be consistent across all ages of patients, those being 22 years old and older being more affected.(31)

The best course of action for the anterior cruciate ligament reconstruction is still subject to controversy and the plethora of factors that affect the outcome of the intervention need further assessment. As far as the graft choice is concerned, we found in the literature that the hamstring graft is a more viable candidate, as the bone-patellar tendon-bone graft can lead to osteoarthritis.(5,6) Double-bundle technique seems to be preferred over single-bundle, as the stability of the knee is better achieved using the former method.(10,11) Some studies suggest that the anteromedial approach should be used instead of transtibial technique, although this is not supported by everyone.(19,21) The best time to intervention is hard to be determined, as there are no universal definitions for the early or late reconstructions, although the majority of studies point out the higher incidence of associated meniscal injury when surgery is usually delayed.(23,24,25)

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