Trends in anterior cruciate ligament reconstruction: an "individualized approach"

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Comment on: Fu FH, Burnham JM. The importance of individualized, anatomic anterior cruciate ligament (ACL) reconstruction—for Annals of Joint Special ACL Edition. Ann Joint 2017;2:46.

Submitted Aug 07, 2018. Accepted for publication Aug 13, 2018.
doi: 10.21037/atm.2018.08.19
View this article at: http://dx.doi.org/10.21037/atm.2018.08.19

Recently, *Annals of Joints* has published a focused issue on "Trends in ACL Reconstruction" conducted by Freddie Fu and Jeremy Burnham. This is a remarkable update for whoever is interested in ACL pathology.

After years of experience in anterior cruciate ligament (ACL) reconstruction, we can go to the conclusion that there is not one similar rupture of the ACL. Each case is particular with its specific mechanism, anatomic lesions which occur on an individual with its native anatomy, neuromuscular control, age, activity and patient's expectations. Thus, there is a need for an individualized treatment and it is the main message highlighted in the preface of this issue, written by Freddie H. Fu and Jeremy M. Burnham (1). We still have a room of improvement in the comprehension and the management of the ACL tear. In this focused issue, different review articles, written by renowned experts, brought the latest updates concerning this topic and will help people that are in charge of the ACL injuries.

The first review article of this focused issue, written by Lucidi *et al.* is a hot topic (2). It is recognized that the anterolateral complex of the knee plays a role to control the internal rotation of the lateral tibial plateau. Different structures has been identified and studied as the iliotibial band, Kaplan fibers, capsule-osseous layer and more recently the anterolateral ligament (ALL). Their respective biomechanical roles in the control of the anterolateral laxity are still controversial. Their exact anatomy is even still controversial like the ALL or the capsule-osseous layer. Lucidi *et al.* review the current literature concerning the anatomy and biomechanics of the anterolateral complex. It appears that we still have a lack of evidence to know which lateral extra-articular procedure must be performed, for which kind of laxity, for which patient and if there is a risk of over-constraint with consequences for the future. This is an area which should be more explored as it can help to reduce the possibility of ACL reconstruction failures due to a persistent rotational laxity.

The knowledge of the micro-structural properties of the ACL facilitates to understand the pathology and guides the treatment. With the help of a new imaging technique, the quantitative polarized light imaging, Skelley *et al.* concludes that the anteromedial and posterolateral bundles have different microstructural properties (3). The anteromedial part of the ACL is stronger and stiffer. Actually, this supports the choice of anteromedial bundle reconstruction in case of single bundle reconstruction. An important information highlighted by this chapter is that the microstructural human ACL properties follow a linear gradient across the ligament, rather than grouping by distinct bundle. So, double bundle defenders are comforted in the same time than those opposed to double bundle. However, it is clear that the ACL microstructure is complex, not homogeneous, with variation of properties from the posterolateral part to the anterolateral part of the ligament. The article written by Skelley *et al.* helped the surgeons in their difficult task to reproduce the native anatomy of the ACL.

The medial meniscus is a secondary stabilizer for anterior tibial translation. It is recognized that the lesions of the medial meniscus body must be repaired, if possible, during the ACL reconstruction. There is still controversy about

the diagnosis and the treatment of the ramp lesions, as mentioned by Pfeiffer *et al.* in their paper (4). The incidence is significant, between 9.3% and 17%. The capability of the MRI to detect the ramp lesion is limited (the sensibility is less than 80%). Therefore, the gold standard remains the arthroscopy but it needs to be specifically identified. At least an intercondylar view must be performed, but the best way to detect these lesions is the posteromedial view. Does it mean that we have to perform a posteromedial portal in every ACL reconstruction? No current evidence can support that but a better awareness of the existence of this lesion should be recommended. Highlighting on the preoperative MRI, systematic intercondylar exploration and, in case of doubt, an additional posteromedial portal must be performed particularly in chronic cases, where the lesions are more frequent and the capability of self-healing is less important. Both direct suture through the posteromedial portal and all-inside devices have shown good results in the repair of the ramp lesions.

Burnham *et al.* focused their chapter on the bone morphologic factors affecting injury risk, rotator stability, outcomes and re-rupture after ACL reconstruction (5). The risks of ACL tear or ACL graft tear are multifactorial. Currently, multiple studies have shown that some bony characteristics in patient's native anatomy can increase the risk of ACL tear and can influence the rotation's knee laxity. A high posterior tibial slope (>12°), a bigger posterior condylar offset and a narrow intercondylar notch (Notch Width Index <0.27 or absolute width <15 mm) are recognized as risk factors for ACL tear and ACL re-tear after ACL reconstruction. The rotatory laxity of the knee is influenced by the posterior tibial slope, the lateral tibial plateau's width and the posterior condylar onset.

The surgeon must take into consideration these factors before to perform the surgery and must adapt sometimes the treatment. Even if a tibial deflexion osteotomy can be performed in case of high posterior tibial slope, particularly in case of ACL revision, all anatomic factors can't be corrected. Furthermore, their presence can lead to additional procedure, like additional extra-articular procedure in case of factors increasing the rotational laxity, optimization of the graft position and choice of graft diameter in case of narrow intercondylar notch, or adjustment of the postoperative protocol and return to play. This illustrates again how the treatment must be individualized.

The success of the ACL reconstruction is in part related to the anatomic reproduction of the native ACL. It is particularly challenging on the femoral side as the access is more difficult than for the tibial side. Nowadays, the discussion is not much on the transtibial technique which has been abandoned by the majority of the surgeons. The question remains about which technique is better between outside-in and through anteromedial portal. Shino *et al.* describe their outside-in technique and through the far anteromedial portal (6). For them, the advantages of the first technique are: good view on the femoral site while drilling, no risk of medial condyle cartilage damage and no need for deep flexion of the knee during the procedure. However, it needs an additional short lateral incision and a specific drill-guide. The anteromedial portal technique is routinely performed with a good access to the femoral site insertion in the majority of the cases. Young surgeons should be aware about the risk of medial condyle damage during the drilling process. A simple protection avoids this complication but it worths to be mentioned as it is probably under-estimated.

ACL revision are more challenging than primary ACL reconstruction. Sometimes, the cause is multifactorial, it must be identified before any revision and the surgery itself is often more difficult. One of the technical challenges is the tunnel enlargement and bone deficiency, particularly when the previous tunnels are overlapping the new anatomical tunnels. The surgery can be done in one or two stages, according to the tunnels and the quality of the bone. In case of a massive osteolysis, defined as more than 14 mm of tunnel enlargement, Laidlaw *et al.* recommend to perform the surgery in 2 stages (7). During the first stage, all metallic hardware should be removed. The tunnels are debrided, using curettes and serial reamers. Then the surgeon has different options to fill the cavity: allograft chips, allograft dowels (preference of the main author of this chapter), allograft femoral head or autograft from the Iliac crest. The second stage won't be planned before perfect bone integration and consolidation, usually between 4 and 6 months.

When one stage is possible, it is frequent to face the problem of overlapping tunnels where the previous trajectory and aperture are partially included in the new planned tunnels. Different techniques, sometimes combined, are used to solve the issue: different orientation of the new drilled tunnel, use of allograft dowels before the drilling, use of stacking screws, optimization of the graft diameter (quadriceps, 5 bundles hamstrings, hybrid grafts). A double fixation in ACL revision is highly recommended, particularly on the tibial side as the quality of the bone is usually poorer than in a primary reconstruction.

The ACL injuries are so frequent that, since few years,

the term "epidemy" has been used in the literature. It represents a heavy burden in short term and long term. Thus, efforts have been developed these last years to identify and detect the extrinsic risk factors through screening techniques and to implement prevention programs. The article written by Hickey Lucas *et al.* illustrates this (8). Position of the trunk (vertical position, lateral position) and hip strength and position (adduction and internal rotation) are correlated to the rate of ACL tears. Early identification of abnormal hip and trunk position, and detection of impaired strength can be done by using different tests like LESS (Landing Error Scoring system), isometric hip strength, the Tuck Jump, and hip rotation passive range of motion. The authors emphasize that only the two first tests have been assessed prospectively.

The two most studied prevention programs are the FIFA 11+ program and the neuromuscular programs including strength and balance training. Both can decrease the rate of ACL tears but it is recommended to start these programs while the athlete is young and to continue the training throughout their career.

The screening tests can identify the high risk patients to sustain an ACL tear in their career. However, a study comparing the cost-effectiveness of prevention in all athletes versus only high risk athletes, has suggested that inclusion of all athletes is more cost-effective. This is a message to send to all coaches, team doctors and athletes.

After ACL reconstruction, the usual and probably the most important question for an athlete is: "When can I go back to play?" Despite the progress of the ACL tear management, there is still a high rate of re-ruptures after ACL reconstruction, up to 18% or more depending on the population and the follow-up. Half of these re-ruptures happen within the first 12 months highlighting the role of functional recovery and premature return to sport. Herbst *et al.* summary in their article the current functional tests that are used for a safe return to play (9). There is not one universal test which can help to give the green light for return to activity, one must selects a battery of different tests that are used for physiotherapy discharge criteria. There is little evidence of normative values of these tests, the majority of teams are using the Limb Symmetry Indices (LSI), meaning comparison with the opposite healthy side. Three main factors are tested: muscle strength, speed/agility and neuromuscular/postural control.

The muscle strength is assessed with isokinetic measurements and with dynamic tests like hop tests. A quadriceps and hamstrings LSI >90% is the usual accepted threshold for return to play. However, the hamstring to quadriceps ratio is also important and should be around 80%. Hip and trunk muscle strength must be considered as well. Speed and agility are prerequisites for return to play, especially for competition. They are assessed by different tests like speedy test or agility T-test. In order to test the neuromuscular control and the postural control, different tests and devices are used to assess the balance.

The functional assessment should be integrated to the rehabilitation program after ACL reconstruction, even if there is still a lack of evidence whether which tests must be used to define accurate discharge criteria. Nonetheless, it needs several devices which are not always available in every physiotherapy center and the practical implementation of these functional assessments should be simplified in order to generalise them.

There is no doubt that the clinical outcomes measurements should be used after any ACL reconstruction. It is the best way to assess the results of the surgery and it is a base for studies and comparison between different centers of treatment. Which one is the best after ACL reconstruction in daily practice? Currently, there is no clear answer. Meta *et al.* propose an excellent review of the current outcome data measurements after ACL reconstruction with their advantages and disadvantages (10). They emphasize on the use of patient reported outcomes (PRO). The objective measures have the advantages to be consistent and reliable, but they don't incorporate the patient's perspective. Besides objective measures, the patient's perspective must be considered, particularly for the functional outcomes.

Within the PRO systems, the International Knee Documentation Committee (IKDC) Subjective Knee Form (SKF) is the most used. The authors consider IKDC-SKF to be the preferred choice to assess the PROs after ACL reconstruction, with well-established measurement properties and patient relevance. The Lysholm knee score combined with Tegner activity scale is the older PRO measures but it is still valid and used as it is simple, brief and convenient. This makes it as one of the preferred system used.

KOOS (Knee Injury and Osteoarthritis Outcome Score) is the fourth used in the literature. The authors consider that the number of questions and unrelated sub-scales make it a weaker choice for ACL reconstruction reporting.

They propose that clinicians should consider a "milestone PRO" when evaluating high-demand patients: the time required to return to pre-injury level of function. In addition, an important factor for ACL recovery is the patient reported

psychological assessment. The psychological factors are important in the quality of return to sport and there is certainly a need for a psychological assessment tool to predict recovery in ACL-reconstructed patients.

One original article completed this booklet, Jacobs *et al*. reported the cost-effectiveness of hamstrings reconstruction with or without allograft augmentation in ACL reconstruction (11). In a previous study, they showed that in adolescent population, the augmentation of the hamstrings graft with an allograft reduced the rate of re-rupture and therefore it was cost-effective. In the current study, for patients aged more than 25 years, they founded that the allograft augmentation did not reduce the rate of re-rupture and was not cost-effective. This information can help surgeons who have the possibility to use allograft augmentation to select their patients for hybrid reconstruction.

In conclusion, this focused issue is worthy to be read as it provides at large most recent updates about the ACL reconstruction. I hope you will enjoy reading it as much as I did.

Acknowledgements

I would like to show my gratitude to Mr. Fawaz Hamie for his participation to the manuscript edition.

Footnote

Conflicts of Interest: The author has no conflicts of interest to declare.

References

1. Fu FH, Burnham JM.. The importance of individualized, anatomic anterior cruciate ligament (ACL) reconstruction—for Annals of Joint Special ACL Edition. Ann Joint 2017;2:46.
2. Lucidi GA, Hughes JD, Herbst E, et al. Role of the anterolateral complex in rotatory instability of the anterior cruciate ligament deficient knee. Ann Joint 2017;2:35.
3. Skelley NW, Lake SP, Brophy RH. Microstructural properties of the anterior cruciate ligament. Ann Joint 2017;2:19.
4. Pfeiffer TP, Murphy CI, Arner JW, et al. Identification and treatment of RAMP lesions in anterior cruciate ligament-injured knees. Ann Joint 2017;2:17.
5. Burnham JM, Pfeiffer T, Shin JJ, et al. Bony morphologic factors affecting injury risk, rotatory stability, outcomes, and re-tear rate after anterior cruciate ligament reconstruction. Ann Joint 2017;2:44.
6. Shino K, Iuchi R, Tachibana Y, et al. Anatomical femoral tunnel creation: outside-in versus anteromedial portal. Ann Joint 2017;2:34.
7. Laidlaw MS, Buyukdogan K, Werner BC, et al. Management of bone deficiency in revision anterior cruciate ligament reconstruction. Ann Joint 2017;2:38.
8. Hickey Lucas KC, Kline PW, Ireland ML, et al. Hip and trunk muscle dysfunction: implications for anterior cruciate ligament injury prevention. Ann Joint 2017;2:18.
9. Herbst E, Wierer G, Fischer F, et al. Functional assessments for anterior cruciate ligament reconstruction return to sport. Ann Joint 2017;2:37.
10. Meta F, Lizzio VA, Jildeh TR, et al. Which patient reported outcomes to collect after anterior cruciate ligament reconstruction. Ann Joint 2017;2:21.
11. Jacobs CA, Malempati CS, Makhni EC, et al. Allograft augmentation of hamstring autografts was not a cost-effective treatment option for middle aged patients undergoing primary anterior cruciate ligament reconstruction. Ann Joint 2017;2:24.

Cite this article as: Landreau P. Trends in anterior cruciate ligament reconstruction: an "individualized approach". Ann Transl Med 2018;6(22):430. doi: 10.21037/atm.2018.08.19

