Hubert LANTERNIER ISAKOS

Short Grafts for ACL Reconstruction

Basic Science; Surgical Technique; Tips/Pearls/Pitfalls/Advantages/Disadvantages; Clinical Results

Short graft anterior cruciate ligament reconstruction has set itself apart from standard ACL reconstruction techniques. The noticeably shorter nature of the graft requires that almost every facet of the procedure be re-examined. Thus graft preparation, tunnel management, graft placement and fixation need to be approached differently, which brings into question a number of biological, biomechanical and surgical issues. **By short graft we imply the introduction of a minimum and adequate collagen tissue bundle being press fit into a limited socket in the epiphysis at the anatomic footprints of the native ACL to obtain a primary fixation and healing of the ligament.**

The first part did touch on the theory behind this concept and attempt to answer the legitimate questions that have been raised about this new approach.

In this part we will tackle the technical details of this procedure, which will lead to a discussion of commercially available products, since a specific fixation system is required with a short graft. We will describe and share our experience about the TLS / CoLS technique, we do not intend to cross swords in a mini battle with other systems, because the approaches are quite similar and the spirit remains the same.

The short graft is not merely a new length or new fixation method—it is a whole new surgery: all is different. The graft’s preparation (only one tendon), the pretension (to obtain a rigid construct), the bone sockets (retro-drill), the graft introduction (through the medial portal), the fixation (allowing a 360° contact) will be described and discussed.

**The graft preparation and pre-tension**

**The deal:** create a short complex “fixation / graft / fixation” with high rigidity which will be introduced and secured with low tension to reproduce, as close as possible, the normal laxity of the native ACL. Regarding the properties of the complex, we don’t have to consider over tensioning to anticipate a secondary distension. And this approach leads to numerous advantages: The posterior subluxation, the cartilage stress, the pain and the high stress on the graft waiting for the secondary distension are all avoided.

**The technique:** we need 30 /35 mm to replace the ACL, plus 10 mm to fill the femoral socket, plus15 mm for the tibial socket, total length about 55 /60 mm. The Semi Tendinosus (ST) is wrapped and sutured around the posts and tapes (pulley effect) and then the complex “tape-graft-tape” receives a tension of 300 N on a bench for 2 minutes usually resulting in a lengthening of 2-3 mm. This elongation occurs at the tape/graft junction, not in the collagen structure that is not damaged by 2 minutes of traction as shown by Robert and Guillard (8). This pre-tension at 300 N is lower than the one induced by the post op walking and
rehabilitation (12) and it’s certainly better to get an elongation of the graft before implantation than in the first several weeks following implantation.

**The bone sockets and the retro-drill**

**The deal:** two sockets, position, diameter, depth.

**The technique:** hand-powered retro-drill, from the outside-in for the tibia and the femur. The correct position is decided and then marked with a pilot hole in which the guide will be secured. A K wire is inserted, then overreamed at 4.5 mm before the manual retro-drill is inserted. The depth of the socket is 10 mm on the femur, 15 mm on the tibia and its diameter (6 to 11 mm) is determined by the graft size. The cancellous bone is soft and there is no need for a power tool. The soft cancellous bone allows for the “pull and glide technique” and protects the posterior wall on the femur. Due to the soft cancellous bone the graft will easily enter the socket even in the case of a tight press-fit. The extra articular part of each tunnel is tapped to receive a firmly secured canula. The retro-drilling is less aggressive to the bone than classical drilling and the following observations have been confirmed: less micro-fractures in a cadaver study (10), less post-operative pain and bone bruising as shown by R. Lopes in a clinical study that compared the pain scores and bone imaging with early post op MRI (9).

**The graft introduction through the medial portal**

**The deal:** the graft is introduced through the arthroscopic medial portal, this avoids the paradox of a classical trans-osseous introduction: the comfortable diameter required to avoid damaging the graft prevents the good press fit. The shallow socket also avoids the creation of a large life-long bone tunnel to drive in a few seconds the graft into the joint. This concept is bone saving as it is possible to scale down the diameter of the socket due to the cancellous bone accepting the graft when appropriate force is applied to the tapes even if the graft itself is tightly press fit.

**The technique:** threads and shuttle relays drive the graft which is firmly pushed into the sockets “to fit like a glove” by pulling the tapes. The sardine key technique (wrap the tapes around a clamp at the exit of the cannula and turn it) will increase the power of the traction and gently push the cancellous bone for a good press fit in both depth and diameter. The sardine key technique is not intended for applying a tension but for fitting the graft: the traction is released as soon as the graft is correctly settled. A tight 360° bone to graft contact will promote the conditions for aperture healing (2).

**The graft tension is a leading question**

**The deal:** reproduce the normal laxity (no over-tension) and secure the graft with stiff fixation (to avoid a secondary elongation). This challenging goal has to be analysed as a normal ACL is not tight. (The normal ACL exhibits a few millimetres of normal laxity on the KT 1000). The “à la carte” reconstruction is not only a matter of position and thickness, but the tension also has to be considered. The ideal tension is the one which reproduces the contra-lateral knee, as described and discussed by Dominik (7) and Bastian (1). Obviously this concept
needs a very stable fixation and rigidity as there is no security reserve anticipating an eventual secondary elongation.

The technique: the graft has been correctly pulled into the sockets. Maintain the traction on the tapes by gently pulling on them and insert the screws to lock the tapes. An over tension is not recommended as it would induce immediate posterior subluxation and cartilage stress. An over tension is not necessary as there’s no need for anticipating a secondary elongation insured during graft preparation. An over tension is dangerous as the graft might keep its stiffness: the necessary adaptation could then occur later and damage the graft or the knee or both. In a preliminary study of 74 knees operated on according to the principles recommended with the TLS/CoLS technique at 5.5 years we have a 5.2% rate of failure or re-rupture and the remaining cases have a differential laxity of 1.6 mm (+/- 1.3mm) on the KT 1000. The concept of a low manual tension and a stiff graft and fixation seems promising.

The fixation

The deal: maintain the graft at the decided tension.

The technique: the screws will lock the tapes: by strongly gripping in the cortex and packing the tape into the cancellous bone they create a semi-aperture fixation. The mechanical properties of the complex “graft fixation” have been tested according the the experimental protocol of Coleridge and Amis (3) with a mean elongation after cycling loading of 1.23 mm and a mean yield load of 1015 N.(13). Besides those mechanical properties it has to be considered that the graft which will not be damaged by the screws and the bone will be protected as the 360° graft / socket contact avoids the large connection of the synovial fluid to the cancellous bone.

Conclusion

The short graft is not merely a new length or new fixation method—it is a whole new surgery. It has come of age and has not experienced any major setbacks in the past decade. It is now a mature and validated technique. Its initial fundamental principles have been proven and have changed little over time


