Anatomic ACL Reconstruction: "Back to the Future"

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The anterior cruciate ligament (ACL) is a ligament in the knee that courses from the posterolateral wall of the intercondylar notch to the anteromedial tibial plateau. The ligament is partially responsible for the complex kinematics of knee range of motion. Specifically, the ACL is responsible for limiting anterior tibial translation and internal rotation of the tibia.

Tears of the ACL are very common in athletes both young and old. It is estimated that over 200,000 ACL injuries occur every year in the US. Unfortunately, it is challenging to return to higher demand cutting sports without an ACL. Occasionally, high level athletes are able to return after an intensive physical therapy regimen. More commonly, however, an ACL reconstruction is required for return to high level athletics.

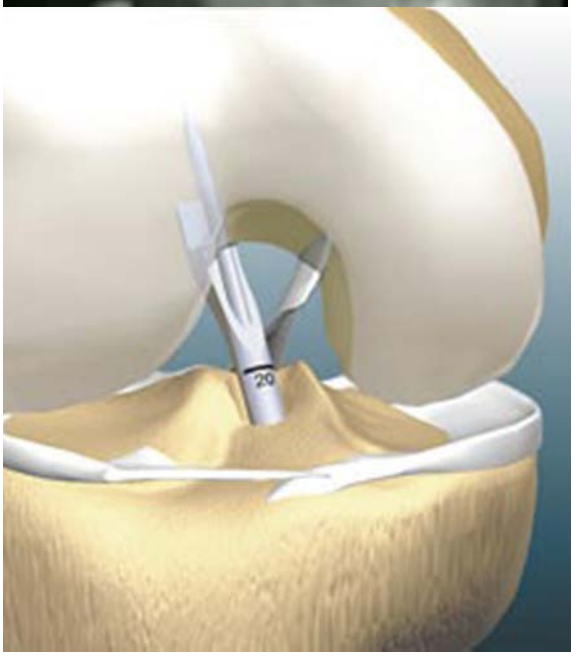
Injury to the ACL was once thought to be a career ending injury for athletes before the 1970's. ACL reconstruction surgeries, however, have been described since 1903. Early efforts with silk ligaments were not particularly successful. For many years, extra-articular reconstructions using the iliotibial band were utilized in an attempt to stabilize the knee joint. These techniques were met with variable levels of success. The first use of the patellar tendon for ACL reconstruction was by Dr. Enjar Ericksson of Sweden. His reconstruction technique utilized the intact insertion of the patellar tendon to stabilize the knee. After Dr. William Clancy attended one of his lectures, he built on the choice of the graft patellar tendon for reconstruction. Dr. Clancy took the next crucial step of taking that graft and placing that graft into drilled tunnels at the origin and insertion of the ACL. Early results were extremely encouraging and the modern ACL reconstruction was born.

The Clancy technique of ACL reconstruction was successful based on a few key reasons. First the graft was placed in the correct anatomic position. Secondly, the graft was rigidly fixed into position to avoid migration during the healing process. Finally, the patellar tendon graft incorporated into the tunnels quickly and remodeled efficiently into a ligament following implantation.

"History is nothing more than taking two steps forward and one step back," Dr. Clancy says. "That has been the total history of the ACL." Early rehabilitation included up to six weeks in a cast prior to initiating motion. Needless to say, we have made some improvements over the years with regard to our postoperative care of ACL reconstructions. The evolution of the surgical technique of ACL reconstruction, however, has not maintained the anatomic accuracy that is required for successful reconstructions.

The original technique of ACL reconstruction involved two incisions to place the graft. One incision was made to drill the tibial tunnel. Another incision was made up on the lateral aspect of the femur to drill the femoral tunnel. One of the key ingredients to success with this technique was the ability to independently drill the tibial and femoral tunnels. This allows **anatomic** placement of both the origin and insertion of the ligament reconstruction. Where else would you want to put it??

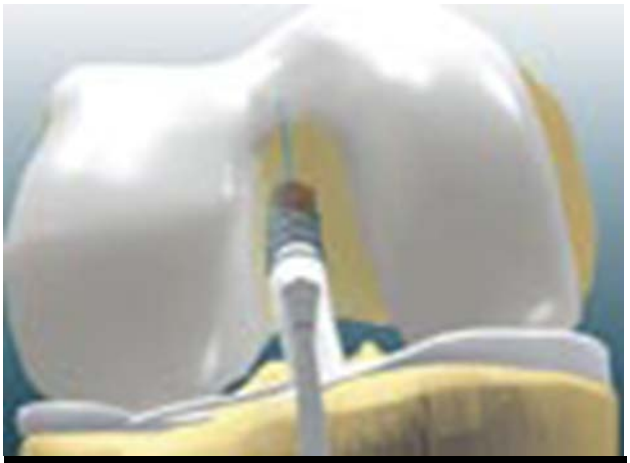
As arthroscopic techniques evolved, an all arthroscopic ACL reconstruction technique referred to as the "transtibial technique" took over in the mid 1990's. The minimally invasive nature of the technique and relative simplicity allowed this technique to flourish for many years. Even today, this is the most common technique used for ACL reconstruction. The technique involves drilling the tibial tunnel in a standard fashion. The femoral tunnel is then drilled through the tibial tunnel making no further incisions. The literature has shown that it is nearly impossible to place both the tibial and femoral tunnels in the anatomic position with the transtibial technique. That is why this technique is the "step back" in the evolution of ACL reconstruction.

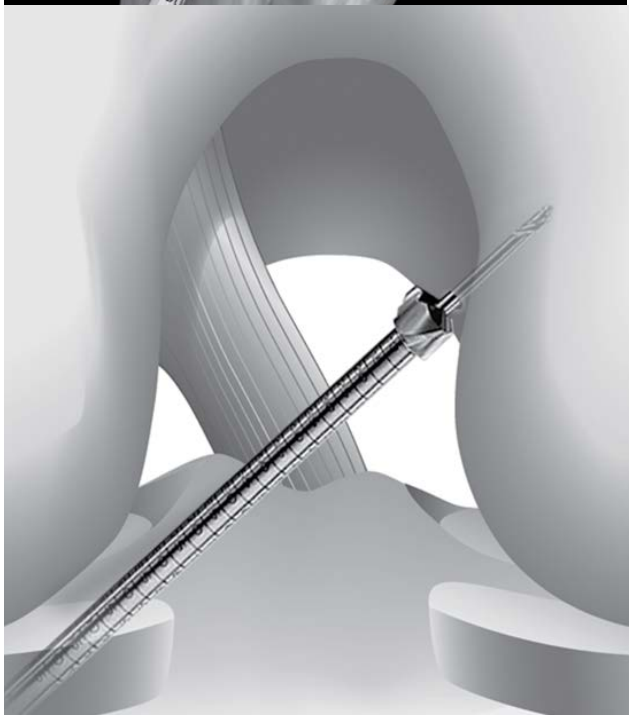


As one can see from the pictures, the compromise of the technique involves a posterior tibial tunnel and a more vertical femoral tunnel. The femoral tunnel is towards the ceiling (or 12 o'clock) position in the intercondylar notch. This does not approximate the native ACL anatomy.

Reconstructing a ligament in this fashion creates a nonanatomical tether that creates a normal Lachman's test and looks good on the KT-1000 testing. However, the resulting vertical graft does not resolve the harder to test rotational stabilizing component of the ACL. The transtibial technique has been taught to countless orthopaedic surgeons (including myself) over the last 20 years. Unfortunately, even in the best hands, the results of this technique may lead to abnormal stresses on the articular cartilage and potentially leading to earlier osteoarthritis.

Over the last 20 years, countless articles have been published comparing bone patellar tendon bone grafts to hamstring grafts. (Minimal differences have been noted from study to study) There is still no consensus on which graft is really preferred. In short, both work fine. While this mildly interesting debate labored over these 20 years, graft after graft continued to be placed in a nonanatomic position.





Fortunately, Dr. Freddie Fu from the University of Pittsburgh, brought this anatomical dilemma to the forefront of the ACL debate with his introduction of the double bundle ACL reconstruction. Dr. Clancy had been telling people that the transtibial technique was not an anatomical reconstruction for years, but his protests fell on largely indifferent ears…

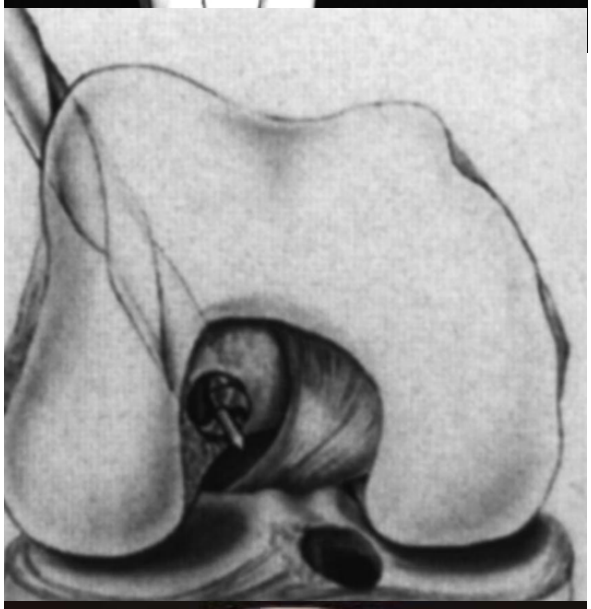
Dr. Fu's work out of Pittsburgh reaffirmed the importance of the femoral origin of the ACL and the anatomic pitfalls of the transtibial technique. His evaluation with 3D CT scans of his own transtibial ACL reconstructions demonstrated that not one of his femoral tunnels were in the anatomic femoral origin of the ACL. Through the work of Dr. Fu and Clancy, there has been a resurgence of anatomical ACL reconstruction focusing on putting the graft in the correct location.

BACK TO THE FUTURE…

With current techniques, we are able to place the ACL graft in the correct position with arthroscopic techniques. The arthroscopic anatomical ACL reconstruction drills the tibial tunnel in the standard fashion. The femoral tunnel is then drilled through a separate small incision near the medial arthroscopic portal allowing anatomic placement of the femoral tunnel.

With the drilling of the femoral tunnel from the medial portal, one can position the femoral tunnel down the wall of the intercondylar notch where the native ACL origin is located.

Generally speaking, the results of ACL reconstructions overall is quite good. Most athletes with a reconstructed ACL can return to



play with a functionally stable knee. The problem that I see is the high rates of osteoarthritis in knees after ACL reconstruction. Longitudinal studies from the Swedish

Registry has shown that having an ACL reconstruction does not decrease the rate of arthritis when compared to a matched group of patients (cohort) that went without reconstruction after their injury. Put another way, ACL reconstruction with a transtibial technique does not reduce the chance of osteoarthritis in the knee when compared to unstable/unreconstructed knees.

My hypothesis is that with an anatomic reconstruction, the stresses across the articular cartilage will normalize and hopefully lead to a decreased incidence of osteoarthritis in the knee. Osteoarthritis of the knee after an injury to the ACL is clearly multifactorial in nature. However, if we can avoid placing a nonanatomic tether, we may have a better chance at recreating a normally functioning knee.

If we have the ability to place the graft in the correct anatomic position, why wouldn't we? So you can debate what graft to use, when to stress it, when to brace it, how to rehabilitate it, and how to fixate the graft. These points are certainly finer points in obtaining optimal results with an ACL reconstruction. It is my opinion that placing the graft in the right position is the most often overlooked and very important aspect of obtaining a great long term result in ACL reconstruction.