Graft Passage and Fixation

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Introduction

Nothing is more frustrating during surgery than difficulty in passing a graft. There are a number of factors that help avoid this situation. Furthermore, failure of the graft due to poor fixation is again frustrating as it is totally avoidable. For the purpose of this presentation I will consider hamstring and patellar tendon grafts. Of course there are many other grafts but features of these two grafts are applicable to those other ones such as quadriceps tendon and Allograft.

Graft Preparation

Generally speaking a bigger graft is a better graft and certainly for hamstring tendons. Data from the MOON Group shows this is relevant for hamstring grafts. This is the reason that I usually triple my hamstring grafts. Of course on occasion this can produce an oversized graft and it is possible that the graft could be too big for the intercondylar notch of the patient therefore causing difficulty with graft passage as well as impingement. The suturing of the strands of the hamstring graft will allow compression of the soft tissue and a stiffer portion of graft to be led into the tunnels. If a tripling technique is used it is essential that the extra strand is tucked in neatly amongst the main strands of the graft to avoid 'snagging' as the graft is pulled in. The leading part of the graft can be compressed whilst awaiting insertion with the appropriate sizing tube.

For a patellar tendon graft it is essential not to take an excessive bone block from the patella as not only will this lead to morbidity related to the patella itself but also a large bone block that is hard to pass. The proximal bone block from the patella should be made trapezoid in shape so that the leading tip is narrower at the base. Furthermore, most of my grafts have orthogonal drill holes in the bone block destined for the femur so that there is an anteroposterior and mediolateral hole to accept sutures that cradle the tip of the graft to prevent 'toggling'. Sometimes the bone plug is too small to allow for a second mediolateral hole and a second anteroposterior hole has to be drilled. This has to be resected if there is fear of fracturing the bone block.

In the days of trans-tibial drilling of the femoral tunnel the graft passage for patellar tendon grafts was easy but with the popularity of drilling the femoral tunnel via the anteromedial portal the angulation of the femoral tunnel is off line of the tibial tunnel. As a result the graft has to deviate off course to get it into the femoral tunnel. Whilst this really is not an issue for the soft tissue graft such as hamstring, it does mean that the femoral bone block has to be rotated within the intercondylar notch. This could be aided by extending the knee as the graft is pulled through the knee joint cavity and the bone block can also be manipulated by the use of an

arthroscopic probe. This situation is far easier if the bone block is no more than 20mm in length. Traditionally 25mm were frequently used but not only is this an unnecessarily large bone block but its manipulation in the intercondylar notch could be problematic.

Choice of Sutures

I like to use robust sutures such as #5 Ethibond or #5 FiberWire and I have found that alternatives will break on occasion.

Graft Length to Tunnel Length Matching

For hamstring graft this is rarely an issue although a multi-strand graft could be made too short. For patellar tendon a calculation is required to create the appropriate length of tibial tunnel. I over-drill the femoral tunnel by 2-3mm to accept bone debris. This calculation is based on the length of the bone block destined for the femur. To calculate the appropriate tibial tunnel length I measure the length of the soft tissue portion of the graft from the base of the femoral bone block down to the distal end of the tibial bone block. This is the graft that will be in the tibial tunnel and the joint. From this length I subtract the estimated length of intra-articular graft (25mm for most patients and 20mm for the small patients). The remaining length is of course what will still be tibial tunnel. This provides a reliable method for avoiding excessively short or long tibial tunnels.

Tunnel Sizing

On one hand it is ideal to have a relatively tight fit for grafts in the tunnel but at the same time avoiding excessively tight tunnels, which will inhibit graft passage. For patellar tendon graft it is desirable to have a relatively loose fit given the friction of the graft against the bony tunnels and also the excellent healing ability of bone blocks means that a compressive fit is not so important. This is further true because of the excellent fixation of bone blocks that is possible. With ACL reconstruction, because the line of pull of the graft is helpful, a relatively tight fit is appropriate. When undertaking PCL reconstruction, with the different angles of pull for the tunnels it is prudent to have a less tight fit of the graft, particularly in the tibial tunnel. In this scenario I routinely use sterile lubricant placed at the leading end of the graft to aid graft passage. This is not necessary at ACL reconstruction but could be a consideration if graft passage is difficult.

If the graft is not advancing then early decision to abandon the graft passage and re-drill larger tunnels is appropriate.

Length of Femoral Tunnel

For patellar tendon grafts I have indicated the appropriate length above. With soft tissue graft when the tunnel has been drilled from within the joint to without and

suspensory fixation is used, care has to be taken not to drill the far cortex as this would mean that various devices would fail to grip. Nevertheless insufficient length of the femoral tunnel may mean that the fixation device does not come out of the far cortex and allow satisfactory fixation. When using hamstring tendons I use suspensory fixation and my practice is to drill up to the cortex (but not through it!) and this always allows passage of the device and its appropriate deployment.

ACL Stump Preservation

Whilst ACL stump preservation is to be desired to help seal the tibial tunnel from synovial fluid inflow out of the bulk of the ACL graft and possibly maintain blood supply and nerve supply, it is straightforward for hamstring tendons but for a patellar tendon femoral bone block it may offer difficulty in graft passage. I therefore maintain the ACL stump as much as possible for hamstring grafts and I resect most of it for patellar tendon graft.

Graft Fixation

There are a multitude of fixation devices available with varying costs and efficacy. Reading the company literature and publications on the devices is confusing. In such a scenario it is important to remember basic principles. Stable fixation of the graft is essential. Any movement of the graft within the bony tunnel will adversely affect healing. Furthermore, as much of the graft as possible should be exposed to the raw bone of the tunnel. With certain devices the surface area of the healing in this way will of course be reduced. An example is interference screw fixation. The closer the graft is fixed to the intra-articular apertures of the tunnels then the shorter and therefore stiffer the construct will be.

Interference screws are extremely effective at fixing bone plugs although suspensory techniques are described. Their insertion pushes the graft eccentrically within the tunnel. This is more relevant to the femoral side where the screw is introduced and in most cases from within the joint towards outside. This can be used deliberately, particularly in revision cases, to push a graft into the desired position but if there is excess grip of the screw it can spin the graft in both a primary situation and revision situation into an appropriate position. Care must be taken to avoid this. On the tibial side this is less important as the screw is introduced from externally and therefore (unless a long screw is used or the tibial tunnel is short) the graft is rarely fixed right up to the internal aperture.

In situations where the standard fixation device has suspect fixation then backup fixation should be used to ensure graft stability. This is particularly pertinent to revision cases. Simply tying of sutures over a button or screw can make a big difference.

Many devices are ‘bioabsorbable’ but my preference is not to use these as there is little proof that the devices disappear and become bone, as is the hope that allows them to be sold. Their only advantage is that there is less effect on MRI scan compared to metal devices but in reality this is rarely a problem anyway. The problems with bioabsorbables are their tendency to be brittle and therefore there is potential for breakage on insertion, biological reaction with bony lysis and, on occasion, synovitis. There is also their excessive expense. Some proponents like the idea that in revision cases the drills can be simply ‘drilled through’ but this produces debris and may be the reason for increased tunnel widening seen associated with bioabsorbable implants. Metal is cheaper, safe and effective and is therefore my preference.

Fixation devices can be broadly divided into those that fix close to the aperture of the tunnel such as interference screws or those that are suspensory with fixation at the outer cortices of the femur or, more recently, tibia. Both can be very effective. A criticism of suspensory devices is that they allow more likely tunnel widening due to instability of the graft within the tunnel. The terms ‘windscreen wiper effect’ and ‘bungee cord effect’ are often used. This has to be balanced against the excellent pull out strengths of devices such as the EndoButton.

It would seem logical that inflow of synovial fluid into the bony tunnels will inhibit healing and therefore on the tibial side it is worth keeping some of the old ACL stump to try and form a seal against this.