ACL Injury

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Hamstring or Patellar Tendon Graft?

CHOICE OF ACL GRAFT

As you know there are two main options for the graft used for ACL reconstruction - bone-patella tendon-bone (BPTB), or hamstring / gracilis tendon (HG). In the past 20 years there has been a shift towards greater use of hamstring grafts, because of the long-term complications with BPTB – anterior knee pain & inability to kneel on the affected knee. For the recreational athlete (most of the patients you & I see), HG is probably the better option. However proponents of BPTB (such as Dr Merv Cross) still claim this is the best procedure for elite athletes, claiming that HG can lead to short to medium-term loss of hamstring strength & function. It is also suggested that BPTB grafting may lead to less laxity in the short-term, so be preferred by elite athletes seeking early return to sport. However studies show that at 1 & 2 years plus, there is no significant difference in laxity. So the argument will continue. In the May 2009 issue of the British Journal of Sports Medicine, some of the top surgeons from both camps have argued the case for their procedure. Here is a summary of their main arguments.

Patellar Tendon Graft (1): [This procedure involves taking a bone block from the distal patella, the medial third of the patella tendon, and a bone block from the tibial tuberosity. This allows bony stabilisation proximally & distally, and a short graft healing time of 6 weeks.]

Advantages:

1. The authors claim there is a marked reduction in knee laxity, particularly side to side.
2. Tibial sided graft fixation is potentially problematic because this area that has naturally lower bone density. Bony fixation may offer a more stable attachment.
3. "the surgeon using the HG is presented with a baffling array of fixation options, whereas the vast majority of BPTB grafts are fixed with interference screws*." This is considered a much more secure method.
4. In '2002' 97% of surgeons treating professional athletes in the American NFL used BPTB grafts (16) [The paper was published in 2002, but the actual study period was 1994 to 1998, so trends may have changed]
5. There is known to be an increased incidence of contralateral knee ACL injury in patients who have had BPTB. They interpret this to show that this population is more likely to return to at-risk sports.

Disadvantages:

1. Where discomfort on kneeling will be a significant hindrance (e.g. occupationally), or in a skeletally immature patient, there is no question that a HG should be the procedure of choice.
2. They claim that quadriceps weakness is due to poor rehab rather than operative procedure.
3. They acknowledge pain on kneeling, but claim that this tenderness can be reduced by impacting bone grafts into the bony defects
4. They dispute an increased incidence of anterior knee pain, except with kneeling.
5. Sensory disturbance is due to operative damage to the infrapatellar branch of the saphenous nerve, & is a complication described for both procedures. They claim that the nerve lies close to the gracilis tendon, and is therefore harder to avoid with HG.
6. Arthritis. There has been published research showing greater incidence of OA after BPTB. The authors can see no logical reason why this would be the case, and quote their own research to dispute this.
7. They acknowledge that BPTB is a technically more difficult operative procedure than HG.

Disadvantages with HG:

There are complications associated with HG which include knee laxity, hamstring deficit & pain, tunnel widening, anterior knee pain & sensory deficit.

1. Tunnel widening. The mechanism for this in not well understood, but they claim there is an increased incidence with the use of soft-tissue grafts.
2. It has been suggested that hamstring graft healing to bone is slower than BPTB.
3. Hamstring weakness in flexion & rotation is reported. Functional weakness of the hamstrings may be persistent & contribute to reduced return to full activity.
4. They claim anecdotal experience that HG are associated with a greater re-rupture rate.

Hamstring Graft (2): Reported complications with BPTB include quadriceps deficit, a greater degree of arthritis, post-op stiffness, anterior knee pain, an inability to kneel, & sensory disturbances. There have also been reports of fixed flexion deformities (loss of terminal extension) at the 2 & 5 year mark associated with degenerative changes in the patellofemoral & medial compartments.

Arthritis: The eitiology of OA after BPTB graft is two-fold: firstly due to patellar ligament contracture (~5-10% of its overall length) causing patella baja, altering patellofemoral contact pressures. Secondly, decreased knee flexion moments during the stance phase results in higher impact loads on the medial compartment.

Perceived laxity with HG: The authors argue that since 1995 interference screw fixation (*used by the authors), reverse threaded screws for femoral fixation, supplementary tibial fixation to prevent slippage, & increased length & diameter of the screw have addressed this deficiency. If fixation is secure, patellar tendon is shown to be joined to the tunnels within 6 weeks, compared to 8 weeks for HG. Thus the earlier fixation of the BPTB graft may be only 2 weeks. They feel any laxity in recent years will be a function of surgical technique & placement of the graft rather than graft type.

Rates of re-rupture: The authors state that large scale meta-analysis & systematic reviews report no difference in rupture rates. The rate of re-rupture is 20% over two years (2 per year for 100 patients followed up) for both groups.

In summary: the authors state that the major advantage of HG over BPTB is that the patient will have a better outcome "for the rest of their life", if not for the short period of their sporting career.

So what does the rest of the literature say? Several studies & meta-analyses have been published over the last 10 years, looking at the results for both procedures. The majority of these report no significant differences (see particularly 4, 5, 6, 11, 15). Differences in ROM were in the order of 0.7 to 3º, & laxity differences approx 1mm (11). Rates of graft failure were also not-significantly different (5, 9, 11). The initial strength of the 4-strand HG is stronger than the BPTB (5, 10) but the difference at 3 months+ is probably insignificant. Only 1 study that I read, performed in Sweden, compared the different operations, performed by different surgeons, within the one study (6). There were no significant differences between the groups, although the HG group had better ability on a 1 leg-hop test (at av. 26 months). There was no difference in subjects ability to return to their previous sporting level (4)

Early hamstring strength deficits, up to 11% in HG group, were of "questionable clinical significance" (11), and after 1 year there was no strength differences (3, 6). Hamstring strength was found to be reduced in the HS compared to BPTB at 9 months (12). A study with 2 year follow-up (8) found some weakness at 90º, but not at lesser angles where functional strength is required for most sports. The weakness at 90º may have been due to the fact that rehabilitation would be likely to target strength between 0 & 90º, and often not beyond. One study specifically looked at hamstring strength, & found isometric strength returned to normal at 3 months, & isokinetic strength returned to normal at 12 months (13). Ferretti et al (3) examined biopsies of the hamstring / gracilis to assess the extent of regeneration, and found that the tendons showed complete regeneration, particularly at 24 & 27 months. (Ultrasound studies suggested regeneration back to normal at 18 months). The difference was that the regenerated tendon(s) were found to insert approx 3cm higher than the original pes anserinus insertion point, - in the 'gastrocnemius fascia'. But regardless of this there were no significant strength deficits.

While the BPTB procedure results in quicker graft to bone healing (approx 6 weeks) the HG procedure takes approx 8 (2) to 12 weeks (4) to reach good graft to bone strength. However this is not a disadvantage under conventional rehabilitation protocols, where the graft is subject to only minimal stresses during the first 3 months.

There is no question that the BPTB group have more pain on kneeling (5, 6, 9, 11). And anterior knee pain was found to be greater in the BPTB group in 4 studies (6, 9, 12, 14). This may have been partly due to damage to the infrapatellar branch of the saphenous nerve. However, it may also be due to prolonged deficits in extension strength, even at 7 years post-op after BPTB graft (14). This deficit was found to correlate strongly with anterior knee pain & with patellofemoral arthritis. Certain studies showed a greater chance of some loss of extension range with BPTB (4).

An increased incidence of OA in patients having the BPTB graft has been reported (9, 14). It has been suggested this is due to altered knee kinematics resulting in decreased knee flexion moment & increased loading of the medial compartment. One study (4), which looked at gait patterns between the two groups, found the BPTB group had less knee flexion on heel strike (probably to reduce patellar tendon or joint stress). This would result in reduced shock absorption, thus potentially contribute to OA. A Swedish study looked at OA incidence in the two groups, using radiographic & clinical examination (7). They had a median follow-up of 86 months. There was a small but statistically insignificant increased OA incidence in the BPTB group.

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