GRAFT CHOICES FOR ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION

Julian A Feller, FRACS, Melbourne, AUSTRALIA

The question of which graft to use for anterior cruciate ligament (ACL) reconstruction continues to be debated at meetings around the world. The overall choice of grafts consists of autografts, allografts, and synthetic grafts. By far the two most commonly used grafts are central third bone-patellar tendon-bone and hamstring tendon, either semitendinosus alone or semitendinosus combined with gracilis. Seventy per cent of the 132 members of the ACL study group who responded to the recent biannual survey indicated that the patellar tendon is their graft of choice, while 25% use hamstring tendon. [1] The next most popular graft was quadriceps tendon, followed by allograft tendon. It is worth noting that there may be considerable geographic variation in the choice of graft for ACL reconstruction. Half of the returned questionnaires came from surgeons working in the USA. A survey of the Australian Knee Society indicated a more even distribution between patellar and hamstring tendons. [2]

In selecting a graft for ACL reconstruction there are a number of factors that need to be considered (for a comprehensive review see Bartlett RJ et al [3]). The graft must have been shown to provide satisfactory outcomes. The morbidity associated with harvesting the graft needs to be taken into account, as do, in the case of allografts, cost and the risk of disease transmission. These factors need to be evaluated in regard to the patient's occupation, the type of sport in which they are involved, their skeletal age, associated ligamentous pathology, the chronicity of the injury, and their inherent degree of ligamentous laxity. In revision ACL reconstruction there are additional considerations such as the graft that was used for the primary reconstruction and the presence and degree of bone tunnel enlargement that is present. Grafts that include a bone block may be more suitable where enlarged bone tunnels are present.

As a result of the increased interest in hamstring tendons, largely due to the development of new fixation methods, there have been a number of randomised controlled trials (RCTs) published in the past few years comparing patellar tendon and hamstring tendon grafts. [4-11] . Both grafts have been shown to produce satisfactory functional outcomes. In general hamstring tendon grafts have been associated with less morbidity, particularly in terms of anterior knee pain and more specifically pain on kneeling. Patellar tendon grafts seem to be associated with an increased risk of extension deficit but in many studies have been associated with slightly less anterior knee laxity as measured by arthrometer. Some studies have shown a higher rate of return to preinjury sport with patellar tendon grafts. In those studies that have looked at radiographic bone tunnel enlargement, hamstring tendon grafts have generally been shown to be more frequently associated with this phenomenon than patellar tendon grafts. To date, bone tunnel enlargement has not been associated with clinical sequelae but does remain a potential concern in the longer term and also in the setting of revision surgery.

These recent studies have involved relatively small numbers and for the most part have had inadequate power to provide clear answers. Although meta-analysis of these trials may provide a clearer picture, a recent preliminary analysis found that there was insufficient data to conclude differences in patient function. Interestingly, the authors noted that they had variable access to the raw data from the authors of published RCTs. [12] They also reported that, because of inadequate and inconsistent reporting of outcome measures and a failure to employ validated patient-based measures, it was difficult to synthesise and analyse the data from the various trials. However, their analysis did demonstrate a slightly increased objective laxity following ACL reconstruction with hamstring grafts, although the clinical significance of a mean difference of 0.8mm is unclear. The authors were also able to confirm an increased incidence of anterior knee pain following use of patellar tendon grafts.

Most randomised trials must necessarily have a set of inclusion and exclusion criteria. This raises the issue of whether the results of a randomised trial can be extrapolated to a wider patient population. Overall the RCTs have had a 3:1 predominance of male subjects and the applicability of their findings to only female patients is unclear. Barrett et al recently reported that hamstring tendon grafts were associated with a much higher rate of failure than patellar tendon grafts in a female population. [13] On the other hand, Siebold et al have recently demonstrated equivalent functional outcomes with both graft types in females but with less morbidity and better subjective outcomes with hamstring grafts. [14]

Patellar tendon remains the gold standard for many surgeons. The graft can be harvested from either the ipsilateral or contralateral knee. Whilst the use of the contralateral patellar tendon has not achieved widespread popularity in the setting of primary reconstruction, it is used more frequently in the setting of revision surgery. Much of the morbidity originally attributed to the graft itself has subsequently been shown to be able to be controlled by adequate preoperative preparation, particularly restoration of a good range of motion, and by appropriate postoperative rehabilitation. [15] Rapid rehabilitation protocols have been developed for patellar tendon grafts and a desire or need for a rapid return to sport may represent a relative indication for the use of a patellar tendon graft. [16] Shelbourne has demonstrated that patients can

return to sport as early as four months following their surgery, particularly if they have had the graft harvested from the contralateral knee. [17]
A history of previous patellar tendinopathy or Osgood Schlatter's disease probably constitutes a relative contraindication to the use of the patellar tendon, and a requirement to kneel also needs to be taken into account in selecting an appropriate graft. Bone grafting of the patellar and tibial tubercle defects and the use of transverse incisions may reduce the incidence of kneeling pain.

Hamstring tendon grafts can be double, triple, or quadruple stranded. Most surgeons appear to favour a four strand graft. This can either consist of a quadrupled semitendinosus tendon, or a doubled semitendinosus tendon combined with a doubled gracilis tendon. Although quadrupled semitendinosus grafts are relatively short, their diameter tends to be greater than doubled gracilis/doubled semitendinosus grafts. Whatever graft is used, a variety of fixation options exist. In general, femoral fixation can be adequately achieved with a variety of methods including suspensory, transfemoral and interference screw techniques. Tibial fixation remains an ongoing concern for many surgeons due to issues of bone density and prominence of subcutaneous hardware in the proximal tibia.

The applicability of rapid rehabilitation protocols to hamstring tendon grafts remains unclear. A recent study has suggested that early motion following hamstring tendon and ACL reconstruction may be associated with increased radiographic bone tunnel widening. [18]

Most studies that have looked at quadriceps and hamstrings strength following ACL reconstruction have shown little in the way of long term deficit, but this may reflect the methodology employed rather than the absence of a real difference. In addition, the relatively small numbers of subjects involved in these trials may mean that there was inadequate power to detect a clinically significant difference. A recent presentation suggested that testing hamstring strength at high degrees of flexion can demonstrate a significant deficit associated with the use of hamstring tendon grafts. [19] It remains to be seen whether preservation of the gracilis tendon results in better hamstring function.

Quadriceps tendon has had some strong proponents over a long period but has not gained widespread acceptance. This appears to relate in part to a lack of familiarity with the use of this graft as well as concerns about harvest, cosmesis, and the potential to interfere with the extensor mechanism.

Allograft tendon seems to have gained increased popularity in recent years, particular in the USA. Allografts effectively eliminate the morbidity of graft harvest but are expensive and are associated with a very small potential risk of transmission of viral disease. In the past, allografts have been associated with an increased incidence of bone tunnel widening. A variety of allograft tendons are available. Recently the tibialis anterior tendon has been popular.

From a practical perspective, individual surgeons must decide whether to use one graft for all situations or to tailor the graft choice to the individual. Those surgeons performing large numbers of ACL reconstructions will be more likely to understand the nuances and subtleties associated with a particular graft. They may therefore be able to extend the indications for a particular graft. On the other hand, they may have been performing a sufficient number of procedures to be comfortable with using a variety of grafts, making it possible to be selective. Surgeons performing only a relatively small number of procedures should probably stick to one graft type, and where this graft type is not suitable for an individual, refer the patient to a surgeon who is familiar with a more appropriate alternative.

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