Aspects of current management

COMPLICATIONS OF ARTHROSCOPIC RECONSTRUCTION OF THE ANTERIOR CRUCIATE LIGAMENT

Robin Allum

Complications of anterior cruciate ligament (ACL) reconstruction may, as with any surgical procedure, be operative or postoperative.

Operative complications

These can be related to the three stages in the operation: graft harvest, graft placement and graft fixation.

**Graft harvest.** The extensor mechanism is a vulnerable structure. It is possible to violate the patellar tendon when making the preliminary arthroscopy portals. The medial or lateral border may be damaged, making it difficult to use the middle third if a bone-patellar tendon-bone (B-PT-B) graft is being harvested. Since the patella can be fractured when taking the bone block, care must be taken not to lever too hard on the block until it has been cut completely. It is likely that some degree of microscopic damage will occur to the articular cartilage and subchondral bone by the vibrations from the power saw, however carefully it is used.

Harvest of the hamstring tendons is more demanding technically and it is not difficult to divide the tendons with inadequate length for reconstruction. Care should be taken to release all the peritendinous adhesions before passing the tendon stripper. If this does not pass freely, it should be removed and the tendon released by further dissection.

**Graft placement.** It is of prime importance to replace the ACL anatomically so that its function can be reproduced as closely as possible.

If the tibial tunnel is positioned too far forwards, extension will be limited. The reference points for the intra-articular opening of the tibial tunnel are the posterior cruciate ligament (PCL), the anterior horn of the lateral meniscus and the stump of the ACL. The tip of the guide-wire should emerge posterior to the posterior edge of the anterior horn, which is 5 to 7 mm anterior to the anterior attachment of the PCL. The hole should be drilled through the posterior part of the stump of the ACL, if still visible. If the drill hole is anterior to this point impingement may occur on the roof of the intercondylar notch causing limitation of extension. Commercially-produced drill guides are available for this step. Care must be taken to ensure that the tip of the drill guide is placed sufficiently posteriorly (Fig. 1). Commonly, the guide is designed so that the guide-wire hits the ‘axilla’ of the intra-articular portion rather than the tip and this may produce a tunnel which is too anterior.

Extension may also be limited by a build-up of scar tissue at the front of the intercondylar notch, the so-called ‘cyclops’ lesion (Fig. 2). The stump of the ACL should be removed from the tibia and the ‘trapdoor’ formed by the drilling of the tunnel should be shaved away.

The most common fault is to place the femoral tunnel too anteriorly. The architecture of the intercondylar notch may well be altered by osteophytes and scar tissue which have formed in response to instability. It is essential to identify the back of the intercondylar notch accurately. The so-called ‘resident’s ridge’, approximately 1 cm in front of the posterior edge of the intercondylar notch, may cause confusion to the inexperienced. This is a ridge of bone which initially appears to represent the back of the notch but on probing it becomes clear that there is more bone posteriorly. Defining the anatomy is easier with modern arthroscopic equipment and certainly there are advantages over conventional open surgery as regards visualisation. If the notch is narrowed, an arthroscopic osteotome can be used to open up the front of the intercondylar area. The posterior part of the fat pad can be removed with a shaver, so that the arthroscope can be backed up for a clearer view of the intercondylar notch. Using a combination of hand instruments, soft-tissue shavers and bony burrs, the lateral wall of the intercondylar notch is cleared until a probe can be passed clearly over the back. As in all arthroscopic surgery observation must be reinforced by palpation and there is no substitute for feeling the probe pass out over the back of the notch. This is completely different from the feeling when the probe is passing over the ‘resident’s ridge’. A bridge of bone of 1 to 2 mm only should be left at the posterior edge of the femoral tunnel (Fig. 3) and commercially-available drill guides can be used for this important step. The tunnel is drilled at the 11 o’clock position for the right knee and at 1 o’clock for the left. Failure to visualise the posterior aspect of the intercondylar notch adequately may result in too anterior a posi-
tion of the femoral tunnel. This will restrict flexion and/or lead to stretching and rupture of the graft.\(^5\)

**Graft fixation.** Interference screws can be dangerous if used incorrectly. When a B-PT-B graft is employed it will not always follow the track between the bone block and the wall of the tunnel, and fixation may be inadequate if divergence occurs. Guide-wires are commercially available but they are easily bent. It is important to insert the screw at the correct angle. The knee must be flexed to at least 90° and drilling of the femoral tunnel through the medial portal rather than through the tibial tunnel will facilitate this step. The graft must be taut when the screw is inserted to reduce the risk of damage as a result of the screw catching on the soft tissue. The bone block in the femoral tunnel should be inserted with the cancellous surface uppermost and the screw superiorly so that the screw threads are well away from the soft-tissue part of the graft.

The fixation of hamstring grafts is more challenging. Soft tissue has to be fixed to bone rather than bone-to-bone.

An EndoButton (Smith & Nephew), screw-washers, belt-buckle staples, ligament anchors, and interference screws all appear to be satisfactory. At least 2 cm of graft are required in the bone tunnels for adequate fixation.

**Postoperative complications**

**Donor site**

**Anterior knee pain.** Anterior pain in the knee after B-PT-B reconstruction of the ACL is well documented.\(^6-12\) The use of hamstring tendons for the graft is generally thought to reduce the incidence of such pain. There have, however, been conflicting reports in the literature.\(^13-17\) In anatomical terms, the pain can arise from the skin, the prepatellar tissues, the patellar tendon or its sheath, the patella itself, and in the case of hamstring tendons the tissues adjacent to the insertion of the pes anserinus.

Pain and discomfort on kneeling are very common and this may be troublesome in those patients whose job involves kneeling. A neuroma of the infrapatellar branch of the saphenous nerve may cause considerable symptoms. Patellar tendinitis has been reported in patients after harvest of the patellar tendon. In most cases this settles with time.

The patellofemoral joint is a very vulnerable structure and chondromalacia can be a problem as a consequence of the injury, the surgery, or the postoperative immobility.

Chondromalacia may be inevitable in some patients after a serious injury to the knee. Harvest of the patellar tendon must damage the patella, no matter how careful and gentle the surgery, and there must be a disturbance of patellofemoral biomechanics. It has been suggested that careful attention to a vigorous and aggressive rehabilitation regime will reduce the incidence of postoperative patellofemoral problems.\(^18\) and it is important to achieve and maintain full extension for the well-being of the patellofemoral joint.

**Fracture of the patella and rupture of the patellar tendon.** After any major operation on the knee there is inevitably a
degree of inflexibility no matter how successful the surgery and rehabilitation. The extensor mechanism is therefore vulnerable if the knee is injured. Increased forces will be transmitted across the patella and its tendon because of the lack of mobility of the joint. There will be a defect in the anterior aspect of the patella after harvest of the graft which will take some months to fill in. This will act as a stress riser and a fracture may occur at the junction between the defect and the normal bone.

**Femoral fracture.** Cases have been reported of fracture of the distal femur in relation to the stress risers at the bone tunnel or the site of fixation.

**Muscle weakness.** Some degree of muscle weakness is inevitable after such a major surgical procedure, and it can be a long-term problem.

**Rupture of the graft.** The graft may fail because of either a new injury or a technical error in insertion, usually poor placement of the tunnel or inadequate notchplasty leading to impingement.

**Limitation of movement.** Any loss of movement after injury will lead to considerable disability. Patients requiring reconstruction of the ACL are usually involved in considerable athletic activity and will therefore need maximum mobility of their knees. Even if the knee is perfectly stable postoperatively a patient with severe limitation of movement may well not be able to return to his or her sport. Loss of extension causes particular problems during sport and in normal gait and function. Knee flexion of less than 125° interferes with activities such as sitting, squatting, stair-climbing and running. Loss of movement, particularly extension, leads to an increased incidence of patellofemoral problems with anterior knee pain and painful patellofemoral crepitus. Rehabilitation is slower and return to physical activity both at work and on the sports field will be delayed. The gait pattern never returns to normal and muscle function recovers slowly and incompletely.

A loss of extension of between 50° and 10° and flexion to only 125° or 130° have been reported. The incidence of stiffness therefore varies, depending on the definition, but problems with loss of movement have been reported in up to 24% of cases. Sachs et al carried out a survey of 50 prominent knee surgeons who had published papers in the field of reconstruction of the ACL. From the 40 who replied, flexion contracture was the most common complication after ligament surgery. It is associated with a high level of patient dissatisfaction and is very frustrating for the patient, surgeon and physiotherapist. Treatment is difficult, requiring hard work on the part of the patient and progress is usually slow. Shelbourne, Patel and Martini have devised a classification of arthrofibrosis based on a review of 72 patients. There are four types:

- **Type 1.** Extension loss of <10° with normal flexion.
- **Type 2.** Extension loss of >10° with normal flexion.
- **Type 3.** Extension loss of >10°, with loss of >25° of flexion and a tight patella.
- **Type 4.** Extension loss of >10°, with loss of 30° of flexion or more, and patella infera with marked patellar tightness.

A number of risk factors have been suggested.

**Age.** The older patient will recover more slowly from reconstructive surgery because of age-related changes in connective tissue. There is, however, no conclusive evidence that the results of reconstruction of the ACL in this age group are any worse than in the younger patient.

**Early surgery.** This is open to debate. As with many controversial subjects a search through the literature will produce differing opinions. Several papers suggest that there is a strong link between early surgery and postoperative limitation of movement and a number support the opposite view. It would seem appropriate to wait for the inflammatory reaction in the knee to settle after injury so that the knee is ‘quiet’. Certainly, to operate on a knee which has considerable restriction of movement, particularly extension, would be unwise.

**Concomitant injury.** The more widespread the injury to the knee, the more likely it is that there will be complications such as stiffness.

**Additional surgery.** Similarly, additional operations such as meniscal repair (Fig. 4) or other procedures on the ligament will increase the risk of limitation of movement. Meniscal injury commonly accompanies rupture of the ACL and may lead to a dilemma in management. It is wise to let the knee settle down before undertaking a major reconstructive procedure, but it may be felt that meniscal surgery should not be delayed. There is no evidence that delaying meniscal surgery has a harmful effect and the results of repair are probably not prejudiced by delay. Indeed, a proportion of acute peripheral meniscal tears occurring at the time of injury to the ACL may have the capacity to heal spontaneously. The haemarthrosis and inflammatory response to the acute injury create an ideal environment for healing. An aggressive attitude towards meniscal repair at an early stage may result in unnecessary procedures being carried out. Fitzgibbons and
Shelbourne have shown that certain types of lateral meniscal tear can be left alone at the time of reconstruction of the ACL without causing later symptoms. These are avulsion tears of the posterior horn, vertical tears posterior to the popliteus tendon and stable longitudinal tears usually of one surface only. This may partly explain the success of meniscal repair at the time of reconstruction of the ACL. Stabilising the knee may reduce the stress on the meniscus and the tear then either heals or remains mechanically stable. The only situation in which early surgery must be seriously considered occurs when the knee is locked due to a displaced bucket-handle meniscal tear. The mechanical block needs to be dealt with before a fixed flexion deformity develops. Shelbourne and Johnson have recommended a two-stage procedure with a partial meniscectomy or meniscal repair followed by reconstruction of the ACL when the knee has recovered from the initial surgery. This is said to have several advantages including the more aggressive use of repair, the prevention of problems in regaining movement, a second look to judge the success of the meniscal repair and time for the patient to prepare for the reconstruction physically, mentally and socially. Certainly, a major surgical reconstruction carried out on a locked knee carries a considerable risk of limitation of movement. Care should be taken when carrying out an in-to-out meniscal repair not to tie the sutures with the knee flexed, particularly on the medial side, since this will cause restriction of extension because of tethering of the capsule.

Injuries to the medial collateral ligament (MCL) may occur in association with rupture of the ACL. In recent years, the approach to this injury has become more conservative. There appears to be no advantage in surgical repair of the MCL in association with rupture of the ACL. Certainly, there is a risk with open surgery to the MCL and the posteromedial capsule that postoperative scarring may lead to difficulty in regaining a full range of movement, particularly extension.

There are few reports in the literature regarding combined ACL and PCL injuries and ACL and lateral complex injuries. After operation recurrent instability is more likely to be a problem than limitation of movement and the advantages of early repair may outweigh the risks of limitation of movement.

Inadequate rehabilitation. An adequate and appropriate rehabilitation programme is essential for the return of full movement and function, particularly extension. This has been emphasised by several authors, notably Shelbourne and Nitz. The correct surgical technique and adequate fixation of the graft should allow early aggressive restoration of movement, particularly extension.

The management of rehabilitation is not easy and requires much care and patience. Progress is almost invariably slow. If the patient fails to regain movement satisfactorily in the early postoperative phase despite adequate conservative measures, a decision will have to be made regarding more active intervention. The timing is difficult. If an invasive procedure is carried out when the knee is still inflamed from the surgery the problem may be aggravated. If there is undue delay, an established contracture may occur which will be difficult to correct. With modern techniques of accelerated rehabilitation, manipulation under anaesthetic (MUA) and arthroscopy are indicated between six and 12 weeks after operation if there is fixed flexion of 10° or more.

Ideally, the patient should achieve 120° of flexion by six weeks after surgery and failure to achieve this target or to progress satisfactorily indicates that further measures may be necessary. Each patient must be individually assessed and several factors may have to be taken into consideration in deciding on management. It may be better to rest the knee and stop active rehabilitation for a short period to allow the joint to settle, particularly if the patient has been working the knee very vigorously. If the knee is tender, swollen and inflamed, excessive manipulation or physiotherapy may make matters worse.

If arthroscopy is thought to be necessary, adhesions are removed with a combination of hand instruments and power shavers. The position and state of the graft are assessed and the knee is put through as full a range of movement as possible to check that there is no impingement, particularly in extension. Watanabe and Howell have described the typical radiological, MRI and arthroscopic appearances of impingement. Notchplasty is carried out if indicated. A gentle MUA is also performed. If there are significant technical errors partial or total resection of the graft with or without revision will have to be considered.

The postoperative management must be closely supervised. Pain should be minimised with an aggressive approach to return of movement with both active and passive exercises. A bivalved cast or extension board may be used if fixed flexion is a problem and continuous passive motion may help to maintain improvement in the range of movement. Shelbourne et al described the management of the 72 patients with established arthrofibrosis who formed the basis for the classification system described previously. Arthroscopy was carried out at a mean of 12.5 months after reconstruction of the ACL. Patients with type-1 arthrofibrosis had an arthroscopic resection of scar tissue from the front of the intercondylar notch, including the cyclops lesion if present, so that full extension was possible without impingement. This was followed by appropriate postoperative physiotherapy. In the type-2 patients, extrasynovial scar tissue anterior to the proximal tibia required excision as well as a full clearance of the anterior part of the intercondylar notch. An extension cast was applied for 24 hours, followed by extension exercises and prone hanging with further casting on a daily basis for two or three days if full extension could not be achieved. Patients in type 3 required resection of scar tissue from between the fat pad and the patellar tendon, into the fat pad and proximally as far as the insertion of vastus medialis obliquus and vastus lateralis. If the ACL graft was too anterior the anterior fibres were
resected and a notchplasty was performed. A similar procedure was carried out in the type-4 patients with a more extensive scar resection medial and lateral to the patella. An MUA was carried out in all type-3 and type-4 patients followed by serial casting usually for three to four days, with physiotherapy and a bivalved cast at night. Once full extension had been achieved and maintained, flexion exercises were introduced. Using this regime at a mean follow-up of 35 months, type-1 patients gained a mean of 7˚ of extension, type-2 patients 14˚ of extension, type-3 patients 13˚ of extension and 28˚ of flexion and type-4 18˚ of extension and 27˚ of flexion. No patient in any group developed problems with symptomatic instability or on objective testing despite partial resection of the graft in ten and complete resection in four. In the type-4 patients, the mean length of the patellar tendon increased from 42 mm preoperatively to 45 mm postoperatively.

To summarise the management of this difficult condition: 1) Prevention is better than cure. 2) Operation should be performed when the knee is ‘quiet’ with no significant restriction of movement. 3) The tunnels must be in the right place.

There must be adequate postoperative analgesia with correct rehabilitation, concentrating on immediate return of full extension.

References