Anterior cruciate ligament reconstruction without the use of a tourniquet

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ABSTRACT

INTRODUCTION Anterior cruciate ligament tears are a common ligamentous knee injury and are usually managed with arthroscopic reconstruction surgery using a tourniquet. The employment of a tourniquet in the management of an anterior cruciate ligament tear has been a debatable topic for some time. Here, we discuss our technique in the reconstruction of anterior cruciate ligament tears without the use of a tourniquet.

MATERIALS AND METHODS We performed 26 anterior cruciate ligament reconstruction surgeries using hamstring grafts without the use of a tourniquet. The outcomes measured were pain using the visual analogue scale, knee swelling, range of movement and bleeding.

RESULTS Using this technique, we have noted considerable reduction in knee swelling and pain. In addition, there was considerable improvement in the range of movement postoperatively, and there were no bleeding complications noted.

CONCLUSION We consider ACL reconstruction without a tourniquet to be an excellent alternative to conventional reconstruction with the use of tourniquet.

KEYWORDS

Tourniquet – Anterior cruciate ligament – Anterior cruciate ligament injuries – Reconstruction – Arthroscopy

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Introduction

Sport injuries are common in athletes, with an estimated 200,000 anterior cruciate ligament (ACL) tears in the United States alone, with more than 50% undergoing surgical intervention, making ACL reconstruction one of the most commonly performed arthroscopic procedures in the United States.^{1–4} Historically, ACL tears have been treated either conservatively or surgically. However, conservative measures have been abandoned due to poor functional outcomes, inability to resume regular sporting activities and increased incidence of instability and meniscal injury.⁵ The majority of ACL tears are currently managed by arthroscopic reconstruction surgery, with the aim of regaining knee stability and avoiding secondary damage to the knee joint and its structures. In the past few years, there has been an increase of 37% in the rate of ACL reconstruction surgeries being performed.⁶ In most cases, ACL reconstruction surgery employs a tourniquet to provide a bloodless field and to improve vision intraoperatively. This procedure is, however, associated with multiple adverse effects. We discuss our technique and outcomes in repairing ACL tears without a tourniquet.

Materials and methods

Technique

The patient is positioned supine with the knee flexed to 45 degrees using a side support attached to the operating table. The knee is allowed to fully flex to facilitate the harvesting of the hamstring tendons. Prior to the incision the pes anserinus is delineated clinically and the incision is marked with a sterile marking pen. Prior to incising the skin, 20 ml lidocaine HCL 2% mixed with 1:100,000 adrenaline is injected at the site of the incision. An oblique incision is made and dissection commences on to the pes anserinus; the semitendinosus and gracilis tendons are identified and harvested using a closed tendon stripper. Once the tendons are harvested, the wound is packed with sterile gauze. We have found this technique to negate the need for a tourniquet, as the field remains bloodless. There is no bleeding associated with the harvesting of the grafts using this technique. The knee arthroscopy is then performed using the anteromedial and anterolateral portals, which are also injected with 20 ml of lidocaine HCL 2% mixed with 1:100,000 adrenaline. The native ACL remnants are shaved with an arthroscopic shaver

and the femoral notch is prepared using an arthroscopic achromioniser. A guide wire is then passed at the appropriate ACL footprint across the femur and drilling is started to the appropriate tunnel size once the harvested grafts are sized. The tibial tunnel is then prepared using a tibial guide at 55 degrees and a guide wire is then passed into the appropriate ACL footprint on the tibial side. Drilling then commences to the appropriate tibial tunnel size. The graft is then passed through the tunnels and fixation is performed using the tightrope on the femoral side and standard bioabsorbable screws on the tibial side for fixation. The arthroscopy is performed using an Arthropump® (Karl Storz) at a pressure of 85 mmHg and a flow of 40 ml/minute. We found that this technique allows us to visualise the graft with almost minimal to no bleeding noted. It also allows for successful femoral tunnel placement, as there is no visual impairment impeding the steps of the procedure, including tunnel drilling. We postulate this to be related to the pressure setting of the pump, as well as the use of local anaesthesia and adrenaline at the site of injection.

Results

Patients were evaluated immediately postoperatively for knee swelling, pain (using the visual analogue scale, VAS), bleeding and range of movement. This technique has been used in 26 patients and we have noticed considerable reduction in knee swelling of 50%, which was measured using a tape measure at the mid-point of the thigh and mid-point of the calf. In addition, we have had no wound complications in terms of oozing or residual haematoma postoperatively. The VAS postoperatively at day 1 was noted to be 3/10 as opposed to 6/10 in the standard technique group using the tourniquet; thus, there is an appreciable reduction in the pain score. Finally, we have found that the average range of movement postoperatively at day 1 was 110 degrees of flexion as opposed to 95 degrees in the control group.

Discussion

Multiple studies have stated that patients should undergo physical therapy as soon as possible after the surgery to maximise functional outcomes, and that individuals may return to unrestricted sports activities six months or later following ACL reconstruction.^{1,7} The available graft options in current practice include allograft and autograft and the decision between either graft remains unclear.^{2,8} Multiple clinical studies and meta-analyses have favoured autografts over allografts.^{9–11} However, Li *et al* demonstrated no clinically significant differences between the two grafts.⁸ Autograft may include patellar, hamstring, tibialis anterior, quadriceps and achilles tendon grafts, however, the two most commonly used grafts are the patellar tendon and the hamstring tendon.^{5,9}

Despite the patellar tendon being the most commonly used graft,⁹ some surgeons remain doubtful regarding the decision between patellar and hamstring tendon,⁵ while

others consider patellar tendon to be the best choice for ACL reconstruction [9]. The advantages of autograft include improved re-rupture rates, higher clinical outcomes and faster rate of maturity;^{3,8} however, while autograft disadvantages remain minimal, the accompanying site postoperative pain must be considered.⁹ Allograft advantages include reduced surgical and anaesthesia time, improved postoperative pain and faster postoperative recovery time.¹² Disadvantages of allografts include, risk of infection, transmission of disease and higher rates of failure compared with autografts.^{13–18}

The advantages of a patellar tendon graft include greater maximum load and stiffness, lower re-tear rate, and improved failure rate (1.9% patellar tendon vs 4.9% hamstring tendon).⁵ Disadvantages include a higher rate of anterior knee pain and kneeling pain (17.4% vs 11.5 for hamstring tendon graft) and a higher rate of osteoarthritis (45% vs 14% for hamstring tendon graft).⁵ Hamstring tendon graft advantages include a smaller incision with improved cosmetic outcome, decreased donor site pain and reduced time to regeneration.⁵ The main disadvantage reported for the hamstring tendon graft is increased tunnelling, the rate of which was found to be twice that of the patellar tendon graft.⁵

The most commonly used surgical approach for ACL reconstruction are anteromedial and transtibial techniques, with the anteromedial technique being favoured by orthopaedic surgeons.⁵ Routinely, a tourniquet is applied to the proximal thigh to apply compression during ACL reconstruction to achieve a bloodless field, improve vision intraoperatively, and to allow for a better surgical field management.^{19–20} However, arthroscopy in ACL reconstruction is considered to be a long procedure, and its use can be associated with adverse effects including muscle atrophy, metabolic changes and numbness.^{21–24} In one study, 118,590 knee arthroscopies were followed; neurological complications accounted for 7% and, of these, 80% were believed to be directly related to the use of a tourniquet.^{25–26} Postoperative pain due to tourniquet use has been reported in multiple studies. The theory behind this is related to delayed axonal conductivity, which leads to nerve damage and ultimately nerve paralysis.²⁵

Other reported tourniquet complications include joint swelling, stiffness, decreased muscle endurance and increased functional weakness.^{25,27–29} In addition, it is noted that patients can suffer from electromyographic changes up to six months after surgery.²⁵ From a vascular point of view, the tourniquet has been noted to cause direct damage to the vessels. It increases the incidence of deep vein thrombosis (especially if tourniquet time is more than 60 minutes), pulmonary embolism, cardiac arrest and, finally it can lead to hyperaemia upon deflating the tourniquet.^{25,30} In addition, it has been shown that the use of a tourniquet can result in neuromuscular damage distal to the site of compression. This was proven histologically by noting ultrastructural changes in muscles and nerves, together with decreased ability of the muscles to contract.¹⁹

Owing to the increased number of knee arthroscopic surgeries and related tourniquet complications, other means of reducing intraoperative and postoperative blood loss have been explored. A successful alternative to the tourniquet in knee arthroscopy includes injecting a local anaesthetic mixture of lidocaine with adrenaline and bupivacaine combined with intravenous sedation.⁵¹ This results in a bloodless field comparable to that provided by a tourniquet. The theory behind this procedure is related to the vasoconstrictive effect of the adrenaline.⁵¹ This method has also been found to reduce consumption of postoperative pain medication.⁵¹

Recent studies have looked into the use of tranexamic acid (TXA) to reduce blood loss during ACL reconstruction surgery. One study has shown that postoperative drainage and pain in the TXA group is significantly reduced compared with a control group.⁵² Patient satisfaction and overall knee function was significantly improved in the group receiving tranexamic acid compared with the control group. Finally, the need to aspirate the knee postoperatively was significantly lower in the tranexamic acid group when compared with the control group.⁵²

Conclusion

Our study has demonstrated that ACL reconstruction without the use of a tourniquet is a safe, effective and reproducible method for arthroscopic ACL reconstruction. In our study, there was considerable reduction in pain and knee swelling, and an improved range of movement of the knee in the immediate postoperative period. In addition, there was no bleeding intraoperatively, which allowed for adequate visualisation to perform the procedure. We would recommend performing ACL reconstruction without the use of tourniquet because of the potential adverse effects associated with prolonged ischaemia.

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