European Journal of Orthopaedic Surgery & Traumatology (2019) 29:1115–1118
https://doi.org/10.1007/s00590-019-02408-4

ORIGINAL ARTICLE • KNEE - ARTHROSCOPY

The 'sentinel' vessel: an anatomical landmark to identify the pes anserinus during hamstrings harvest for ACL reconstruction

Satish Babu[1] · **Chinmay Gupte**[2] · **Shreyash Gajjar**[3] · **Hayden Morris**[4]

Received: 15 October 2018 / Accepted: 25 February 2019 / Published online: 2 March 2019

Abstract
Hamstrings identification and subsequent graft harvest can be made difficult by body habitus and variability in tendon anatomy. We describe a 'sentinel' blood vessel near the insertions of gracilis and semitendinosus to facilitate identification. A prospective study of 100 patients (100 knees) undergoing primary arthroscopic ACL reconstruction (via the anterior approach) with hamstrings graft was conducted. We searched for a 'sentinel' vessel and studied its position, orientation and perpendicular distance from the pes tendons. The 'sentinel' vessel was present in 98/100 knees. It passed from the superficial fascia to the periosteum at the pes insertion at a mean perpendicular distance of 8 mm from the upper border of the pes tendons. The 'sentinel' vessel was a consistent anatomical finding and served as a reliable guide in determining the pes insertion. Identifying this anatomical landmark allowed a small skin incision with limited wound dissection minimising risk of injury to the infra-patellar branch of the saphenous nerve.

Keywords Sentinel blood vessel · ACL · Pes anserinus · Hamstrings · Graft · Morbidity

Introduction

Ipsilateral hamstrings tendon (HS) autograft is a popular choice for primary anterior cruciate ligament (ACL) reconstruction. The anterior approach is the most commonly used surgical approach for HS graft harvest. Several external guides have been described to locate the pes anserinus insertion [1, 2]. These include the distance from the tibial tubercle, distance below the medial joint line and simple palpation of the tendons with three fingers. However, each of these techniques can be limited by large body habitus and variability in tendon anatomy and location making graft harvest difficult. After the skin incision, extensive soft tissue dissection to locate the pes insertion can cause haemorrhage or iatrogenic injury to the infra-patellar branch of the saphenous nerve (IPBSN).

During primary ACL reconstruction, we have routinely used a vertical anterior longitudinal incision for HS graft harvest and have noted the presence of a well-defined blood vessel in the vicinity of the pes insertion, hence termed the 'sentinel' blood vessel.

The purpose of this study was to assess the incidence of this vessel and to study its position, orientation and perpendicular distance from the pes tendons. If the presence and location of this vessel were consistent, it would be a useful anatomical landmark in identifying the location of the pes.

Materials and methods

Over 6 months, 100 consecutive patients (100 knees) undergoing primary arthroscopic ACL reconstruction using HS autograft were prospectively included in the study. There were 72 males and 28 females aged 18–46 years (mean age 29.5 years). All patients sustained an isolated knee injury playing sport. The diagnosis of ACL rupture was made from the history, clinical examination and confirmed on MRI scans when available. The right knee was involved in 45 and the left in 55 patients.

✉ Satish Babu
sbabu@doctors.org.uk

[1] Frimley Park Hospital, Portsmouth Road, Frimley GU16 7UJ, UK

[2] Imperial College Healthcare NHS Trust, London, UK

[3] Kokilaben Dhirubhai Ambani Hospital, Mumbai, India

[4] St. Vincent's & Mercy Hospitals, Melbourne, Australia

Operative technique for graft harvest

All operations were performed under general anaesthetic using a thigh tourniquet. The leg was supported with a foot and thigh side support with the knee in approximately 70 degrees flexion. After standard skin preparation and draping, HS graft harvest was performed. The tibial tubercle was palpated, and using three fingers, we attempted to locate the pes anserinus tendon insertion by palpating over an area 1.5 cm medial and 1.5 cm below the lower margin of the tibial tubercle. If palpable, a 2-cm skin incision was made centred over the pes insertion. In cases where it was not easily palpable, an initial 2-cm vertical skin incision was made 1.5 cm medial and 1.5 cm below the lower border of the tibial tubercle.

After superficial dissection and haemostasis, a Langenbeck retractor was placed medially to lift the superficial tissues and fat off the expected site of the pes insertion. At this point, a well-defined 'sentinel' blood vessel was seen to pass horizontally in the fascial fold at the upper border of the pes. This blood vessel terminated in the periosteum at the pes insertion on the tibia. Its presence or absence, orientation, and macroscopic anatomy were noted. The perpendicular distance of this blood vessel from the upper border of the pes was measured using a sterile paper ruler.

Thereafter, a horizontal stab incision was made below the sentinel vessel on the fascia just above the pes insertion. The sentinel vessel was routinely left intact but cauterised if accidentally damaged during dissection. The fascial incision was then widened medially with Metzenbaum dissecting scissors. The gracilis tendon was identified lying in the fascia above the semitendinosus tendon, exposed and harvested after dividing cross-connections using a closed-type tendon stripper (Linvatec, USA). Keeping the pes insertion on the tibia intact, the semitendinosus tendon was then visualised and harvested in a similar fashion after dividing cross-connections and proximal vinculae.

Both tendons were then whip-stitched after removing muscle. The HS tendons were quadrupled and tunnel diameter determined. Arthroscopy was performed using vertical portals and associated meniscal/cartilage pathology addressed. Routine ACL reconstruction was then performed using the anteromedial portal technique.

Results

The sentinel vessel was present in 98 out of 100 knees and was therefore and incredibly reliable anatomical landmark. It passed horizontally in the fascial fold above the pes to the periosteum at the pes insertion almost perpendicular to the vertical skin incision (Fig. 1). Its mean distance from the upper border of the pes was 8 mm (7–9 mm). The diameter of the vessel varied from 1 to 2 mm to a well-defined 3 mm vessel. Biopsy and histological analysis confirmed this was indeed a blood vessel.

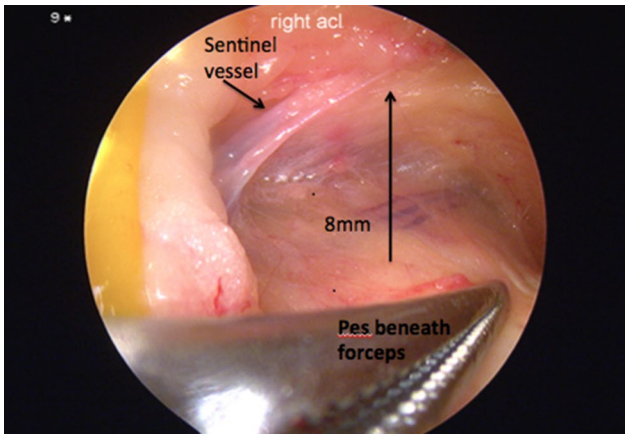

Fig. 1 Hamstrings tendon harvest using a vertical incision in the right knee. Sentinel vessel shown within the sartorial fascia at the upper border of the pes tendons

Discussion

Sartorius, gracilis and semitendinosus originate from distinct bony points on the pelvis and cross the hip and knee joints to insert into the subcutaneous surface of the tibia at a point named the pes anserinus (goose foot). The surgical anatomy of the medial side of the knee is described in three layers [3]. The tendon of the sartorius muscle lies in the outer layer. The gracilis and semitendinosus muscles run between the outer and middle layer of the supporting structures of the knee. The gracilis tendon is situated immediately above that of semitendinosus near its tibial insertion and its upper edge is overlapped by the tendon of sartorius, with which it is part blended. The gracilis and semitendinosus join to form a single tendon before inserting onto the tibia and become part of the outer layer. The three tendons act together to flex the knee and internally rotate the tibia.

The anterior approach is the most common surgical approach for HS tendon harvest in primary ACL reconstruction. Identification of the pes tendons is facilitated by several external landmarks and techniques. The tibial tubercle is the most commonly used landmark in deciding the placement of the skin incision. Palpation of the pes also serves as a guide. However, sometimes identification of the pes insertion through this approach can be difficult, especially in inexperienced hands. This may be further complicated by

patients with a large body habitus (and a thick subcutaneous layer of fat) or by variations in tendon anatomy and location.

Hence more recently, an additional posterior mini-incision technique has been described [4]. This involves a 2-cm longitudinal incision over the medial half of the popliteal skin crease to identify the semitendinosus and gracilis tendons separately, in addition to a 2-cm longitudinal anterior incision overlying their insertion for delivering out these tendons for graft preparation and subsequent creation of the tibial tunnel for graft passage and fixation. However, we do not prefer this technique due to the potential for wound dehiscence and complications as a result of an incision in the intertriginous area of the popliteal fossa [5]. Furthermore, an anteromedial incision is nevertheless required for the tibial tunnel as described above and so we opt to limit the procedure to one incision (excluding the arthroscopy portals).

During our routine use of the anterior approach through a vertical incision, we have consistently noted the presence of a 'sentinel' blood vessel at the upper border of the pes insertion. This study confirmed its presence in 98 out of 100 knees with a diameter ranging from 1 to 3 mm. We therefore propose this blood vessel is a useful tool in identifying the pes anserinus insertion. Tendons receive their blood supply from vessels in the perimysium, the periosteal insertion, and the surrounding tissue via vessels in the paratenon or mesotenon. The semitendinosus and gracilis tendons receive the majority of their blood supply from a vascular network near their tibial insertion [6].

The sentinel vessel therefore appears to be a periosteal artery although this needs to be confirmed by further vascular studies which would also confirm the direction of blood flow. If the sentinel vessel is accidentally damaged during HS harvest, we cauterise it to prevent post-operative haemorrhage following tourniquet deflation and subsequent donor site haematoma formation.

Injury to the IPBSN is a potential complication of the anterior approach [7, 8]. The saphenous nerve gives off its infra-patellar branch at the level of the knee which passes around the posterior border of the sartorius muscle, pierces the fascia lata and continues further to supply the skin over the medial aspect and the front of the knee along with the patella tendon. The saphenous nerve continues its descent along the posterior border of sartorius along the medial side of the knee and gives cutaneous branches to overlying skin and underlying fascia over the medial border of the tibia. It accompanies the saphenous vein down the leg and foot and terminates on the dorsal surface of the first metatarsal.

The IPBSN emerges at the posterior border of sartorius in the majority of cases [9]. It then passes between the lower pole of patella and tibial tuberosity in 98.5% and distal to the tibial tuberosity in 1.5% of cases [10]. Additionally, it runs as two branches in 62%, one branch in 25% and four branches in 1.5% of individuals [11]. Due to this anatomical course of the IPBSN, a conventional large vertical incision poses greater risk of nerve injury. Indeed, studies have reported a higher incidence of nerve injury with a vertical graft harvest incision compared to a horizontal [12, 13].

From our experience, a small 2-cm vertical incision was sufficient for hamstrings identification and graft harvest even when the tendon location was initially unclear. This was because we identified and tracked the sentinel artery to locate the pes insertion thereby avoiding extensive wound dissection and potential post-operative haematoma. The risk of injury to the IPBSN should fall with this technique preventing painful neuromas and altered sensation to the anteromedial knee. While we routinely use a vertical incision in our practice, a 2-cm horizontal anterior incision should also allow easy identification of the sentinel vessel and hence the pes anserinus.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest related to the publication of this manuscript.

Informed consent The study was authorised by the local ethical committee and was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki as revised in 2000.

References

1. Solman CG, Pagnani MJ (2003) Hamstrings tendon harvesting: reviewing anatomic relationships and avoiding pitfalls. Orthop Clin N Am 34:1–8
2. Pagnani MJ, Warner JJP, O'Brien SJ et al (1993) Anatomic considerations in harvesting the semitendinosus and gracilis tendons and a technique of harvest. Am J Sports Med 21:565–571
3. Warren LF, Marshall JL (1971) The supporting structure and layers on the medial side of the knee. J Bone Joint Surg 61:56–62
4. Prodromos CC, Han YS, Keller BL et al (2005) Posterior mini-incision technique for hamstring anterior cruciate ligament reconstruction graft harvest. Arthroscopy 21:130–137
5. Wilson T, Lubowitz J (2013) Minimally invasive posterior hamstring harvest. Arthrosc Tech 2(3):e299–e301
6. Zaffagnini S, Golano P, Farinas O et al (2003) Vascularity and neuroreceptors of the pes anserinus: anatomic study. Clin Anat 16(1):19–24
7. Mochizuki T, Muneta T, Yagishita K et al (2004) Skin sensory change after anterior cruciate ligament reconstruction using medial hamstrings tendons with a vertical incision. Knee Surg Sports Traumatol Arthrosc 12:198–202
8. Bertram C, Porsch M, Hackenbroch MH et al (2000) Saphenous neuralgia after arthroscopically assisted anterior cruciate ligament reconstruction with a semitendinosus and gracilis graft. Arthroscopy 16:763–766
9. Arthornthurasook A, Gaew-Im K (1990) The sartorial nerve: its relationship to the medial aspect of the knee. Am J Sports Med 18:41–42
10. Arthornthurasook A, Gaew-Im K (1988) Study of the infrapatellar nerve. Am J Sports Med 16(1):57–59

11. Kartus J, Ejerhed L, Eriksson BI et al (1999) The localization of the infrapatellar nerves in the anterior knee region with special emphasis on central third patellar tendon harvest: a dissection study on cadaver and amputated specimens. Arthroscopy 15:577–586
12. Portland GH, Martin D, Keene G et al (2005) Injury to the infrapatellar branch of the Saphenous nerve in anterior cruciate ligament reconstruction: comparison of horizontal vs. vertical harvest site incisions. Arthroscopy 21(3):281–285
13. Papastergiou SG, Voulgaropoulos H, Mikalef P et al (2006) Injuries to the infrapatellar branch of the saphenous nerve in anterior cruciate ligament reconstruction with four-strand hamstring tendon autograft: vertical versus horizontal incision for harvest. Knee Surg Sports Traumatol Arthrosc 14:789–793