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Original Article

Posterior semitendinosus tendon harvesting minimizes the risk of injury to the infrapatellar and sartorial branches of the saphenous nerve

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Abstract

There are several reports of iatrogenic injury to the saphenous nerve branches during anterior cruciate ligament (ACL) reconstruction attributed to tendon harvesting through an anterior approach. Other investigators advocate that there is virtually no nerve damage when the tendons are harvested through a posteromedial knee incision. The aim of the present study was to compare the incidence of iatrogenic injury to the infrapatellar and sartorial branches of the saphenous nerve with anterior and posterior tendon harvesting. A prospective, randomized clinical study was conducted comparing patients treated with ACL reconstruction employing the conventional technique with a semitendinosus/gracilis autograft versus the all-inside technique with a short, quadrupled semitendinosus autograft. Tendon harvesting for these two groups was performed through the anterior and the posterior approach, respectively. Skin sensation of the anterior aspect of the operated knee and tibia was assessed by the pin prick test and was compared to the contralateral side. No sensory alterations were noted on the anteromedial aspect of the operated knee and tibia in patients of the posterior harvest group.

Keywords: Saphenous nerve, Short grafts, All-inside, ACL reconstruction, Posterior ST harvest

Introduction

Arthroscopic anterior cruciate ligament (ACL) reconstruction is a commonly performed orthopaedic procedure[1]. Nowadays, there is a widespread use of the semitendinosus (ST) and gracilis (G) tendons (hamstrings) as autografts. ST and G tendons are harvested through an incision over the anteromedial aspect of the knee at the level of their insertion site at the pes anserinous[2]. Several authors have reported an increased incidence of injury to the saphenous nerve itself, as well as to its two terminal branches, the infrapatellar (IBSN) and sartorial branch (SBSN), during ST and G tendon harvesting through the anterior approach[3-5]. The IBSN supplies sensory innervation to the anteromedial aspect of the knee and the SBSN continues along the great saphenous vein to provide sensation to the medial aspect of the lower leg[6]. Iatrogenic nerve damage may cause hypoesthesia, dysesthesia, painful neuroma, reflex sympathetic dystrophy, anterior knee pain and kneeling pain[7].

Some investigators advocate that the size and orientation of the anterior skin incision for graft harvesting is responsible for the nerve injury (mainly to the IBSN), thus suggesting a small oblique skin incision[7-11]. Others, however, believe that SBSN injury may be an intrinsic problem associated with blind, distal-to-proximal direction of G tendon harvesting[12] and that the flexor tendons should be harvested with the knee placed in a "figure-four" position so as to relieve the pressure on the saphenous nerve[13]. Despite these

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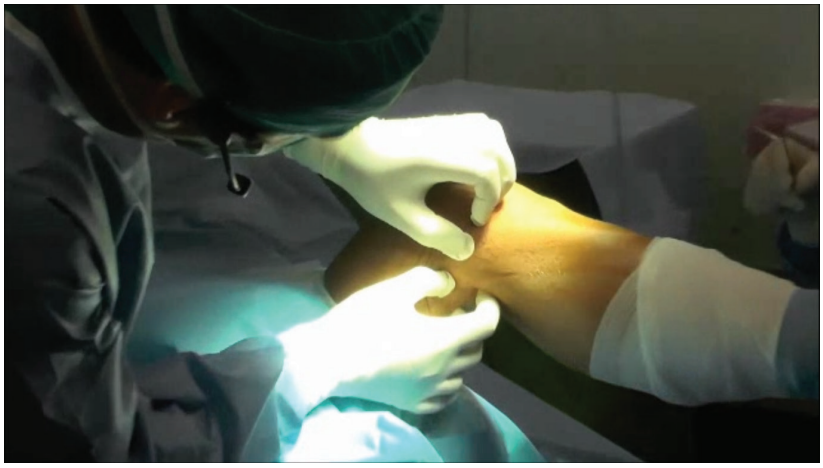

Figure 1. Palpation of semitendinosus tendon.

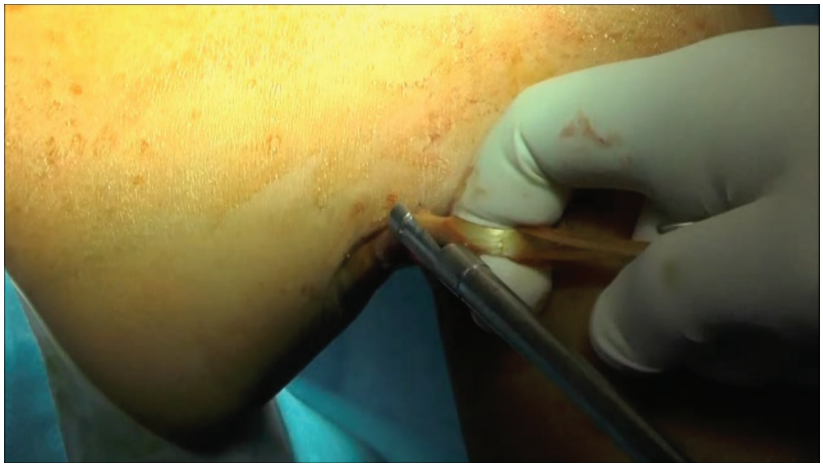

Figure 2. The use of an open stripper in a distal to proximal direction.

technical modifications, nerve injuries still occur[12]; This led to the hypothesis that preservation of the G tendon in ACL reconstructions may lower the incidence of nerve injuries[14].

In this context, Prodromos et al[15] introduced a posterior mini-incision technique for hamstring graft harvesting. They reported no sensory impairment during a two-year follow-up. Similar results have been reported by other investigators as well[16-18].

The purpose of the present study was to compare the incidence of IBSN and SBSN injury in the immediate post-operative period as well as at 2 years in patients undergoing ACL reconstruction with hamstring autografts harvested through: (a) the "traditional" anterior approach, (b) a posteromedial incision in the popliteal fossa at Jobert's groove[19].

Materials and methods

Study design

From January 1015 to December 2016, a prospective, randomized clinical study was conducted in our clinic comparing patients with ACL injury undergoing ACL

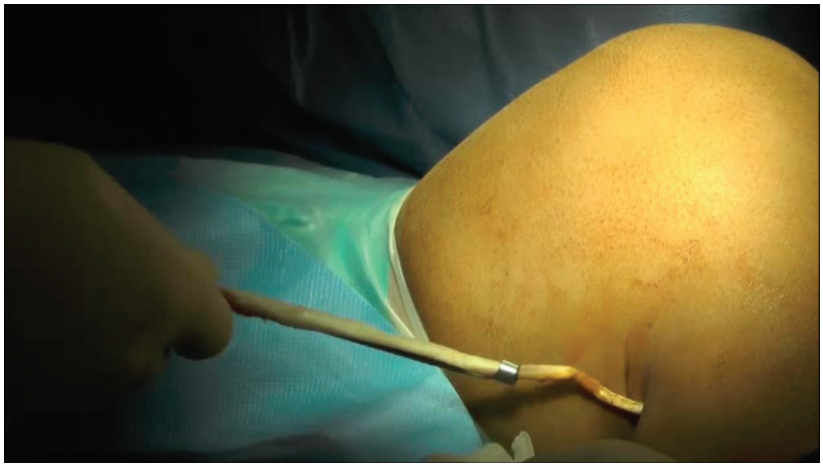

Figure 3. The use of a closed stripper in a proximal to distal direction.

reconstruction with the conventional technique using a semitendinosus/gracilis (ST/G) autograft with suspensory fixation on the femur and interference screw fixation on the tibia (Group A) versus the all-inside technique and a short-quadrupled semitendinosus (ST4) autograft and suspensory fixation on both the femur and tibia (Group B). Graft harvesting was performed with the anterior approach in patients of Group A, and with the posterior approach in patients of Group B. Patients with concomitant cartilaginous, meniscal or other ligamentous injuries, as well as patients with previous fracture, injury, or surgery of any kind in the operative knee were excluded. Patients with ACL tears fulfilling the inclusion criteria were evaluated, and after informed consent was obtained, patients were randomized into one of the two groups using the block randomization method. If a meniscal or chondral lesion was identified intraoperatively, the patient was excluded from the study.

In Group A (42 patients), both ST and G were harvested through an anteromedial oblique skin incision over the pes anserinous with the knee in 90° flexion. The sartorial fascia was split and the tendons were mobilized and harvested with an open tendon stripper in a distal-to-proximal direction. A conventional ST/G, four string autograft was formed, with a suspensory device on the femoral side (Flipptack® button system, Karl Storz, Tuttlingen, Germany) and an absorbable interference screw fixation (Megafix®, Karl Storz, Tuttlingen, Germany) on the tibial side. The graft was pre-tensioned before insertion. The antero-medial arthroscopic portal was used for femoral tunnel drilling and the tibial tunnel was formed by antegrade drilling. The graft was inserted from the distal tibial opening.

In Group B (44 patients), ST was harvested through a posteromedial incision in the popliteal fossa as described by Wilson et al[17]. With the knee in 60° flexion and the hip in slight external rotation, the ST tendon is palpated in the postero-medial aspect of the knee (Figure 1). A 2-cm transverse skin incision is made parallel to the skin lines and blunt dissection is performed with a right-angle clamp. The tendon is secured with a Penrose drain and gently pulled out of the wound. Any adhesions are removed and a "tug test" ensures that there are no residual adhesions especially to the gastrocnemius[17]. With an open-ended tendon stripper aiming at the ischial tuberosity, the tendon is released from the muscle (Figure 2). Any muscular remnants are removed from the tendon with the use of scissors in a single, one hand, distal-to-medial move, to facilitate tendon insertion in the closed-end stripper. In a proximal to distal direction, the closed-end stripper that also acts as a periosteal elevator, releases the tendon from the bone insertion (Figure 3). A quadrupled ST (ST4) autologous graft is formed with suspensory fixation on both femoral and tibial sides. Graft pre-tensioning was performed before positioning. ACL reconstruction was carried out with a modification of the all-inside technique as described by Lubowitz et al[20]. Bone sockets were drilled instead of bone tunnels. A modification of the originally described technique was used, as the femoral socket was created by antegrade drilling through the anteromedial arthroscopic portal. The graft was inserted from this portal as well.

Our senior surgeon (PK) operated on every case. All patients signed an informed consent form before surgery; the Institutional Ethics Committee has approved our study.

Post-operative management

All patients followed the same rehabilitation protocol starting from the first post-operative day with quadriceps isometrics, knee range-of-motion exercises, and weight

bearing as tolerated without a knee brace. Regular follow-up visits were scheduled on weeks 1, 4 and 8 and on months 6, 12 and 24 post-operatively.

During each follow-up visit, the skin sensation of the anterior aspect of the operated knee and tibia was assessed by the pin prick test and was compared to the contralateral side. Patients were then categorized as having or not sensory alterations.

Descriptive statistics were used to report demographics. Continuous variables are expressed as mean±SD, whereas categorical variables are expressed as frequency (%). The Chi-square test was used to compare the incidence of sensory deficit at the area supplied by the saphenous nerve between patients of the two groups. Statistical significance was set at p=0.05.

Results

Initially, 44 patients were enrolled in each group; two patients from group A were lost at follow-up. There were 52 men and 34 women with mean age of 28.7±11.2 years and a mean BMI 25.3±2.9 kg/m^2.

In Group B, no sensory alterations were noted on the anteromedial aspect of the operated knee and tibia. In Group A, hypoesthesia indicating IBSN injury was found in 9 patients (20,5%). The difference between the two groups was statistically significant (p=0.0038). In 4 out of 9 cases the sensation was restored by the 6 month follow-up visit. In the remaining patients (11,3%), hypoesthesia was still present at the 24-month follow-up visit.

Discussion

There is wide variation in the course of IBSN, even between lower extremities of the same individual. The nerve's numerous small terminal branches cover almost all the anteromedial knee surface[10]. Currently, it seems that injury to the IBSN is still difficult to avoid in ACL reconstruction with hamstring autografts harvested through an anterior incision[21]. The incidence of postoperative sensory disturbance on the anteromedial tibia has been reported to range from 39.7% to as high as 74%[4,12]. Our results in patients with anteriorly harvested hamstrings were relatively low (20.5%) but nevertheless important. As iatrogenic neural injuries can have medicolegal implications[22], patients should be informed in advance about the possibility of nerve damage during ACL reconstruction.

Franz and Prodromos described the technique of posteromedial ST tendon harvest with the purpose of minimizing iatrogenic injury to the IBSN and SBSN[15,23]. Low complication rates have also been reported by several authors who have used the posteromedial approach[15,16,19,24,25]. Our study is in accordance with these reports. To our knowledge, there are no reports in the literature about iatrogenic damage to the IBSN or SBSN during isolated posterior ST harvesting. Moreover, posterior harvesting allows for shorter operating times, easier ST tendon identification, better cosmetic results and greater patient satisfaction[15,18,24]. When retrograde tibial drilling is used, the scar over the anterior tibia is minimal and the harvesting wound scar is hidden in the popliteal fossa.

Graft length is always a concern with posterior harvesting. Anterior tendon harvesting affords for approximately 20-mm longer tendon grafts in average[18]. This difference is not important when using the all-inside technique for ACL reconstruction, in which a graft length of 27 mm seems to be adequate. Nuelle reported no need for quadrupled ST graft augmentation with G tendon in a series of 60 ACL reconstructions with the all-inside technique and posterior ST harvesting. The mean tendon length was 268 mm in Nuelle's study and 272 mm in Franz's study[18,25]. In our study, no patient in Group B required graft augmentation with the G tendon.

Our study has several strong points. All patients had exactly the same pathology. This allowed us to have an identical operative plan in every patient within each study group, as well as to implement the same rehabilitation protocol in every case. The exact same surgical team was involved in all surgical operations, and therefore there are no technical differences or variations. The follow-up time was adequate and patient adherence was high.

On the other hand, our study has certain limitations that need to be highlighted. First, a subjective test was used for evaluation of skin sensation. Patients may have different perspectives on what a sensory deficit is or should feel like. However, as quantifying sensory function is not easy, pin-prick test is an acceptable modality for evaluating sensory deficits. Another limitation is that the study includes the senior surgeon's learning curve of the all-inside technique and the posterior hamstring harvesting. Nonetheless, posterior harvesting is not a demanding technique and high-volume surgeons may relatively quickly become proficient of it.

Conclusion

Hamstring harvesting from a posteromedial incision in the popliteal fossa carries no risk of injury to the IBSN and SBSN. From this aspect, it is preferable to graft harvesting through an anteromedial approach. Therefore, we recommend its routine use for hamstring autograft harvesting.

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