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A Comparison between Oblique and Vertical Incisions on the Hamstring Tendon Harvesting in Anterior Cruciate Ligament Reconstruction and Infrapatellar Branch Injury of the Saphenous Nerve

Uma comparação entre incisões oblíquas e verticais na coleta do tendão dos isquiotibiais na reconstrução do LCA e na lesão do ramo infrapatelar do nervo safeno

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Abstract

Objective The present study aimed to compare the oblique and vertical incisions in hamstring tendon harvesting in anterior cruciate ligament (ACL) reconstruction and in infrapatellar branch injury of the saphenous nerve.

Methods The present study was conducted at a tertiary referral center for 12 months. Patients with an indication of reconstruction of ACL tear were included in the study, who were then randomized into two groups (vertical [VG] and oblique [OG] groups). After excluding a few cases, 92 patients were eligible for further analysis (VG: $n = 44$; OG: $n = 48$). They were followed-up for 9 months after the surgery, and loss of sensation over the knee and over the proximal aspect of the operated leg was recorded.

Results The mean lengths of the incisions were 27 mm and 38 mm for the OG and VG groups, respectively. The total rate of hypoesthesia was 40% (27 patients). A total of 12 (25%) and 25 patients (56.8%) on the OG and VG groups, respectively, reported hypoesthesia symptoms. The presence of hypoesthesia in patients in the VG group was two times higher than in the OG group. No statistical correlation was observed between the nerve injury and age, gender, education, and delay from injury to reconstruction.

Keywords
- anterior cruciate ligament
- oblique incision
- reconstruction
- saphenous nerve

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Conclusion Oblique incision, which showed lower risk of nerve damage, might be more recommended for graft harvesting. Patients who underwent reconstruction of the ACL in the OG group had a lower incidence of peri-incisional hypoesthesia when compared to those in the VG group.

Resumo

Objetivo O presente estudo teve como objetivo comparar as incisões oblíquas e verticais na coleta dos tendões dos isquiotibiais na reconstrução do ligamento cruzado anterior (LCA) e na lesão do ramo infrapatelar do nervo safeno.

Métodos O presente estudo foi realizado em um centro de referência terciário por 12 meses. Pacientes com indicação de reconstrução de uma ruptura do LCA foram incluídos no estudo, os quais foram randomizados em dois grupos (vertical [GV] e oblíquo [GO]). Após a exclusão de alguns casos, 92 pacientes foram elegíveis para análise posterior (GV: $n = 44$; GO: $n = 48$). Eles foram acompanhados por 9 meses após a cirurgia, e a perda de sensibilidade sobre o joelho e sobre o aspecto proximal da perna operada foi registrado.

Resultados Os comprimentos médios da incisão foram de 27 mm e 38 mm para os grupos GO e GV, respectivamente. A taxa total de hipoestesia foi de 40% (27 pacientes). Um total de 12 (25%) e de 25 pacientes (56,8%) dos grupos GO e GV, respectivamente, relataram sintomas de hipoestesia. A presença de hipoestesia em pacientes no grupo GV foi duas vezes maior do que no grupo GO. Não foi observada correlação estatística entre a lesão do nervo e idade, gênero, escolaridade e demora entre a lesão e a reconstrução.

Conclusão A incisão oblíqua, que apresentou menor risco de lesão nervosa, pode ser mais recomendada para a coleta do enxerto. Pacientes submetidos à reconstrução do LCA no grupo GO tiveram menor incidência de hipoestesia peri-incisional quando comparados aos pacientes do grupo GV.

Palavras-chave
- ligamento cruzado anterior
- incisão oblíqua
- reconstrução
- nervo safeno

Introduction

The anterior cruciate ligament (ACL) is one of the main prevalent injured ligaments of the knee. It has been estimated that among 200 thousand ACL injuries for every year in the United States, almost half of them undergo ACL reconstruction.[1] Regardless, graft choices and techniques that are used to harvest them are imperative. The most utilized autologous graft options incorporate the central third of the patellar tendon, the quadriceps, and the hamstring tendons (semitendinosus and gracilis).[2] All of these methods have been widely used, and their complications and outcomes are described in the publications.[3,4]

The arthroscopically-assisted reconstruction of the ACL using grafts from the semitendinosus and gracilis tendons requires a small incision, which is an effective and safe option in contrast to the patellar tendon autograft, with lower donor-site morbidity.[4] However, because of the specific anatomical location, there is a potential risk of damage to the infrapatellar branch of the saphenous nerve (IPBSN) during hamstring graft harvest, which can prompt complications such as peri-incisional dysesthesia and local pain.[5] The incidence of any sensory disturbance in the distribution of the IPBSN arising from arthroscopically-assisted knee surgery, including ACL reconstruction, has varied widely from study to study, and it has been reported in up to 88% of the cases.[6,7]

Several investigations suggest the utilization of horizontal and oblique incisions to expose and harvest the tibial insertion of the hamstring tendons to reduce the damage to the IPBSN compared with vertical incisions; however, there is no consensus so far.[4,8] It has been articulated that the incisions with greater respect to the anatomy of the IPBSN could guarantee a lower complication rate. Subsequently, the present study aimed to compare the incidence of IPBSN injury between two different incisions, vertical and oblique, used for hamstring tendon graft harvest.

Materials and Methods

Patients

The present research is a case-control study conducted at a tertiary referral center of Akhtar Hospital, Tehran, Iran, for 12 months (from May 2017 to April 2018). A total of 245 patients underwent primary ACL reconstruction with hamstring graft.

The study was performed in compliance with the World Medical Association Declaration of Helsinki on Ethical Principles for Medical Research Involving Human Subjects and was reviewed by the Institutional Review Board of the Shahid Beheshti University of Medical Sciences. The authors provided informed written consent forms during the study period

to all of the included patients. The intervention was explained before the surgery to each patient, and a questionnaire was completed to determine the cause of ACL injury, the injury to surgery interval, age, gender, and education. Patients were randomized into two groups (vertical group [VG], and oblique group [OG]) using a random number-generating software. Odd numbers were assigned to the VG, and even numbers were assigned to the OG. All of the patients were subjected to a primary ACL reconstruction with a standard hamstrings autograft technique, in the same healthcare center, and by the same surgical team. Concomitant meniscal injuries were treated by partial meniscectomy or repair using an all-inside meniscal repair technique. There were no extra incisions for meniscus surgeries.

Inclusion Criteria

Patients with an indication of reconstruction due to an ACL tear were included. After surgery, 153 patients were excluded from the study, due to previous surgeries in the region of the studied knee, any peripheral neurological abnormality before the procedure, old scars around the knee, multiligament injury, and loss to follow-up. After excluding all of these cases, 92 patients were eligible for further analysis (VG: $n = 44$; OG: $n = 48$).

Surgical Technique

All of the incisions for graft harvesting were made with a 90° flexed knee, 2 cm below the superior extremity of the anterior tibial tubercle (ATT) and 1 cm medial to it. Vertical incisions were made in a plane parallel to the ATT; the oblique incisions were made with an inclination of 45° in relation to this plane, from superomedial to inferolateral (►**Fig. 1** and ►**Fig. 2**).[9] To harvest the tendons, a 2-cm longitudinal incision was made. The length of the incision was elongated when required. The gracilis and semitendinosus tendons were palpated after the incision, and the overlying sartorial fascia was opened along the superior border of the gracilis tendon. Once the two tendons were isolated with a clamp, these distinct structures were detached from their insertion to the tibia, as distal as possible, and then harvested with a close-ended tendon stripper. The same incision was then used for the preparation and placement of the ACL graft. A formal transportal quadruple hamstring ACL reconstruction was performed. Endo-Button was used for femoral fixation, and an interference screw was used for tibial fixation.

Rehabilitation

A common rehabilitation protocol was used for both groups. In the present study, at 9 months after the surgery, the patients were examined for sensory loss around the knee by means of the pinprick test. Then, the area with sensory loss was marked, and digital pictures were snapped with a ruler as a scale. After that, the sensory loss area (cm^2) and the incision length (mm) were measured with Photoshop software (Adobe Inc., Mountain View, CA, USA). Clinical assessments were performed by a single researcher.

Fig. 1 Vertical incision for hamstrings tendon harvesting.

Statistical Analysis

Data were imported to IBM SPSS Statistics for Windows, Version 22 (IBM Corp., Armonk, NY, USA) for analysis. The chi-squared test and the student *t*-test were used for nonparametric and parametric data, respectively. $P < 0.05$ was considered as statistically significant.

Results

Among the 92 patients included, 86 were male, and 6 were female (mean age = 26.9 years old, range: 17–47 years old). A total of 65 (71.6%) injuries were due to sports, with football accidents being the most frequent cause of ACL tear ($n = 45$; 48.9%). Some injuries were caused by other sports ($n = 20$; 21.7%), falling, and vehicle accidents ($n = 18$; 19.5% for both), along with other causes ($n = 9$; 9.7%). Amongst the patients, 25% had a university degree (i.e., bachelor's, master's, Ph.D., etc.), 45% had complete high school education, and 30% had education only up to high school. The mean injury to surgery delay time was 11 months (with a range of 1.5–61 months), and the mean length of incision was 27 mm (20–39 mm) for the OG, and 38 mm (25–47 mm) for the VG. There was no difference between groups regarding the type of injury, as

Fig. 2 Oblique incision for hamstrings tendon harvesting.

well as no differences regarding surgery delay time, and gender of patients.

The oblique incision was used in 48 out of the 92 knees assessed. Of these, 12 (25%) had hypoesthesia around the operated knee and proximal leg region after a 9-month follow-up. The mean length of hypoesthesia in the OG was 9.6 cm^2 (with a range of 1.7–20.2 cm^2) (►**Fig. 3**). Among the 44 patients with a vertical incision, 25 (56.8%) had some degrees of hypoesthesia after 9 months of follow-up, with the mean length of hypoesthesia being 34.2 cm^2 (3.3–76.2 cm^2) (►**Fig. 3**). According to the odds ratio (OR) test, the presence of hypoesthesia in patients undergoing vertical incision was 2 times higher (2.27 times; confidence interval [CI] = 95%) than in patients operated with oblique access. In patients who had complaints of hypoesthesia, the proximal anterolateral region of the leg was the most affected (75%) area. Furthermore, proximal anteromedial involvement of the leg was observed in 10% of the patients, and both anterolateral and anteromedial involvement was observed in 15% of patients. There was no statistically significant difference between the OG and the VG regarding the location of hypoesthesia.

When the patients were questioned about IPBSN complaints, the complaint rate was noticed to be lower than the measured ratio. However, the ratio of subjective complaints was significantly lower in the OG compared with the VG ($p < 0.05$). This indicates that the patients did not recognize this problem or that they neglected it. The incidence of any

Fig. 3 Sensory disturbance area of patients who underwent anterior cruciate ligament reconstruction, using the vertical (A) and oblique (B) incisions, and marking of area.

reported numbness for the OG was of 41.6% (5/12) (patients reporting numbness/patients who have hypoesthesia complaints) at 9 months, while the incidence of numbness for the VG was 60.0% (15/25). There was no statistically significant difference between groups comparing the incision length and other demographic data. In addition, the incidence of any reported complaints about pain at the site of the incision after 9 months was 6.2% (3/48) and 20.4% (9/44) for the OG and the VG, respectively. The pain did not interfere with the daily activities of any of the patients. The patients who had subjective complaints were seen to have a larger hypoesthesia area. Age, gender, education, and delay from injury to reconstruction did not show any significant correlation with nerve injury, and with complaints of the patients.

Discussion

In the present study, two types of oblique and vertical incisions were compared over the pes anserinus region, through which the medial hamstring tendons are harvested. In addition, the present study proposes that, in contrast to the traditional vertical incision, the oblique incision can significantly decrease IPBSN injury, leading to decreased complaints by the patients. An overall prevalence of 40.2% of hypoesthesia was observed in the present study, while a 2-fold lower prevalence of peri-incisional hypoesthesia was seen in the OG when compared with the VG. This may be due to greater conformity to the anatomy of the IPBSN, in this situation.

A standard incision has not been described in the literature for semitendinosus and gracilis graft harvest. Brown et al showed an oblique incision in parallel with the skin lines in the superior region of the pes anserine. This parallel incision was supposed to give a superior vision and lead to less scarring by facilitating skin retraction.[10] Marder et al[11] recommended a 4-cm oblique incision, 3 fingers distal from the joint level over the insertion of the pes anserine. In a cadaver study of Pagnani et al,[12] they announced that the insertion site of hamstring tendons is at 1.9 cm distal and 2.25 cm medial of the tibial tubercular apex, and they suggested graft harvesting from 4 parts of the knee in order to relax the saphenous nerve when running the gracilis tendon at the posteromedial aspect of the knee. A vertical incision is considered to cause more scar tissue due to it being vertical to skin lines and also to increase the risk of nerve injury due to being vertical to the IPBSN.[13]

The IPBSN exits from the adductor canal and descends at a 45° angle through the anterior knee.[14] Also, there are numerous varieties of the transverse branches of the IPBSN, from the lower pole of the patella up to the distal tibial tubercle.[15] Therefore, nerve injury is inescapable when the skin is incised for tendon harvesting. Wisely, an incision parallel to the nerve passage may cause less nerve injury.[16] A sartorial branch injury may also happen, which has just been accounted for in up to 23% of patients.[17]

Our results confirm the theory that an oblique incision may decrease nerve damages. In addition, the numbness was significantly linked with the sensory loss region and happened less frequently in the OG ($p < 0.001$). An examination on cadaveric knees showed that the IPBSN is relatively parallel to the superior border of the anserinus tendon (from medial-superior to lateral-inferior).[4] The proximity between these structures, related to the surface position of its terminal branch in the anteromedial area of the knee, could clarify the incidence of iatrogenic IPBSN injuries in ACL reconstruction with flexor tendons, which, as indicated by the literature, can reach 77%.[6,18,19] Tavakoli Darestani et al[17] investigated 60 cases and found that an oblique incision was related to decreased incidence of injury; however, this link was not statistically significant. The agreement among specialists depends precisely on the presence of a parallelism between the horizontal and oblique incisions and on the anatomy of the IPBSN. Portland et al[19] analyzed three complications related to these two incisions in the removal of the flexor tendon, including pain, cosmetic appearance, and dysesthesia. In all of the assessed items, the vertical incision displayed a higher rate of complications.

Several studies were performed to limit the complications during graft harvesting for ACL reconstruction. Letartre et al,[20] to avoid injuries in the saphenous nerve and in its branches in the anteromedial district of the knee, suggested a technique that utilizes the posterior access for removing the flexor tendons. In another examination, de Padua et al[21] reported a lower rate of saphenous nerve injuries in patients in whom only the semitendinosus tendon was removed (thus preserving the gracile), when compared with the harvesting of both grafts. To evaluate the impact of the IPBSN position on dynamic knee mobility in 20 cadaver knees, Tifford et al[13] presumed that incisions in the anterior aspect of the knee should be made in flexion. In concurrence with those authors, all of the patients in our investigation underwent the incision with the knee in flexion.

The effect of nerve injury on knee function was not surveyed, and this was the main limitation of the present examination. In addition, other methods, like electrophysiological studies, would have been more useful for the analysis of the level of nerve injury. Moreover, the functional effect in cases with neurological deficit was not determined.

Conclusion

Injury to the IPBSN might be observed in hamstring graft harvest. However, according to our findings, an oblique incision causes less injury to the IPBSN in arthroscopic ACL reconstruction with hamstring tendon autograft. In addition, sensory loss does not impair normal daily activities in most of these patients. As a possible complication, nerve injury and its benign prognosis should be explained to the patient before the surgery.

Conflicts of Interests

The authors declare that there are no conflicts of interests.

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