Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Gracilis tendon harvesting using the posterior approach for anatomical ankle ligament reconstruction: a rapid and reliable technique with minimal neurological complications

Maria Khvesyuk
Clinique Trénel
. ReSurg
floris@resurg.com

Resurg (Switzerland)
Alexis Nogier
Clinique Trénel
Philippe Beaudet
Clinique Trénel

Research Article

Keywords: Graft harvesting, Gracilis, posterior approach

Posted Date: April 23rd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-7997508/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Graft harvesting is an important step when performing ligament reconstruction. The anterior approach is a well-described technique for hamstring tendon harvesting as it is commonly used for anterior cruciate ligament reconstruction, as an anterior incision is required to drill the tunnel. However, in case of gracilis harvesting for ankle ligament reconstruction, an anterior approach could lead to unnecessary complications and donor-site morbidity, and therefore the posterior approach is preferred, as it decreases complications and morbidity.

Purpose

To report donor site morbidity following gracilis harvesting using a posterior approach for anatomic ankle ligament reconstruction.

Methods

Between January 2023 and March 2025, 33 patients underwent anatomic ankle ligament reconstruction with a gracilis autograft for chronic ankle instability. In 2 patients, it was not possible to harvest the gracilis due to obesity, leaving 31 patients for assessment. The gracilis was harvested in flexion or extension position, based on the BMI of the patient. The authors noted graft length, diameter, time to harvest the gracilis, and whether patients had any neuropathy of the saphenous nerve or discomfort around the donor-site.

Results

The remaining 31 patients comprised 12 males, and 19 females, were aged 36.8 ± 12.6 (range, 17–60) with a BMI of 27.1 ± 4.4 (range, 18–37). Of the 31 patients, the gracilis was harvest with the knee flexed in 30 (97%), and knee extended in 1 (3%). The length of the graft was 18.9 ± 2.9 cm, and was cut to 13.8 ± 0.6 cm, with a diameter proximally of 3.7 ± 0.4mm and distally of 3.9 ± 0.5mm. The time to harvest the graft was 6.6 ± 4.3 minutes. At a follow-up of 5.1 ± 3.8 months, 1 patient reported neuropathy of the saphenous nerve, and 5 reported discomfort around the donor-site, which resolved in 3.

Conclusion

Gracilis harvesting using the posterior approach is a safe technique with minimal complications and donor-site morbidity.

Background

Gracilis tendon harvesting conventionally involves an anteromedial approach on the proximal tibia at the level of the pes anserinus, which is used by the majority of surgeons. This surgical approach has been associated with complications, including injury to the infrapatellar branches of the saphenous nerve, premature graft amputation, and unintentional gracilis harvesting when only the semitendinosus tendon is required [1–4].

Prodromos et al.[5] recommended a primary posterior approach to guide harvesting via a reduced anterior approach, avoiding risk of premature sectioning due to adherence.The technique has undergone several modifications to reduce complications and improve postoperative outcomes [6, 5, 7–9]. This approach was believed to simplify the identification of hamstring tendons, reduce saphenous nerve injury, and prevent premature amputation of the tendons [5]. Several studies have been published regarding the posterior approach to harvest the graft followed by anterior cruciate ligament reconstruction. However, in the case of graft harvesting for ankle ligament reconstruction, it is even more important to minimize donor-site morbidity at the knee.

The principal objective of the present study was to report the clinical outcomes of harvesting the gracilis tendon using the posterior approach, especially terms of nerve injury, .

Methods

Between January 2023 and March 2025, 33 patients underwent anatomic ankle ligament reconstruction for chronic ankle instability using a gracilis autograft harvested through the posterior approach. The gracilis was harvested in flexion or extension position, based on the BMI of the patient. All patients provided informed consent, and study was approved by a local ethics committee (E2026-12).

Preoperative assessment

All patients underwent standard ankle assessment (clinical examination, X-ray, MRI). Patients were assessed whether they underwent previous knee surgery with hamstring graft harvesting.

Surgical technique

The patient is positioned with the lower limb in external hip rotation and knee flexion (Figs. 1 and 2). The surgeon positions themselves on the medial side of the knee. The tendons in the popliteal fossa are located by rotating the foot externally to stretch the structures. A transverse incision of a few centimetres centered on the tendons is made, if possible in a flexion crease, which will be enlarged if necessary. The subcutaneous tissue is dissected and then the tendon fascia is opened using Metzenbaum scissors or a dissector.

The semitendinosus tendon can be identified as the largest and most lateral tendon, while the gracilis tendon is more medial and superficial. The tendon is isolated and pulled outside. To facilitate this, knee flexion can be increased (Fig. 3).

The gracilis tendon is harvested in retrograde using a closable stripper. The stripper is oriented towards the proximal insertion of the tendon in the direction of the pubis (Fig. 4). The graft is extracted at the incision site, and the distal stump is left in place (Fig. 5). The muscle fibres are removed using Mayo scissors. The

harvested tendon is measured and cut to 14 cm to form the graft. Then the skin is closed with absorbable sutures.

The graft is then prepared by a non-absorbable running suture of both ends over 1 cm. The surgeon then continues with the arthroscopic procedure of reconstructing the ankle ligaments.

Postoperative rehabilitation

Patients are required to use a walking boot for 3–4 weeks, and are allowed weight-bearing. Physiotherapy is started after this period.

Intra- and post-operative assessment

Intraoperatively, the authors noted graft length, diameter and recorded the time to harvest the gracilis. At a follow-up of minimum 4 weeks following the surgery, an observer assessed the joint range of motion and stability with examination for laxity using external manoeuvres. Furthermore, sensory-motor deficits are examined, and whether patients had any neuropathy of the saphenous nerve or discomfort on a numeric rating scale (0, no discomfort; 10, maximum discomfort) around the donor-site. In case of no saphenous nerve injury or discomfort, no further follow-ups were required.

Statistical analysis

Due to the small cohort size, only descriptive statistics were used to summarise the data. No sample size calculation was performed, as all patients registered were enrolled.

Results

Of the 33 patients, it was not possible to harvest the gracilis through the posterior approach due to obesity in 2 patients, leaving 31 patients for assessment (Table 1). The remaining 31 patients comprised 12 males, and 19 females, were aged 36.8 ± 12.6 (range, 17–60) with a BMI of 27.1 ± 4.4 (range, 18–37). Of the 31 patients, the gracilis was harvested with the knee flexed in 30 (97%), and knee extended in 1 (3%).

Table 1: Patient characteristics of the initial and final cohort

	Initial cohort (n = 33)						Final cohort (n = 31)					
	Mean	±	SD	Range			Mean	±	SD	Range		
	n		%				n		%			
Age	36.5	±	12.3	17	–	60	36.8	±	12.6	17	–	60
Weight (kg)	78.3	±	17.2	54.0	–	138.0	77.4	±	17.3	54.0	–	138.0
Height (cm)	1.68	±	0.1	1.55	–	1.93	1.68	±	0.09	1.55	–	1.93
BMI	27.5	±	4.6	18.5	–	37.0	27.1	±	4.4	18.5	–	37.0
Female	21		58%				19		61%			

Abbreviations: BMI, Body Mass Index; cm, centimeter; kg, kilogram; SD, Standard Deviation

The length of the graft was 18.9 ± 2.9cm, and was cut to 13.8 ± 0.6cm, with a diameter proximally of 3.7 ± 0.4mm and distally of 3.9 ± 0.5mm (Table 2). The time to harvest the graft was 6.6 ± 4.3 minutes (range, 2 to 25). At a follow-up of 5.1 ± 3.7 months, 5 reported discomfort around the donor-site, which resolved in 3 (Table 3). One patient reported neuropathy of the saphenous nerve, as this patient was obese (BMI, 32.7) it took 25 minutes to identify the anatomic structures.

Table 2: Intraoperative characteristics

	Final cohort (n = 31)					
	Mean	±	SD	Range		
	n		%			
Harvested graft length	18.9	±	2.9	12	–	24
Graft length after sectioning	13.8	±	0.6	12	–	15
Diameter graft proximal	3.7	±	0.43	3	–	5
Diameter graft distal	3.9	±	0.5	3	–	5
Graft harvesting time (min)	6.6	±	4.3	2	–	25
Overall surgery time (min)	59.2	±	12.0	39	–	89

Abbreviations: BMI, Body Mass Index; cm, centimeter; kg, kilogram; SD, Standard Deviation

Table 3: Postoperative characteristics						
	Final cohort (n = 31)					
	Mean	±	SD	Range		
	n		%			
Follow-up time (months)	5.1	±	3.7	1	–	18
Saphenous nerve injury	1		3%			
Donor-site discomfort	5		16%			
Abbreviations: BMI, Body Mass Index; cm, centimeter; kg, kilogram; SD, Standard Deviation						

Discussion

The most important findings of this study were that, harvesting the gracilis tendon through the posterior approach is a safe and effective technique, with minimal donor-site morbidity. In a recent systematic review by Thamrongskulsiri et al.[10], the authors found that anteromedial approaches for hamstring harvest had higher rates of saphenous nerve injury and longer operative times compared to posteromedial approaches. The anteromedial approach also resulted in a longer semitendinosus graft length. Furthermore, Thamrongskulsiri et al.[10] found that the posteromedial harvest group reported higher cosmetic satisfaction than the anteromedial harvest group, though overall satisfaction levels were similar between the groups. It is worth noting that Thamrongskulsiri et al.[10] investigated graft harvesting for anterior cruciate ligament repair, which might lead to different outcomes compared to graft harvesting for ankle ligament reconstruction.

Harvesting through the posterior approach has several benefits; Roussignol et al.[9] found that the tendon can be havested through an incision with a mean length of 26.5 mm, which could be further reduced in case of good tendon palpation. Furthermore, posterior gracilis tendon harvesting leads to less saphenous nerve lesions. In a study by Mochizuki et al.[11], the authors reported a 58% rate of postoperative hypoesthesia in a series of 103 patients following anterior graft harvesting, and Sanders et al.[12] reported a 74% rate. Furthermore, when nerve lesions occur, they are usually chronic. In the present study, there were minimal nerve lesions as only 1 patient reported neuropathy of the saphenous nerve, and 5 reported discomfort around the donor-site, which resolved in 3. Finally, the authors recommend harvesting the tendon with the knee in flexion and the hip in external rotation, which relaxes the saphenous nerve.

In the authors' experience, the graft length is shorter using the posterior approach, because it is cut more proximally, but it is still sufficiently long to perform the reconstruction. Furthermore, more experience is required as harvesting is more difficult and time-consuming, but it is commonly performed for anterior cruciate ligament repair. It provides a more aesthetic outcome, especially as this procedure is often performed in young athletic patients, as the scar is hidden in the popliteal fossa using the posterior approach. This approach is unfortunately not possible in obese patients, as it is more difficult to use the posterior approach, and therefore the anterior approach is preferred.

Limitations

The results of this study should be interpreted with the following limitations in mind. First, these are only the results of a small case series. Comparative studies could provide more information on the differences in rates of nerve injury and donor-site morbidity. Second, due to the small cohort size it was not possible to perform uni- and/or multivariable analysis to determine which patient characteristics influence the outcome. Third, no clinical scores of the ankle were collected, as this was not the aim of the study.

Conclusion

Gracilis harvesting using the posterior approach is a safe technique with minimal complications and donor-site morbidity, but is not preferred in patients with obesity.

Declarations

Ethics approval and consent to participate

All patients provided informed consent, and study was approved by a local ethics committee (Comité d'Ethique pour la Recherche sur Données Existantes et/ou hors loi Jardé CHU de Rouen; E2026-12). The study adhered to the rules outlined in the Declaration of Helsinki.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

Funding

The authors are grateful to Clinique Trenel for funding the statistical analysis and manuscript preparation for this study.

Author Contribution

PB Conceptualization, Project administration, Interpretation of findings, Writing, ValidationMK Data collection, Interpretation of findings, ValidationFVR Project administration; Data analysis, Statistics, Visualisation, Interpretation of findings; Writing, ValidationMS Interpretation of findings, ValidationAN Funding, Validation

Acknowledgements

Not applicable

Data Availability

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

References

1. de Padua VB, Nascimento PE, Silva SC, de Gusmão Canuto SM, Zuppi GN, de Carvalho SM (2015) Saphenous nerve injury during harvesting of one or two hamstring tendons for anterior cruciate ligament reconstruction. Rev Bras Ortop 50 (5):546-549. doi:10.1016/j.rboe.2015.08.007
2. Ochiai S, Hagino T, Senga S, Yamashita T, Oda K, Haro H (2017) Injury to infrapatellar branch of saphenous nerve in anterior cruciate ligament reconstruction using vertical skin incision for hamstring harvesting: risk factors and the influence of treatment outcome. J Orthop Surg Res 12 (1):101. doi:10.1186/s13018-017-0596-x
3. Ruffilli A, De Fine M, Traina F, Pilla F, Fenga D, Faldini C (2017) Saphenous nerve injury during hamstring tendons harvest: Does the incision matter? A systematic review. Knee Surg Sports Traumatol Arthrosc 25 (10):3140-3145. doi:10.1007/s00167-016-4217-8
4. Charalambous CP, Kwaees TA (2012) Anatomical considerations in hamstring tendon harvesting for anterior cruciate ligament reconstruction. Muscles Ligaments Tendons J 2 (4):253-257
5. Prodromos CC, Han YS, Keller BL, Bolyard RJ (2005) Posterior mini-incision technique for hamstring anterior cruciate ligament reconstruction graft harvest. Arthroscopy 21 (2):130-137. doi:10.1016/j.arthro.2004.09.010
6. Kodkani PS, Govekar DP, Patankar HS (2004) A new technique of graft harvest for anterior cruciate ligament reconstruction with quadruple semitendinosus tendon autograft. Arthroscopy 20 (8):e101-104. doi:10.1016/j.arthro.2004.07.016
7. Wilson TJ, Lubowitz JH (2013) Minimally invasive posterior hamstring harvest. Arthrosc Tech 2 (3):e299-301. doi:10.1016/j.eats.2013.04.008
8. Letartre R, Isida R, Pommepuy T, Miletic B (2014) Horizontal posterior hamstring harvest. Orthop Traumatol Surg Res 100 (8):959-961. doi:10.1016/j.otsr.2014.08.002
9. Roussignol X, Bertiaux S, Rahali S, Potage D, Duparc F, Dujardin F (2015) Minimally invasive posterior approach in the popliteal fossa for semitendinosus and gracilis tendon harvesting: an anatomic study. Orthop Traumatol Surg Res 101 (2):167-172. doi:10.1016/j.otsr.2014.12.009
10. Thamrongskulsiri N, Limskul D, Tanpowpong T, Kuptniratsaikul S, Itthipanichpong T (2024) The Posteromedial Approach for Harvesting Hamstring Autografts Results in Fewer Incidents of Saphenous Nerve Injury Compared to the Conventional Anteromedial Approach: A Systematic Review and Meta-Analysis. Clin Orthop Surg 16 (4):559-569. doi:10.4055/cios23396
11. Mochizuki T, Akita K, Muneta T, Sato T (2003) Anatomical bases for minimizing sensory disturbance after arthroscopically-assisted anterior cruciate ligament reconstruction using medial hamstring

tendons. Surg Radiol Anat 25 (3-4):192-199. doi:10.1007/s00276-003-0130-1

12. Sanders B, Rolf R, McClelland W, Xerogeanes J (2007) Prevalence of Saphenous Nerve Injury After Autogenous Hamstring Harvest: An Anatomic and Clinical Study of Sartorial Branch Injury. Arthroscopy: The Journal of Arthroscopic & Related Surgery 23 (9):956-963. doi:10.1016/j.arthro.2007.03.099

Figures



Figure 1

Location for incision for graft harvesting



Figure 2

Patient postioning



Figure 3

Pulling out the gracilis tendon



Figure 4

The tendon is isolated and pulled outside. To facilitate this, knee flexion can be increased

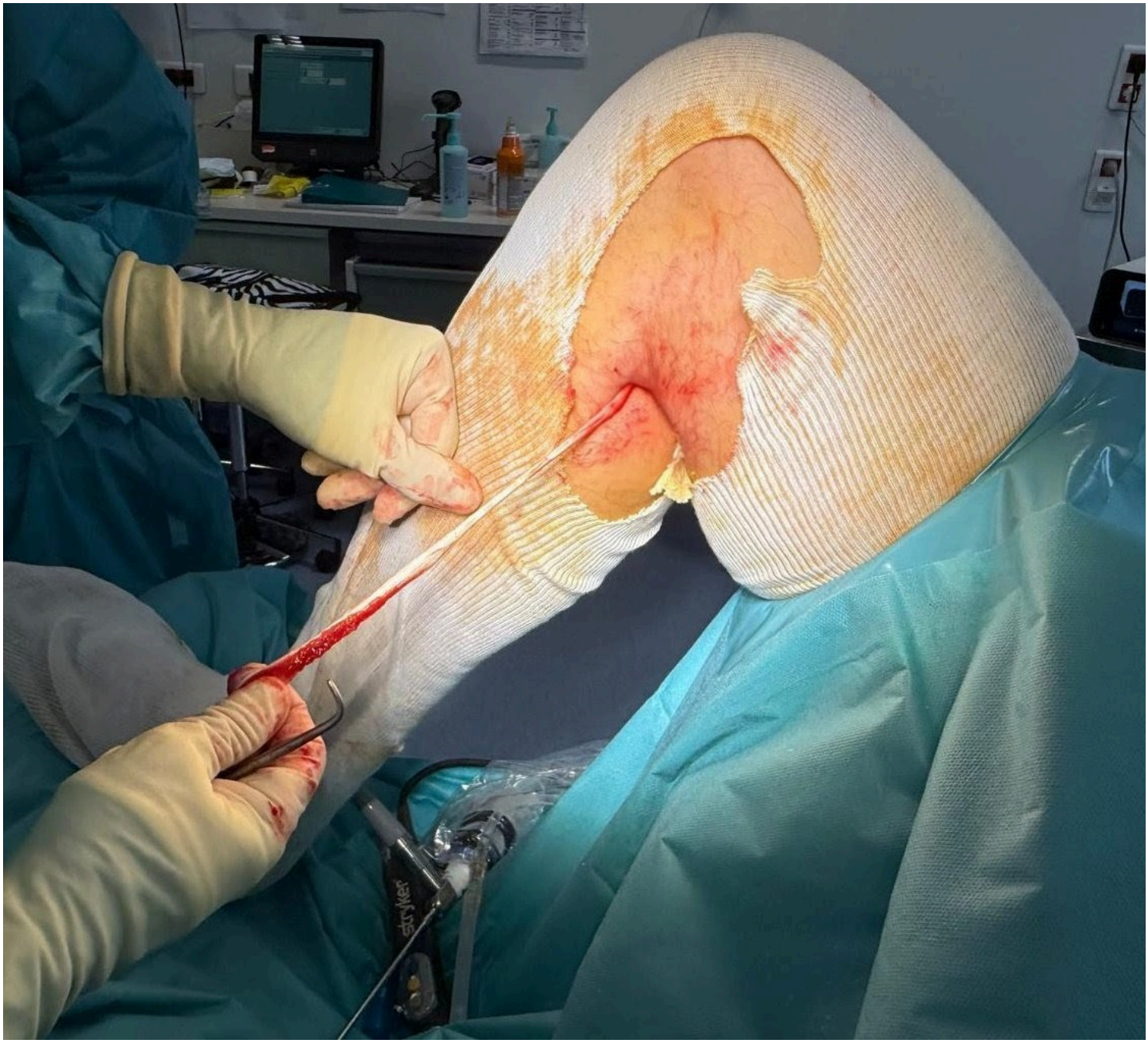


Figure 5

The gracilis tendon is harvested in retrograde using a closable stripper