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Original article

Do outcomes of outpatient ACL reconstruction vary with graft type?

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ABSTRACT

Background: Studies establishing the feasibility of anterior cruciate ligament (ACL) reconstruction as an outpatient procedure in France were usually conducted with hamstring tendon grafts. The objective of this study was to evaluate the outcomes of outpatient ACL reconstruction according to whether the graft was harvested from the hamstring tendons or patellar tendon.
Hypothesis: Outpatient ACL reconstruction can be performed using any type of graft.
Methods: A single-centre retrospective study was conducted in consecutive patients older than 16 years who had primary ACL reconstruction using patellar tendon or hamstring tendons, with or without lateral tenodesis. Patients who underwent other procedures on bones or peripheral ligaments and those with a previous history of ACL reconstruction were excluded. The primary evaluation criterion was the occurrence of complications within 45 days after surgery. Secondary evaluation criteria were the visual analogue scale (VAS) for pain during the first 3 postoperative days, patient satisfaction on day 3, and the IKDC and Lysholm clinical scores on day 45.
Results: The analysis included 104 knees (one knee per patient). Hamstring tendons were used in 77 (74%) knees and patellar tendon in 27 (26%) knees. In the hamstring group, 2 (2.6%) patients spent the first postoperative night in the hospital and 2 others were re-admitted. No hospitalisations were recorded in the patellar-tendon group. None of the patients required revision surgery within 45 days of the reconstruction procedure. None of the postoperative criteria studied showed statistically significant differences between the two groups.
Discussion: ACL reconstruction can be performed on an outpatient basis using any type of graft. The main determinants of successful outpatient ACL reconstruction are a standardised clinical management strategy and an appropriate anaesthesia protocol.
Level of evidence: Level IV, retrospective study.

1. Introduction

In 2013 in France, 41,937 anterior cruciate ligament (ACL) reconstruction procedures were performed, with a mean hospital stay length per patient of 3.15 days (http://www.atih.sante.fr/statistiques-par-ghm-0). Newly introduced surgical techniques are associated with a decrease in intra-operative morbidity [1,2]. Multimodal anaesthesia is designed to minimise the adverse effects of opiates and to expedite postoperative recovery [3,4]. The combination of these surgical and anaesthetic techniques has made ACL reconstruction feasible as an outpatient procedure. Advantages of outpatient surgery include cost reduction, a decreased risk of nosocomial infections, and better patient satisfaction [5].

In 2013, the 3% proportion of ACL reconstruction procedures done on an outpatient basis in France was considerably lower than in other countries (http://www.atih.sante.fr/statistiques-par-ghm-0), e.g., 38% in Norway, 56% in Sweden, and 79% in Denmark [6]. The proportion is highest in the US (95%) [5,7], where the use of allografts limits the morbidity associated with graft harvesting [8]. Outpatient ACL reconstruction using a hamstring tendon (HST) autograft was recently proved feasible in France [9]. However, the patellar tendon (PT) is also a useful graft source for primary or revision ACL reconstruction [10–13].

The primary objective of this study was to conduct a clinical analysis of the early postoperative course after outpatient ACL

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reconstruction using either HST or PT grafts. The hypothesis was that all types of ACL reconstruction, regardless of the technique used, can be performed as outpatient procedures.

2. Patients and methods

A single-centre retrospective study was conducted in patients treated between February and July 2014. Each patient received information about the study, both orally and in writing, then provided consent. Consecutive patients older than 16 years who underwent primary ACL reconstruction using HST or PT grafts were included. Exclusion criteria were concomitant osteotomy or osteochondral grafting, peripheral ligament reconstruction procedures other than lateral tenodesis, and revision reconstruction. Before surgery, the subjective and objective IKDC scores and the SF-36 score were determined. The type of graft was selected based on the patient's occupation and sports activities; the clinical findings, and the laximetry results. The PT was used preferentially in patients who engaged in pivoting sports and the HSTs in other patients. Anterolateral extra-articular reconstruction according to the modified Lemaire procedure was performed in patients with a high-grade pivot shift or more than 10 mm of side-to-side tibial translation as measured using the Telos® device (Telos GmbH®, Laubscher, Holstein, Switzerland) [14–17]. We divided the patients into two groups based on whether HSTs or PT was used to reconstruct the ACL.

2.1. Operative technique

Each patient was scheduled to arrive at the outpatient surgical unit 1 hour before the procedure. Pregabalin (75 mg) was given as premedication. A standardised general anaesthesia protocol was followed (Table 1). The operative technique was identical to that used for inpatient ACL reconstruction. During arthroscopy, independent tibial and femoral tunnels were drilled using the outside-in method and grafts were fixed using Ligafix® interference screws (SBM, Paris, France). Anterolateral tenodesis was performed using a 9-cm long strip of the iliotibial tract that was slipped under the lateral collateral ligament and fixed to the femur using interference screws [18]. Procedures on the menisci were performed as indicated by the intra-operative findings, with suturing as the method of choice. At the end of the procedure, ropivacaine (60 mL in all: 40 mL at 7.5% and 20 mL at 2%) was injected around the sutures but not into the joint cavity. No drains or immobilisation devices were used.

2.2. Management in the post-anaesthesia care unit

Analgesia was with 100 mg of tramadol when the VAS pain score was ≥ 3 and was combined with continuous ice pack application. Morphine titration was performed in the event of persistent pain. Ondansetron (4 mg qid) was given to prevent nausea and vomiting.

Table 1
Anaesthesia protocol.

No nerve blocks were performed	
Premedication	Pregabalin 75 mg Paracetamol 1 g
Intra-operative analgesia	Ketoprofen 100 mg Nefopam 20 mg
Prevention of postoperative nausea and vomiting	Dexamethasone 8 mg Droperidol 1.25 mg
Local injection by the surgeon at the end of the procedure	Ropivacaine hydrochloride

2.3. Subsequent management

The patients were discharged after validating Chung's criteria [19] and being assessed by the surgeon. Patients who did not validate Chung's criteria were admitted as inpatients. The postoperative drug regimen consisted of paracetamol (1 g qid), sustained-release ketoprofen (100 mg bid), tramadol (50 mg tid), and a single 75-mg pregabalin tablet to be taken on the evening of the procedure. Oxycodone 10 mg was added in patients with persistent pain. Prophylactic anticoagulant therapy was with enoxaparin sodium (Lovenox®, 0.4 mL injected subcutaneously once a day), which was started before discharge and continued for 2 weeks.

2.4. Outcomes assessment

The primary evaluation criterion was the rate of complications within the first 45 post-procedure days. The secondary evaluation criteria consisted of the VAS pain score, patient satisfaction on day 3 (rated as very satisfied, satisfied, dissatisfied, very dissatisfied), and the subjective IKDC score and Lysholm score on day 45. These criteria were recorded prospectively. A form containing the study scores was handed to each patient on the day of the procedure. On the following day, the outpatient clinic nurse interviewed the patients by telephone, and reminded them to complete the form. On day 44, an SMS was sent to the patient with a reminder to bring the completed form to the outpatient clinic for the evaluation at 45 days. During this evaluation, all unexpected events that had occurred during the 45-day interval were collected and the scores were determined.

2.5. Statistical analysis

The demographic and surgical characteristics of the two groups were compared. Then the postoperative events were compared between the groups, using the Wilcoxon test for quantitative variables and Fisher's exact test for qualitative variables. Values of P smaller than 0.05 were considered statistically significant.

3. Results

Of the 211 ACL reconstructions performed during the recruitment period, 112 were done as outpatient procedures, including 8 on knees with a previous history of ACL reconstruction, which were therefore excluded. This left a total of 104 patients (104 knees) for the analysis. None of these patients were lost to follow-up. The graft was harvested from the HSTs in 77 (74%) patients and the PT in 27 (26%) patients.

Table 2 lists the main demographic and surgical data. Compared to the PT group, the HST group was composed of significantly older patients, with a higher proportion of women and a higher preoperative SF-36 score. The operative time was longer in the PT group, in which anterolateral tenodesis was performed in a greater proportion of patients.

Table 3 reports the clinical outcomes and complications recorded during the first 45 postoperative days. Of the 77 patients in the HST group, 2 (2.6%) experienced postoperative nausea and vomiting that precluded same-day discharge. All 27 patients in the PT group were discharged on the day of the procedure. Furthermore, 8 of 77 (10.4%) patients in the HST group and 1 of the 27 (3.7%) patients in the PT group presented to the emergency department between day 2 and day 21 after surgery. Of these 9 patients, 7 (78%) sought help because of pain; none had venous thrombosis and only 2, both in the HST group, were admitted, for a single night. In the remaining 2 patients, the reason for the emergency-department visit was a fever (which proved unrelated to the knee surgery) and a fall (in a PT group patient), respectively.

Table 2
Demographic and surgical characteristics.

	Hamstring tendons, (n = 77)	Patellar tendon, (n = 27)	P value
Age	32.7 (16–59)	26.5 (16–47)	0.014
Sex	29 F/48 M	2 F/25 M	0.003
Body mass index	24.4 (18–35)	24.7 (19–35)	0.95
Time from injury to surgery (months)	9 (0.3–93)	8 (0.5–72)	0.124
Subjective IKDC score	65.8 (38–85)	63 (34–81)	0.442
Objective IKDC grade	1 A 29 B 33 C 14 D	1 A 8 B 11 C 7 D	
SF-36, physical component summary	39 (14–67)	36 (16–56)	0.331
SF-36 mental component summary	43 (15–71)	34 (14–57)	0.002
Telos (difference in mm with 15 kg)	6 (1–13)	7 (2–15)	0.498
Operative time (minutes)	47 (30–75)	55 (39–98)	0.009
Anterolateral tenodesis performed	6 (8%)	7 (26%)	0.04
Medial meniscus	Meniscectomy, n = 15 (19%) Repairs = 19 (25%)	Meniscectomy, n = 3 (11%) Repairs = 8 (30%)	
Lateral meniscus	Meniscectomy, n = 15 (19%) Repairs = 12 (16%)	Meniscectomy, n = 4 (15%) Repairs = 8 (30%)	

Table 3
Complications–Unscheduled visits within 45 days after surgery. Functional outcomes.

	Hamstring tendons, (n = 77)	Patellar tendon, (n = 27)	P value
Same-day discharge contra-indicated	2	0	0.576
Re-admission	2	0	
Emergency room visit	6	1	0.834
D0 VAS	3.1 (0–10)	2.8 (0–10)	0.718
D1 VAS	2.5 (0.6–5.7)	2.5 (0.7–7)	0.904
D2 VAS	2.5 (0.3–8.7)	2.6 (0.7–5.7)	0.389
D3 VAS	2.0 (0–5.7)	2.2 (0.5–5)	0.623
Patient satisfaction (0–10)	55 VS/14 S/6 D/2 VD	12 VS/11 S/3 D/1 VD	0.586
D45 subjective IKDC	49.3	52.6	0.191
Lysholm	46.0	64.4	0.616

D: day; VAS: visual analogue scale for pain; VS: very satisfied; S: satisfied; D: dissatisfied; VD: very dissatisfied.

No significant differences were found between the two groups regarding the VAS pain scores on days 0 and 3 or the clinical scores on day 45. On day 3, the proportion of patients who were very satisfied or satisfied with the outpatient procedure was 89.6% in the HST group and 85.2% in the PT group. None of the 104 patients required revision surgery during the study period.

4. Discussion

The main finding from this study is that outpatient ACL reconstruction is feasible using either HST or PT grafts. No serious complications requiring revision surgery were recorded during the first 45 days. A previous study established the feasibility in France of outpatient ACL reconstruction using a standardised surgical technique with an HST graft (Tape Locking Screw technique) [20]. We believe that the ACL reconstruction technique should be tailored to each patient's clinical and laximetry characteristics. The decision to perform outpatient surgery is dependent, not on the surgical technique, but on the use of a standardised patient management strategy and appropriate anaesthesia protocol [21].

Optimal pain management is associated with reduction in hospital stay length [22]. Pain is the main postoperative symptom [23] and the leading reason for admission of patients initially scheduled for outpatient surgery [24–26]. In our study, the 4 hospital admissions were directly related to pain. The all-inside technique [1,27] and cryotherapy combined with dynamic intermittent compression may minimise pain [28]. Administration of an antiplatelet agent might be an alternative to prophylactic anticoagulant therapy [29,30], and venous thrombosis prophylaxis might be completely unnecessary in patients who have no risk factors for venous disorders. The many anaesthesia techniques reported to date include general anaesthesia, spinal anaesthesia [31], nerve blocks [32,33], and local injections [34]. The drugs used can vary also [35]. Multimodal analgesia plays a central role in outpatient ACL reconstruction.

Cost reduction and nosocomial infection prevention are not the only objectives of outpatient surgery. Patient satisfaction seems better after outpatient than after inpatient ACL reconstruction [36]. In our study, 88% of patients were very satisfied or satisfied with their procedure. Postoperative symptoms are not more common after outpatient compared to inpatient ACL reconstruction [37].

The main strength of our study is that all patients received the same anaesthesia protocol and followed the same clinical pathway. A prospective randomised study design to compare HST to PT grafts would provide a higher level of evidence. Instead, in our study, the type of graft was selected based on the clinical and laximetry findings. We emphasise that ACL reconstruction is performed 'à la carte' and that the success rate is not dependent on the type of graft.

The small number of patients in the PT group is the main weakness of our study. It reflects the current preference for harvesting the HSTs to minimise anterior pain and scar visibility. Although no difference was detected, the complication rate was higher in the HST group. HST harvesting may be associated with worse postoperative pain and larger haematomas. In addition, the two groups were not comparable regarding age, gender distribution, or the SF-36 Mental Component Summary score. PT grafts were used chiefly in patients who engaged in pivoting contact sports, a subgroup characterised by younger age and a higher proportion of males. No published studies have demonstrated differences in outpatient surgery success rate according to age or gender [24,38].

5. Conclusion

Outpatient ACL reconstruction is feasible regardless of the type of graft used and requires no change in the operative technique used for inpatient surgery. The anaesthesia protocol must be consistent with same-day discharge and the clinical pathway of the patients must be standardised. Useful measures include a patient-education leaflet and physical therapy before surgery, favourable conditions in the outpatient surgery unit, and the use of icepacks and appropriate drugs after surgery. The patient is thus at the centre of a multidisciplinary care system.

Disclosure of interest

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References

[1] Benea H, d'Astorg H, Klouche S, Bauer T, Tomoaia G, Hardy P. Pain evaluation after all-inside anterior cruciate ligament reconstruction and short term functional results of a prospective randomized study. Knee 2014;21:102–6.

[2] D'Alessandro P, Wake G, Annear P. Hamstring pain and muscle strains following anterior cruciate ligament reconstruction: a prospective, randomized trial comparing hamstring graft harvest techniques. J Knee Surg 2013;26:139–44.

[3] Williams BA, Dang Q, Bost JE, Irrgang JJ, Orebaugh SL, Bottegal MT, et al. General health and knee function outcomes from 7 days to 12 weeks after spinal anesthesia and multimodal analgesia for anterior cruciate ligament reconstruction. Anesth Analg 2009;108:1296–302.

[4] Koh IJ, Chang CB, Seo ES, Kim SJ, Seong SC, Kim TK. Pain management by periarticular multimodal drug injection after anterior cruciate ligament reconstruction: a randomized, controlled study. Arthroscopy 2012;28:649–57.

[5] Kao JT, Giangarra CE, Singer G, Martin S. A comparison of outpatient and inpatient anterior cruciate ligament reconstruction surgery. Arthroscopy 1995;11:151–6.

[6] Granan LP, Forssblad M, Lind M, Engebretsen L. The Scandinavian ACL registries 2004–2007: baseline epidemiology. Acta Orthop 2009;80:563–7.

[7] Talwalkar S, Kambhampati S, De Villiers D, Booth R, Stevenson AL. Day case anterior cruciate ligament reconstruction: a study of 51 consecutive patients. Acta Orthop Belg 2005;71:309–14.

[8] Nagda SH, Altobelli GG, Bowdry KA, Brewster CE, Lombardo SJ. Cost analysis of outpatient anterior cruciate ligament reconstruction: autograft versus allograft. Clin Orthop Relat Res 2010;468:1418–22.

[9] Lefevre N, Bohu Y, de Pamphilis O, Klouche S, Devaux C, Herman S. Outpatient surgery feasibility in anterior cruciate ligament reconstruction: a prospective comparative assessment. Orthop Traumatol Surg Res 2014;100:521–6.

[10] Paterno MV, Weed AM, Hewett TE. A between sex comparison of anterior-posterior knee laxity after anterior cruciate ligament reconstruction with patellar tendon or hamstrings autograft: a systematic review. Sports Med 2012;42:135–52.

[11] Persson A, Fjeldsgaard K, Gjertsen JE, Kjellsen AB, Engebretsen L, Hole RM, et al. Increased risk of revision with hamstring tendon grafts compared with patellar tendon grafts after anterior cruciate ligament reconstruction: a study of 12,643 patients from the Norwegian Cruciate Ligament Registry, 2004–2012. Am J Sports Med 2014;42:285–91.

[12] Beaufils P, Gaudot F, Drain O, Boisrenoult P, Pujol N. Mini-invasive technique for bone patellar tendon bone harvesting: its superiority in reducing anterior knee pain following ACL reconstruction. Curr Rev Musculoskelet Med 2011;4:45–51.

[13] Mayr HO, Willkomm D, Stoehr A, et al. Revision of anterior cruciate ligament reconstruction with patellar tendon allograft and autograft: 2- and 5-year results. Arch Orthop Trauma Surg 2012;132:867–74.

[14] Dejour D, Vanconcelos W, Bonin N, Saggin PR. Comparative study between mono-bundle bone-patellar tendon-bone, double-bundle hamstring and mono-bundle bone-patellar tendon-bone combined with a modified Lemaire extra-articular procedure in anterior cruciate ligament reconstruction. Int Orthop 2013;37:193–9.

[15] Trichine F, Alsaati M, Chouteau J, Moyen B, Bouzitouna M, Maza R. Patellar tendon autograft reconstruction of the anterior cruciate ligament with and without lateral plasty in advanced-stage chronic laxity. A clinical, prospective, randomized, single-blind study using passive dynamic X-rays. Knee 2014;21:58–65.

[16] Colombet P. Knee laxity control in revision anterior cruciate ligament reconstruction versus anterior cruciate ligament reconstruction and lateral tenodesis: clinical assessment using computer-assisted navigation. Am J Sports Med 2011;39:1248–54.

[17] Marcacci M, Zaffagnini S, Giordano G, Iacono F, Presti ML. Anterior cruciate ligament reconstruction associated with extra-articular tenodesis: a prospective clinical and radiographic evaluation with 10- to 13-year follow-up. Am J Sports Med 2009;37:707–14.

[18] Christel P, Djian P. [Anterio-lateral extra-articular tenodesis of the knee using a short strip of fascia lata]. Rev Chir Orthop Reparatrice Appar Mot 2002;88:508–13.

[19] Chung F. Recovery pattern and home-readiness after ambulatory surgery. Anesth Analg 1995;80:896–902.

[20] Collette M, Cassard X. The Tape Locking Screw technique (TLS): a new ACL reconstruction method using a short hamstring graft. Orthop Traumatol Surg Res 2011;97:555–9.

[21] Valkering KP, van Bergen CJ, Buijze GA, Nagel PH, Tuinebreijer WE, Breederveld RS. Pain experience and functional outcome of inpatient versus outpatient anterior cruciate ligament reconstruction, an equivalence randomized controlled trial with 12 months follow-up. Knee 2015;22:111–6.

[22] Rawal N. Postoperative pain treatment for ambulatory surgery. Best Pract Res Clin Anaesthesiol 2007;21:129–48.

[23] Mattila K, Toivonen J, Janhunen L, Rosenberg PH, Hynynen M. Postdischarge symptoms after ambulatory surgery: first-week incidence, intensity, and risk factors. Anesth Analg 2005;101:1643–50.

[24] Chung F, Un V, Su J. Postoperative symptoms 24 hours after ambulatory anaesthesia. Can J Anaesth 1996;43:1121–7.

[25] Wu CL, Berenholtz SM, Pronovost PJ, Fleisher LA. Systematic review and analysis of postdischarge symptoms after outpatient surgery. Anesthesiology 2002;96:994–1003.

[26] Chauvin M. State of the art of pain treatment following ambulatory surgery. Eur J Anaesthesiol Suppl 2003;28:3–6.

[27] Lubowitz JH, Schwartzberg R, Smith P. Randomized controlled trial comparing all-inside anterior cruciate ligament reconstruction technique with anterior cruciate ligament reconstruction with a full tibial tunnel. Arthroscopy 2013;29:1195–200.

[28] Murgier J, Cassard X. Cryotherapy with dynamic intermittent compression for analgesia after anterior cruciate ligament reconstruction. Preliminary study. Orthop Traumatol Surg Res 2014;100:309–12.

[29] Adala R, Anand A, Kodikal G. Deep vein thrombosis and thromboprophylaxis in arthroscopic anterior cruciate ligament reconstruction. Indian J Orthop 2011;45:450–3.

[30] Drescher FS, Sirovich BE, Lee A, Morrison DH, Chiang WH, Larson RJ. Aspirin versus anticoagulation for prevention of venous thromboembolism major lower extremity orthopedic surgery: a systematic review and meta-analysis. J Hosp Med 2014;9:579–85.

[31] Astur DC, Aleluia V, Veronese C, Astur N, Oliveira SG, Arliani GG, et al. A prospective double blinded randomized study of anterior cruciate ligament reconstruction with hamstrings tendon and spinal anesthesia with or without femoral nerve block. Knee 2014;21:911–5.

[32] Mall NA, Wright RW. Femoral nerve block use in anterior cruciate ligament reconstruction surgery. Arthroscopy 2010;26:404–16.

[33] Choi S, McCartney CJ, van der Vyver M. Femoral nerve block does provide significant analgesia after anterior cruciate ligament reconstruction. Arthroscopy 2010;26:1416 [author reply 7].

[34] Kristensen PK, Pfeiffer-Jensen M, Storm JO, Thillemann TM. Local infiltration analgesia is comparable to femoral nerve block after anterior cruciate ligament reconstruction with hamstring tendon graft: a randomised controlled trial. Knee Surg Sports Traumatol Arthrosc 2014;22:317–23.

[35] Guler G, Karaoglu S, Velibasoglu H, Ramazanogullari N, Boyaci A. Comparison of analgesic effects of intra-articular tenoxicam and morphine in anterior cruciate ligament reconstruction. Knee Surg Sports Traumatol Arthrosc 2002;10:229–32.

[36] Krywulak SA, Mohtadi NG, Russell ML, Sasyniuk TM. Patient satisfaction with inpatient versus outpatient reconstruction of the anterior cruciate ligament: a randomized clinical trial. Can J Surg 2005;48:201–6.

[37] Lefevre N, Klouche S, de Pamphilis O, Devaux C, Herman S, Bohu Y. Postoperative discomfort after outpatient anterior cruciate ligament reconstruction: a prospective comparative study. Orthop Traumatol Surg Res 2015;101:163–6.

[38] Cardosa M, Rudkin GE, Osborne GA. Outcome from day-case knee arthroscopy in a major teaching hospital. Arthroscopy 1994;10:624–9.