Clinical outcome of ambulatory anterior cruciate ligament reconstruction compared with the standard in-patient surgery

Mohamed M.F. Sharaby[a], Younes M. El-Deeb[b,d], Mohamed Abuheif[c]

Departments of, [a]Orthopedic Surgery, [b]Anaesthesia, Mansoura University, Mansoura, [c]Department of Orthopaedic Surgery, Alexandria University, Alexandria, Egypt, [d]Department of Anaesthesia, Armed Forces Hospital, Sothern Region, Saudi Arabia

Correspondence to Mohamed M.F. Sharaby, MD, PhD, Department of Orthopaedics and Traumatology, Al-Gomhoria Street, Mansoura 35516, Egypt
Tel: 00966557125097;
Fax: 0020504060279
e-mail: sharaby_mmf@yahoo.com

Received: 29 October 2022
Accepted: 11 December 2022
Published: 14 April 2023

The Egyptian Orthopaedic Journal 2023, 57:332–339

Purpose
There is a current trend toward performing anterior cruciate ligament reconstruction (ACLR) as a day surgery procedure. However, the full evaluation of this process compared with the traditional inpatient ACLR was not accomplished particularly from the perspective of patient satisfaction, pain improvement, and final outcome. Furthermore, several centers described refusal of patients to pass through the day surgery protocol with more preference to admission.
The aim of this study is the evaluation of early/late results of short-term hospital stay following arthroscopic ACLR with regard to patient recovery, complications, patient satisfaction, and return to daily activities through our algorithm.
Patients and methods
Through a prospective randomized study, 284 patients were operated for ACLR through two pathways; G1 is the day surgery pathway and G2 is the traditional inpatient pathway. Patients were evaluated postoperatively for pain severity, satisfaction, the need for additional analgesia, any readmission, complications, and final outcome.
Results
Patients in both groups showed similar pain and satisfaction levels with no difference regarding the amount of extra-analgesia needed and with no readmission from the day surgery group. However, seven patients were recorded as reattending the hospital seeking for pain medication which was given in ER and the patient was satisfied to return home with no need for readmission.
Conclusions
In conclusion, day surgery can be considered as the protocol of choice for patients undergoing ACLR with no difference from the former standard in-patient ACLR.

Keywords:
anterior cruciate ligament reconstruction, comparative study, day surgery

Egypt Orthop J 2023, 57:332–339

1110-1148

Introduction

Anterior cruciate ligament reconstruction (ACLR) is one of the most common orthopedic surgeries performed nowadays with the aim of restoring knee stability and function [1,2]. Hospital stay after surgery depends on the duration expected for patient recovery following a major surgery. The current usual hospital stay varies within 24–72 h following surgery [3]. However, some centers started day surgery ACLR with increasing popularity in the last decade with the aim of proper hospital bed utilization and reduction of cost with improving the utilization of hospital resources and increasing the number of surgical procedures that might be limited due to unavailability of inpatient beds. The reduced hospital expenditure may reach around 17–68% compared with regular admission [4–6]. Several centers documented that early discharge of ACLR patients after surgery did not negatively influence final recovery [7,8]. However, the immediate effects of early recovery were not clearly discussed particularly those effects related to pain perception, psychological, nociceptive, cardiovascular as well as local functional status and patient satisfaction. This effect might be of particular importance on the delay of patient improvement and the consequent return to work, which will finally affect the cost–benefit theory for which day surgery procedure was adopted for (indirect medical cost) [2,5].

Furthermore, in centers that are currently utilizing day surgery as a routine for ACLR, there is still the need for a standardized algorithm for patient selection and the type of postoperative analgesia [9,10].

This study aimed at evaluation of early/late results of short time hospital stay following arthroscopic ACLR with regard to patient recovery, complications, patient satisfaction, and return to daily activities through our algorithm.

 DOI: 10.4103/eoj.eoj_57_22

Patients and methods

This is a prospective, randomized, comparative study which has been approved by the ethics committee in our institution with informed patient consent in all cases. Between the period from January 2018 and January 2022, a total of 284 patients were operated for ACLR; of these cases, 147 patients underwent the procedure in the out-patient day surgery unit with a range of postoperative hospital stay of 2–5 h (G1). The other group (G2, *N*=137) underwent the procedure through a standard in-patient admission (Table 1). The inclusion criteria in this study were primary ACLR in an adult patient (≥18), who is generally fit for surgery. The patients progressing to day surgery ACLR were also counseled for their ability to the outcome measures and follow instructions with appropriate home hygiene and the availability of a communication method with the hospital and the accessibility to emergency within less than or equal to 2 h from home during the postoperative first day. The exclusion criteria for this study were comorbidity necessitating postoperative hospital stay (ASA score >2), high susceptibility to deep vein thrombosis, history of septicemia, hemostasis problems, and social reasons that might prevent home care at the night of surgery. Multiligament injuries and revision cases were not included in this study. These exclusion criteria were typically used in both groups to insure similar distribution of cases among the study groups. Patients were informed about the study before randomization and were counseled regarding both techniques and in case of refusal of day surgery, the patient was excluded from the study (Fig. 1). The preoperative preparation of our patients and their pathway throughout the study are shown in Fig. 2.

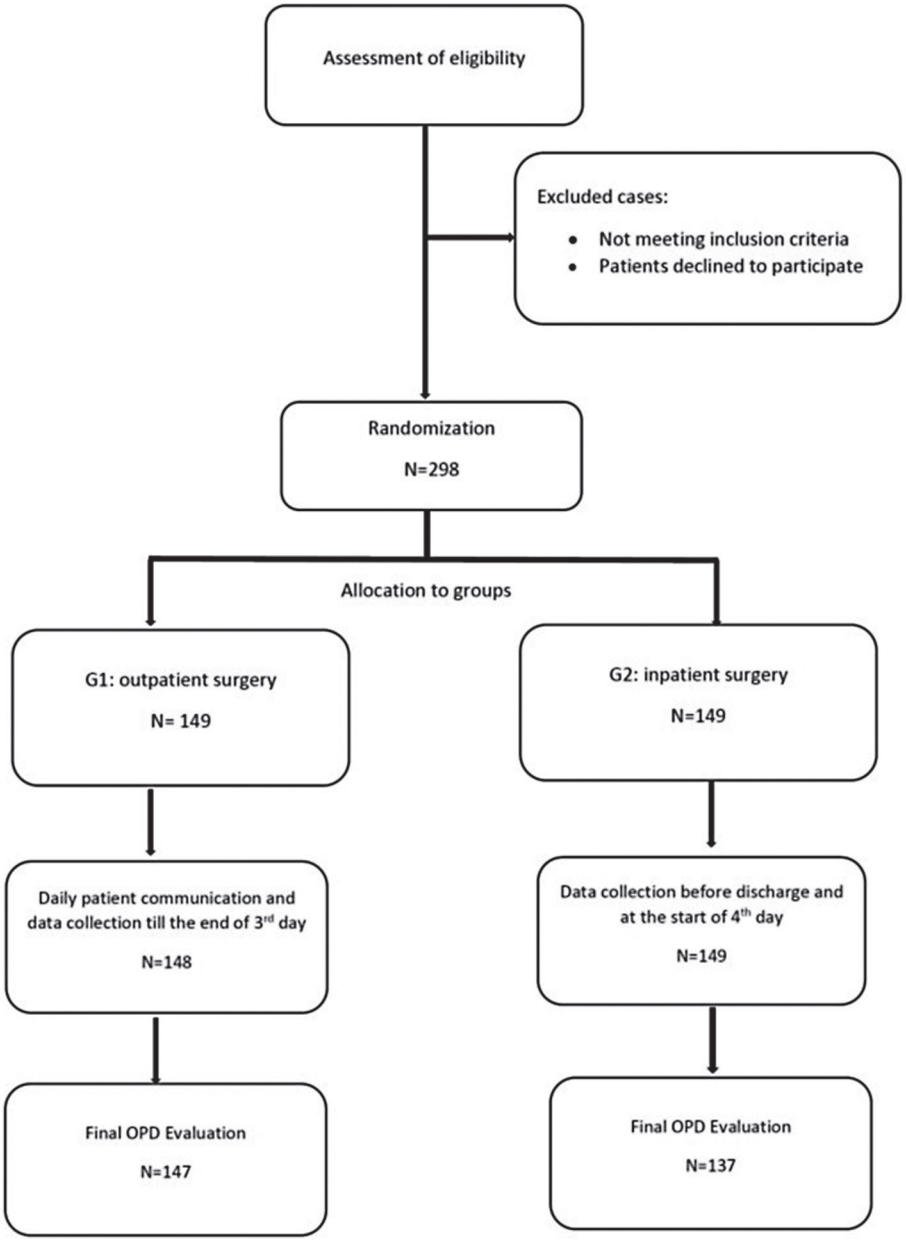
Surgical procedure

Standard general anesthesia protocol was used in all cases in this study with antibiotic prophylaxis formed of a single dose of 2 g cefazolin intravenous during the induction of anesthesia. The hamstring graft harvest, (semitendinosus only; *N*=172 or both Semitendinosus and Gracilles; *N*=112) was fixed in femoral tunnel using suspensory fixation by tightrope and in the tibial tunnel fixation using interference screws (Table 1). Classic closure was done for subcutaneous tissues and skin with approximation/closure of the periosteum. A local anesthetic was injected at the portals and graft harvest site (20 ml of bupivacaine 5 mg/ml) at the end of the procedure. A removable brace and ice packs were applied in operating room and kept for 3 days, and the patient starts the Quadriceps exercises as soon as he is fully conscious and tolerating.

Table 1 Demographic data

	Measure	No admission (day surgery) (147)	Admission (137)	Significance
Age	Mean±SD	28.4±7.8	28.0±8.3	0.7
Sex				
Male	*n* (%)	129 (87.8)	125 (91.2)	0.4
Female		18 (12.2)	12 (8.8)	
BMI				
<18.5	*n* (%)	0	0	0.9
18.5–24.9		27 (18.6)	28 (20.6)	
25–29.9		114 (78.6)	104 (76.5)	
≥30		4 (2.8)	4 (2.9)	
Level of sport				
Professional	*n* (%)	12 (8.2)	11 (8.0)	0.6
Regular recreational		55 (37.4)	41 (29.9)	
Occasional recreational		58 (39.5)	62 (45.3)	
Sedentary		22 (15.0)	23 (16.8)	
Affected side				
Right	*n* (%)	91 (61.9)	85 (62.0)	1
Left		56 (38.1)	52 (38.0)	
Duration between injury and surgery (months)	Mean±SD	18.5±11.2	19.5±11.6	0.5
Operative time (min)	Mean±SD	91.3±19.6	91.7±20.3	0.8
Associated surgical procedure				
None	*n* (%)	68 (46.3)	50 (36.5)	0.26
Meniscectomy		45 (30.6)	54 (39.4)	
Meniscal repair		26 (17.7)	28 (20.4)	
Microfracture or drilling		8 (5.4)	5 (3.6)	
Graft type				
SeMet and Gracilles	*n* (%)	59 (40.1)	53 (38.7)	0.8
Semit only		88 (59.9)	84 (61.3)	

Figure 1



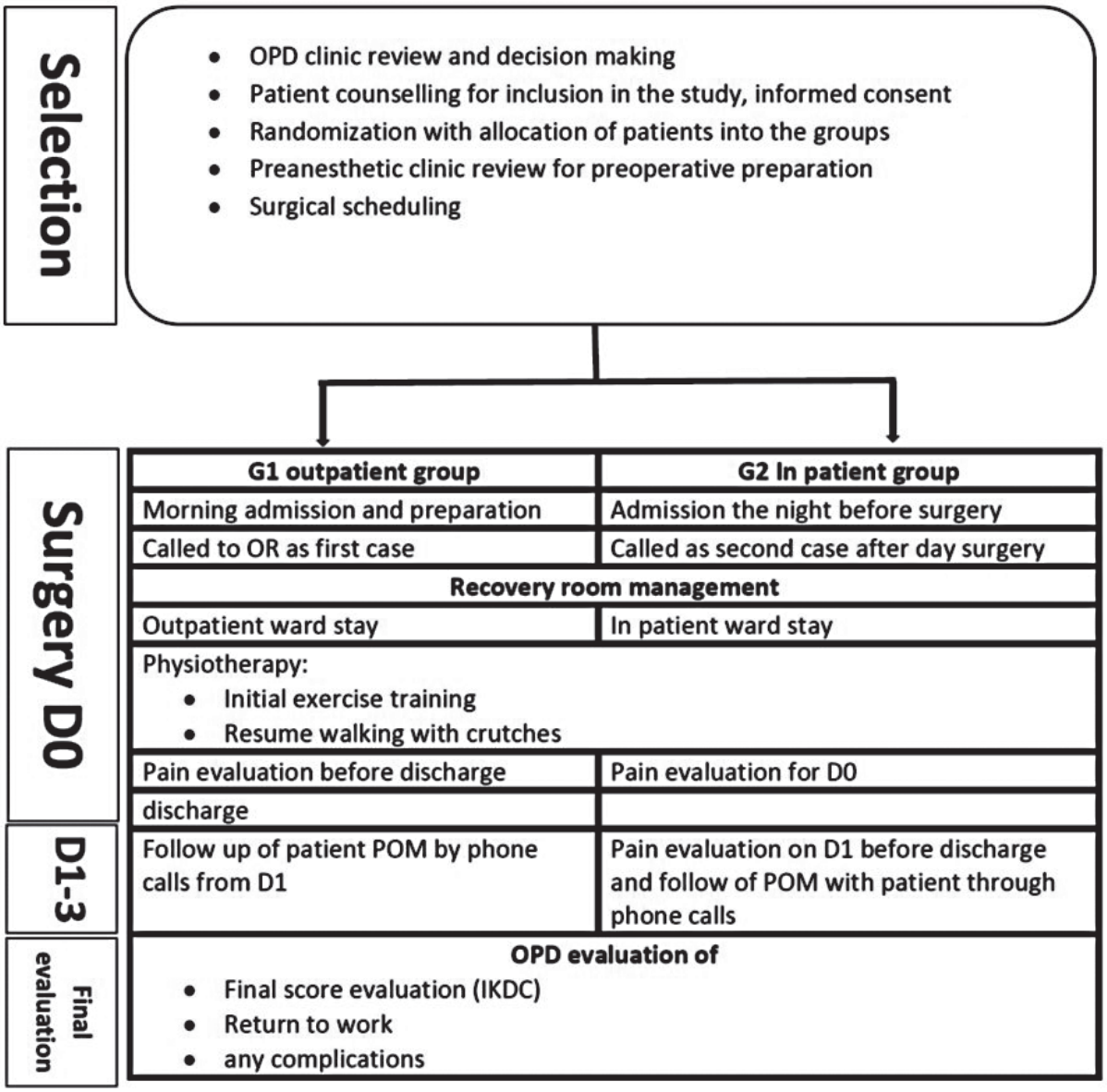
Flowchart of patients selection and allocation in the study.

Ketamine infusion (0.1 mg/kg/h) was given during and after induction of anesthesia and throughout the procedure. Also, Ondansetron 4 mg i.v. was given to prevent postoperative nausea and vomiting. Postoperative analgesia was formed of intravenous paracetamol 1 g (10–15 mg/kg) and Naproxen 500 mg in the recovery room. Pethidine injection was initiated according to the pain severity tested by a recovery room nurse. Patients were discharged from the recovery room to the corresponding unit after fulfilling the criteria for discharge from the recovery room according to the hospital protocol.

In a word, analgesia included paracetamol 1 g i.v., and ibuprofen 100 mg sustained release capsules were used as the primary analgesia. Paracetamol oral tablets 1 g q.i.d. was continued with 100 mg ibuprofen bid after discharge. Furthermore, 100 mg of tramadol when the visual analog scale pain score was more than or equal to 3 and was combined with continuous ice pack application. Pethidine was titrated as (25–50 mg/kg) slow intravenous every 4 h as needed. Analgesia side effects, particularly respiratory adverse effects, were monitored and managed accordingly.

Physiotherapy was initiated by the surgeon to encourage the patient starting with quadriceps drill, straight leg raising exercises. Physiotherapist instructed the patient regarding the starting exercises and how to use crutches in addition to the physiotherapy OPD appointment.

Figure 2



Flowchart of patient preparation for surgery; POM: patient-related outcome measures.

For day surgery cases, they were discharged 2–5 h after surgery after confirming day surgery return home checklist (Table 2), done by the orthopedic on call according to Lefevre *et al* [11]. Patients were not discharged in presence of any complications or any criteria not matching the return home checklist. Patients were contacted by the orthopedic team for evaluation of pain severity, any complication or adverse events related to treatment, surgery, and physiotherapy. The self-assessment form was completed and sent by the patient to the orthopedic team by telephone. Patients' discharge home or readmission on the first 3 days was considered as a failure of the day surgery procedure. For the standard admission group, patients were discharged in the next day afternoon following surgery in most of the cases (55.5%).

Table 2 Discharge criteria

Discharge from recovery area	Discharge from OPD word
Motor activity	Vitally stable
Breathing	Fully oriented
Circulation (blood pressure)	Ambulated out of bed using crutches
O_2 saturation	Oral intake started without nausea
Consciousness (modified Aldrete score)	No urine retention
	VAS ≤3
	Documentation
	Postoperative medication
	Postoperative physiotherapy
	Arranging transport

VAS, visual analog scale.

Postoperative evaluation relied principally on the patient-related outcome measures namely pain, patient

satisfaction, the amount of analgesia consumed, sleep disturbances in the first postoperative night as well as complications in the first 7 days after surgery. International knee documentation committee (IKDC) and time of return to work were considered as late indicators for the success of the procedure.

Pain evaluation was performed using a visual analog scale analog score (0–10) starting from the day of surgery and for the next 3 days at three times: morning, noon, and before sleep.

Patient satisfaction was evaluated at the end of day 3 using a six-point score starting from completely dissatisfied (=1) till completely satisfied (=6). However, on final evaluation, they were divided into two groups: the completely satisfied group and the incompletely satisfied group [12].

Sleep disturbances were evaluated the night of surgery from two perspectives; first is the ability to fall into sleep without difficulty with a score 0–5 (from very easy to very difficult), and the second is any nighttime waking because of pain (yes/no).

IKDC and time of return to normal daily activities were recorded for all patients at 1 year for further evaluation of groups for evaluation of any differences on the final outcome.

Statistical analysis

The demographic and surgical data were compared between both groups to insure matching of data in both groups. Then postoperative data were compared using the Wilcoxon test for quantitative data and Fisher's exact test for qualitative data. Values of *P* smaller than 0.05 were considered statistically significant.

Results

The average duration of follow-up was 21.1 ± 7.5 months (range, 9–40). The demographic data were found matched in both groups with regard to age, sex, BMI, duration till surgery, and the preoperative IKDC score as well as the level of sport (Table 1). The associated findings were mainly meniscal tear which was operated by either meniscal repair or meniscectomy (Table 1). The level of pain recorded was found similar in both groups with no statistical significance. The mean pain score on the day of surgery was reported as 4.5 ± 2.9 in G1 compared with 3.9 ± 2.6 in G2. On the third day, the mean pain score was 1.6 ± 1.8 in G1 compared with 3.9 ± 2.6 in G2. Patients who were discharged showed slightly better pain presentation in the first night but with no statistical significance (Table 3). Pain level distribution showed the highest level at the night of surgery with improvement in the following evaluation with a slight increase at the time of sleep (Fig. 3). The prescription is taken as needed analgesia intake was found less in the outpatient group, however, with no statistical difference (Table 4). Seven cases were recorded as visited the emergency room for analgesia intake needed at the night of surgery but with no need for admission to hospital and were not recorded as failure of outpatient surgery protocol.

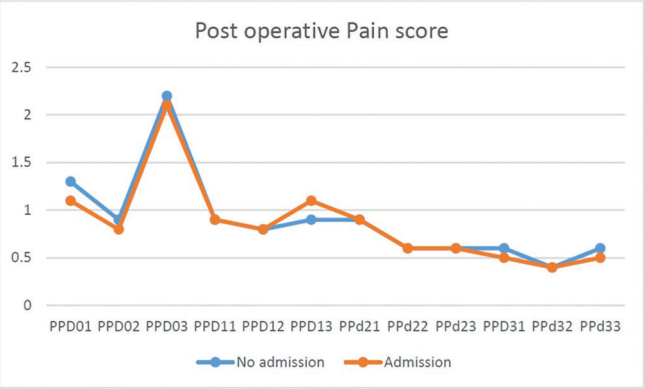
Sleep disturbances and patient satisfaction as well as final IKDC were statistically similar in both groups (Table 4). Complications recorded in this study are described in Tables 5 and 6 with no statistical significance for the whole number of complications between both groups.

Discussion

The most important finding in this study indicated that ACLR is a procedure of choice to be postulated safely as an outpatient procedure with no difference in final outcome compared with the standard in-patient procedure.

ACLR has been recognized as one of the most commonly performed elective orthopedic surgeries. The average direct medical cost of in-patient ACL surgery was described

Figure 3



Pain level curve during the first 3 days.

Table 3 Postoperative results: pain

	No admission (day surgery) (147)	Admission (137)	Significance
Mean postoperative pain score (day of surgery)	4.5 ± 2.9	3.9 ± 2.6	0.08
Mean postoperative pain score (first day after surgery)	2.6 ± 1.9	2.8 ± 1.9	0.3
Mean postoperative pain score (second day after surgery)	2.1 ± 2.4	2.2 ± 2.3	0.8
Mean postoperative pain score (third day after surgery)	1.6 ± 1.8	1.4 ± 1.6	0.5

Table 4 Postoperative results: analgesia intake, sleep disturbances, patient satisfaction and international knee documentation committee, time to return to normal daily activities

	Measure	No admission (day surgery) (147)	Admission (137)	Significance
PRN analgesics taken				
No (basic protocol)	*n* (%)	39 (26.5)	38 (27.7)	0.1
Paracetamol		60 (40.8)	58 (42.3)	
Diclofenac		29 (19.7)	16 (11.7)	
Tramadol		15 (10.2)	24 (17.5)	
Pethidine		4 (2.7)	1 (0.7)	
Nighttime waking because of pain, the night of intervention				
Yes	*n* (%)	87 (59.2)	92 (67.2)	0.2
No		60 (40.8)	45 (32.8)	
Difficulty falling asleep				
No	*n* (%)	68 (46.3)	61 (44.5)	0.9
Easy		12 (8.2)	12 (8.8)	
Average		20 (13.6)	18 (13.1)	
Difficult		14 (9.5)	18 (13.1)	
More difficult		19 (12.9)	14 (10.2)	
Very difficult		14 (9.5)	14 (10.2)	
Patient satisfaction on day 3				
Slightly dissatisfied	*n* (%)	2 (1.4)	5 (3.6)	0.052
Slightly satisfied		20 (13.6)	8 (5.8)	
Moderately satisfied		22 (15.0)	30 (21.9)	
Completely satisfied		103 (52.3)	94 (47.7)	
IKDC postoperative final score	Mean±SD	90.1 ± 4.2	90.0 ± 4.5	0.8
Time to return to normal activity	Mean±SD	3.2 ± 1.2	3.1 ± 1.3	0.46

IKDC, international knee documentation committee; PRN, prescription is taken as needed.

Table 5 Postoperative complications

	G1	G2
DVT	1	1
Reinjury	2	1
Arthrofibrosis	1	2
Infection (SSI)	2	4

DVT, deep vein thrombosis

Table 6 Duration of hospital stay in days in G2

	n	%
Valid		
1.00	76	55.5
2.00	41	29.9
3.00	18	13.1
4.00	2	1.5
Total	137	100.0

as $9220 (2.4 hospital days) compared with the average outpatient cost of $3905 [13]. In spite of that the study is not recent with a cost which would be different than the current days; however, the figures indicate triple the cost of in-patient compared with the outpatient ACLR.

Several studies have recommended the use of ambulatory ADLR with no difference compared with traditional admission with regard to complications and results but with the recommendation to have a standardized algorithm for patient selection and the pathway of ambulatory ACLR to preserve its acceptability among society with limited pain after surgery [10,14]. In the countries where ambulatory ACLR was used, patient admission for several reasons with failure of discharge was described for multiple reasons [9]. Some studies have indicated more patient satisfaction with day surgery ACLR compared with the in-patient ACLR done by the same technique and in the same center [15].

In this study, the results of both groups were comparable regarding postoperative pain and satisfaction as well as return to work and the final IKDC score. This outcome has been described by other authors with the only difference being regarding the difference in cost between both surgeries [11,13].

Another study reviewed the difference between ambulatory ACLR relative to the in-patient surgery from a different perspective, namely surgical time and efficiency of the center in performing the surgical procedure in both situations. It was described that there is a significant difference between both procedures regarding the median turnover time in OR and OR work efficiency (measured as the work done before midday), which was 72.5% at the ambulatory facility and 49.5% at the inpatient facility [8]. Patrick *et al.* [16] evaluated the efficiency of OR in both groups with comparing the duration of OR (total OR time) split into in-room to incision time, total procedure time, and stop time

to out-of-room time and found statistically significant difference between both groups with better OR time in the day surgery group. In the current study, the surgical time was statistically insignificant between both groups.

Pain is known to be the primary symptom of outpatient surgery, irrespective of the surgical indication [17,18] In this study, the control of pain relied mainly on ice, NSAIDs, tramadol hydrochloride, as well as pethidine besides local infiltration of the wound of surgery, and none of our cases needed readmission in the first postoperative week. The trend of pain following ACLR in our study showed an increase in intensity at the night of surgery which drove seven cases to visit emergency room but with no need for readmission. Other studies relied on multimodal analgesia to decrease pain and improve the success of ambulatory ACL procedure such as intraarticular pumps [19] or nerve block as a single injection [20] or continuous catheter local injection [21,22]. Limited multimodal analgesia was used in this study including local infiltration, ice, and oral analgesia with limited use of morphia with similar patient satisfaction comparable to these studies. The local infiltration of the incision seems to play a role in early pain relief postoperatively with relative increase in pain threshold by the end of the day of surgery after the disappearance of its effect and at that time the need to apply a strong analgesia to help sleep such as tramadol besides the cryotherapy, which is used continuously in the first 3 days.

There was no significant difference between both groups in this study regarding patient satisfaction in the first 3 days following surgery. Similar results were documented in the French literature with clear results of absence of discomfort in patients under day surgery protocol for ACLR [23]. However, Lunebourg *et al*. [15] described better patient satisfaction in the postoperative period in the ambulatory group and explained this as being due to the presence of a dedicated team for outpatient cases including staff for nursing and pain control, as well as physiotherapist and a standard algorithm for postoperative pain management. Khan *et al*. [24] added that the development of clinical pathway and standard procedure for ambulatory ACLR is associated with better patient satisfaction other than the in-patient procedure.

The seven patients who visited emergency room at the night of the surgery for increased pain were evaluated with no evident specific character related to this group of patients compared with other patients in G1 (Tables 7, 8).

It was reported that the main reason for exclusion of patients from day surgery in different studies is patient refusal [11]. In our study, patients were offered only one choice; either day surgery or admission. Patients who refused to proceed to the day surgery group were excluded as a whole from the study to avoid any psychological factors which might affect the results in G2.

Table 7 Comparison of the patients returned to emergency room on the night of surgery compared with other cases in the day surgery group

	Measure	Return to ER		Significance
		No	Yes	
Age	Mean±SD	28.5±7.8	25.3±7.9	0.3
Sex				
Male	*n* (%)	123 (87.9)	6 (85.7)	0.8
Female		17 (12.1)	1 (14.3)	
Operative time (min)	Mean±SD	90.6±19.5	105±17.1	0.06
Associated surgical procedure				
None	*n* (%)	65 (46.4)	3 (42.9)	0.03
Meniscectomy		45 (32.1)	0	
Meniscal repair		22 (15.7)	4 (57.1)	
Microfracture or drilling		8 (5.7)	0	
BMI				
18.5–24.9 (normal)	*n* (%)	22 (15.9)	5 (71.4)	0.001
25–29.9 (overweight)		112 (81.2)	2 (28.6)	
≥30 (obese)		4 (2.9)	0	

ER, emergency room

Table 8 Parameter related to the group of patients who visited emergency room on the night of surgery

Patient satisfaction		
Completely satisfied	6	14.3%
Incompletely satisfied	1	85.7%
PRN analgesia intake		
None	1	14.3%
Tramadol	4	57.1%
Pethidine	2	28.6%

PRN, prescription is taken as needed

The main limitation of the study is the patient-related outcome evaluation, which might be affected by other variables rather than the pain and the surgical outcome such as dissatisfaction due to delay in hospital management or unaccepted behavior from hospital staff. The data were collected from patients by phone or social communication and not face to face, which might give more comprehensive data from the patient. Furthermore, our center is not a dedicated day surgery sport center; however, it succeeded in providing the service with no failure.

In conclusion, day surgery can be considered as the protocol of choice for patients undergoing ACLR with no difference from the former standard in-patient ACLR.

Acknowledgements

The authors thank Dr Abdelhady D., Department of Community Medicine, Mansoura University, for performing the design of the study and the statistics.

Authors contributions: Mohamed M.F. Sharaby: formulate research hypothesis, construction of proposal, submitting research approval, calculation of sample size, statistical analysis, data collection, literature review and drafting manuscript, submission of paper. Younes M. El-Deeb: refining research idea, data collection, literature review, review manuscript. Mohamed Abuheif: formulate research hypothesis, data collection, literature review, and drafting manuscript.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Mall NA, Chalmers PN, Moric M, Tanaka MJ, Cole BJ, Bach BRJr, *et al*. Incidence and trends of anterior cruciate ligament reconstruction in the United States. Am J Sports Med 2014; 42:2363–2370.

2 Joseph AM, Collins CL, Henke NM, Yard EE, Fields SK, Comstock RD. A multisport epidemiologic comparison of anterior cruciate ligament injuries in high school athletics. J Athl Train 2013; 48:810–817.

3 Kumar A, Bickerstaff DR, Johnson TR, Appleton DF. Day surgery anterior cruciate ligament reconstruction: Sheffield experiences. Knee 2001; 8:25–27.

4 Stewart BA, Momaya AM, Silverstein MD, Lintner D. The cost-effectiveness of anterior cruciate ligament reconstruction in competitive athletes. Am J Sports Med 2017; 45:23–33.

5 Herzog MM, Marshall SW, Lund JL, Pate V, Spang JT. Cost of outpatient arthroscopic anterior cruciate ligament reconstruction among commercially insured patients in the United States, 2005-2013. Orthop J Sports Med 2017; 5:2325967116684776.

6 Janssen KW, Orchard JW, Driscoll TR, van Mechelen W. High incidence and costs for anterior cruciate ligament reconstructions performed in Australia from 2003-2004 to 2007-2008: time for an anterior cruciate ligament register by Scandinavian model?. Scand J Med Sci Sports 2012; 22:495–501.

7 Fischer S, Zechmeister-Koss I. Is day surgery safe? A systematic literature review. Euro Surg 2014; 46:103–112.

8 Kadhim M, Gans I, Baldwin K, Flynn J, Ganley T. Do surgical times and efficiency differ between inpatient and ambulatory surgery centers that are both hospital owned?. J Pediatr Orthop 2016; 36:423–428.

9 Min CJ, Partan MJ, Koutsogiannis P, Iturriaga CR, Katsigiorgis G, Cohn RM. Risk factors for hospital admission in patients undergoing outpatient anterior cruciate ligament reconstruction: a national database study. J Orthop 2020; 22:436–441.

10 Qin C, Helfrich MM, Curtis DM, Ho S, Athiviraham A. The effect of surgical setting on anterior cruciate ligament reconstruction outcomes. Phys Sports Med 2019; 47:411–415.

11 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; 100:521–526.

12 Lemos P, Pinto A, Morais G, Pereira J, Loureiro R, Teixeira S, *et al*. Patient satisfaction following day surgery. J Clin Anesth 2009; 21:200–205.

13 Kao JT, Giangarra CE, Singer G, Martin S. A comparison of outpatient and inpatient anterior cruciate ligament reconstruction surgery. Arthroscopy 1995; 11:151–156.

14 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; 22:111–116.

15 Lunebourg A, Ollivier M, Delahaye D, Argenson JA, Parratte S. Better satisfaction of patients operated on anterior cruciate ligament reconstruction in outpatient setting. A prospective comparative monocentric study of 60 cases. Arch Orthop Trauma Surg 2016; 136:1709–1715.

16 Patrick NC, Kowalski CA, Hennrikus WL. Surgical efficiency of anterior cruciate ligament reconstruction in outpatient surgical center versus hospital operating room. Orthopedics 2017; 40:297–302.

17 Rawal N. Postoperative pain treatment for ambulatory surgery. Best Pract Res Clin Anaesthesiol 2007; 21:129–148.

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

19 Armellin G, Nardacchione R, Ori C. Intra-articular sufentanil in multimodal analgesic management after outpatient arthroscopic anterior cruciate ligament reconstruction: a prospective, randomized, double-blinded study. Arthroscopy 2008; 24:909–913.

20 Mall NA, Wright RW. Femoral nerve block use in anterior cruciate ligament reconstruction surgery. Arthroscopy 2010; 26:404–416.

21 Alford JW, Fadale PD. Evaluation of postoperative bupivacaine infusion for pain management after anterior cruciate ligament reconstruction. Arthroscopy 2003; 19:855–861.

22 Baverel L, Cucurulo T, Lutz C, Colombet, Cournapeau J, Dalmay F, *et al*. Anesthesia and analgesia methods for outpatient anterior cruciate ligament reconstruction. Orthop Traumatol Surg Res 2016; 102(8s):S251–s255.

23 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; 101:163–166.

24 Khan T, Jackson WF, Beard DJ, Marfin A, Ahmad M, Spacie R, *et al*. The use of standard operating procedures in day case anterior cruciate ligament reconstruction. Knee 2012; 19:464–468.