

# AMBULATORY SURGERY

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This edition of *Ambulatory Surgery* was scheduled to contain abstracts from the European Congress of the Association in Madrid, taking place in April. Unfortunately, the implications of coronavirus infection meant that the meeting was cancelled at short notice. Indeed, like many other countries across the globe, the United Kingdom has been in 'lockdown' for over 6 weeks now, and as I write, there are green shoots developing which means that amelioration of the draconian measures implemented may start soon. COVID-19 is no respecter of status, as the UK heir to the throne and the Prime Minister have both been affected with infections, as have healthcare workers, many of whom have sacrificed their lives in the ongoing battle. We salute you all, in addition to all those struggling across the world to overcome the virus, and hope that in due course, there will be a return to normal working and the ongoing development of ambulatory surgery.

The *Journal* has the usual four papers for publication; a comparison of the types of meshes used in ambulatory hernia repair; the reasons for same day cancellation of day surgery in a dedicated English hospital; factors that contribute to 30 day readmission after surgery and the hypothesis that pre-operative rehabilitation prior to anterior cruciate ligament reconstruction may improve outcomes.

Babo and colleagues evaluated three different meshes used for ambulatory hernia repair to see whether there were changes in acute discomfort, haematoma, seroma or infection, or more chronic complications such as recurrence or chronic pain. The only significant difference obtained was with the duration of surgery, where the use of a self-adherent mesh decreased operative time to 43 minutes, from 51 minutes for the sutured and bi-layered mesh.

Askari et al have contributed two papers from the United Kingdom for this edition. The first one evaluates the reasons for cancellation on the day in a dedicated day surgery unit where they reviewed a two year cohort of patients. Within this time period, they found 8%, or a total of 1692 cancelled on the

day. Nearly one half were due to patient factors, one third for medical reasons, and one sixth for hospital/administrative causes. The authors provide details of potential initiatives to improve these figures with better patient information provision and optimised communication between medical teams, and one hopes such data might improve with subsequent audits.

The second paper reviews the factors associated with readmission within 30 days, following day surgery. The authors found, perhaps predictably, that advanced age (over 75 years), ASA status, surgical speciality, but not obesity influenced the readmission rate. Their overall readmission rate was around 8%. Unfortunately, Askari's paper did not detail the reasons for readmission, so it is difficult to know why obesity should not predispose to return to hospital. Perhaps this provides a fertile opportunity for further work on the subject.

The final paper examines whether pre-operative exercise in the form of a standard protocol improved rehabilitation scores after surgery for anterior cruciate ligament repair. The authors found there were early improvements in the post-operative range of motion at three and six weeks, but these differences had disappeared after three months when compared with a cohort not undergoing such rehabilitation. The authors point out that this is a small study with only 41 patients in both groups, so perhaps larger numbers might produce a more marked difference in outcomes.

Finally, as the impact of COVID-19 begins to regress, there remains a long period of convalescence before we return to normal work and life patterns. Normality will return, and with it, the ongoing development and improvement of Ambulatory Surgery. Until then, stay safe and well.

**Mark Skues**  
Editor-in-Chief



# Comparison of Different Types of Mesh Used in Open Ambulatory Inguinal Hernioplasty

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## Abstract

**Introduction:** The use of a tension free technique is consensual on inguinal hernia surgery. This option provides less postoperative pain and is associated with a lower recurrence rate. However, the type of mesh used is not so consensual, regarding not only the recurrence rate but also the patient comfort and the duration and easiness of the surgery itself.

**Aim:** This study aims to compare three types of meshes used in open inguinal hernia surgery: the self-gripping mesh, the conventional suture-fixed mesh and the bilayered mesh. We performed operations between December 2015 and November 2016 with a mean follow-up time was 29.38 months. Our endpoints were the occurrence of acute pain (according to Visual Analogue Scale), haematoma, seroma or infection and the duration of surgery. We also evaluated the occurrence of chronic pain (defined as pain longer than 6 months) and the recurrence of hernia (evaluated by physical exam on the follow up consults and/or ultrasound in cases of doubt).

**Methods:** Three groups were assigned to receive the self-adherent mesh, a sutured mesh, or a bilayered mesh. The surgical and anesthetic techniques were identical for the 3 groups and all surgeries were performed by the same surgical team. We included adult male patients with unilateral inguinal hernia suited for ambulatory surgery. Patients were evaluated at 6 moments: phone contact 24h after surgery and post-operative appointments at 10-15 days, 1 month and 1, 2 and 3 years after surgery.

**Keywords:** Ambulatory surgery; inguinal hernioplasty; mesh.

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**Results:** Excluding drop-outs and operative complications we had 67 men included on final analysis (group 1= 20, group 2=22 and group 3=26). We had no cases of chronic pain and 1 case of early recurrence in group 3. Mean VAS at 24h was slightly higher with sutured mesh (group 1=2.75, group 2=2.96, group 3=2.3) but there was no significant difference between the three groups (p value=0.634). Mean VAS at 10/15 days was lower on group 3 (group 1=1, group 2=0.96, group 3=0.4) but there was no significant difference between the three groups (p value=0.241). We registered 5 cases of seroma (group 1=2; group 2=1; group 3=2), 14 cases of hematoma (group 1=5; group 2=2; group 3=7) and no cases of wound infection/mesh rejection. The duration of surgery was lower on group 1 (mean of 43.8 min vs 51.36 min for group 2 and 51.96 min for group 3) and this difference was statistically significant (p value 0.003) and also globally decreased as the study progressed.

**Conclusion:** In our study, the choice of the mesh for open inguinal hernia repair didn't affect patient outcome regarding post-operative pain (acute or chronic), nor occurrence of seroma, hematoma or infection. The only endpoint with a significant difference among the 3 groups was the duration of surgery, which was lower for the self-gripping mesh. We concluded that the use of a correct technique is the gold-standard for a successful surgery despite the mesh used.

## Introduction

The use of a tension free technique is consensual in inguinal hernia surgery [1]. This option provides less postoperative pain and is associated to a lower recurrence rate. However, the type of mesh used is not so consensual, regarding, not only recurrence rate, but also patient comfort and the duration and easiness of surgery itself [2].

Post-operative pain is probably the most important predictor factor to recovery, with a strong impact on patient quality of life [1]. The causes for such pain are unclear but mesh material, foreign body reaction, difficulty on dissection, nerve damage or entrapment and mesh fixation are suggested reasons [1]. In that way, it would be expected that self-gripping meshes would accomplish a better outcome. However, the use of a mesh that causes less pain/discomfort may have a higher risk of recurrence, with higher costs for both patient and for the National Health System. We also have to consider that a surgery for a recurrent hernia has higher risks and morbidity than a primary hernioplasty [2].

Considering this, our study aims to compare the results in terms of acute/chronic pain, recurrence, duration of surgery and recovery and occurrence of hematoma, seroma or infection of three types of meshes used in open inguinal hernia surgery: a self-gripping mesh, a conventional suture-fixed mesh and a bilayered mesh.

## Methods

We performed a controlled, prospective, randomised, double blind study, involving 90 patients, divided into 3 groups, comparing long-term results focusing on acute and chronic pain, recurrence rate, operation duration, recovery duration and the occurrence of seroma, hematoma, wound infection and rejection.

The first group was assigned to receive the self-adherent mesh ProGrip® (Medtronic, Dublin, Ireland) which is a semi-resorbable with macroporous knit made of monofilament polypropylene lightweight mesh (density of 38g/m<sup>2</sup> after absorption) [3]. The second group was assigned to receive a standard sutured polypropylene mesh. The third group received the PHS® (Polypropylene Hernia System) bilayered lightweight mesh (Ethicon - Johnson & Johnson, Warsaw, USA), that incorporates the concept of simultaneous anterior and posterior repair [4].

This study included adult male patients with unilateral inguinal hernia suited for ambulatory surgery at our surgical centre. All patients were clinically evaluated at a pre-operative consult and informed consent was obtained.

All surgeries were performed by the same surgical team (a second/third year resident and a senior surgeon) in a 12 month period.

Our endpoints were the occurrence of acute pain (according to the Analogic Visual Scale), hematoma, seroma or infection and the duration of surgery. We also evaluated duration of surgery (time from operating room to recovery room), duration of recovery (time to accomplish discharge criteria from ambulatory surgery recovery room), the occurrence of chronic pain as defined by the International Association for the Study of Pain (pain that persists beyond normal tissue healing time, usually longer than 3 months) [5] and the recurrence of hernia (evaluated by physical exam on the follow up consults and/or ultrasound in cases of doubt).

All patients were evaluated at fixed schedules:

- Hourly during the first four hours after surgery: quantitative representation of patient pain using the Visual Analog Scale (VAS), pain location and analgesic medication used.
- 10 to 15 days after surgery: first follow up appointment, registering primary endpoints.
- 1 month after surgery: second follow up appointment, confirming primary endpoints.
- 1 year after surgery: third follow up appointment, registering secondary endpoints.
- 2-3 years after surgery: forth follow up surveillance appointment.

Exclusion criteria were: Urgent surgery; Female sex; Prior incarceration needing manual reduction, American Society of Anesthesiologists (ASA) physical status classification > 3; Non-controlled Diabetes Mellitus (defined as HbA1C < 6.5% or fasting capillary blood glucose > 110 mg/dL or postprandial blood glucose > 180 mg/dL, following the International Federation of Diabetes guidelines [6]; Body Mass Index < 25 or > 40; Any medical allergy that interferes with protocol; Any anaesthetic or surgical complication that interferes with protocol

The surgical and anaesthetic techniques were exactly the same for the 3 groups and are described in Appendix 1 and 2 at the end of the article.

This study was approved by local Ethics Committee.

### Data processing:

All patients are identified by a numeric code and we performed a computer generated randomization technique and a computer generated list to allocation concealment.

All data were processed using SPSS 22.0 (IBM SPSS Statistics Inc, Chicago, IL) and the analysis of data was performed on April 2019.

The baseline group difference was checked for random distribution by the independent T test and X2 test for normally distribution categorical variables. A p<0.05 difference was considered statistically significant. For continuous data the mean difference with a 95% confidence interval (CI) was calculated; for dichotomies data, the effect measures Odds Ratio (OR) and Risk Ratio (RR) with a 95% CI were calculated to evaluate the statistical difference between outcomes.

## Results

### Baseline Characteristics

From the 90 patients initially enrolled we had 23 excluded for the following reasons:

- 11 patients that dropped out early
- 1 patient needing tracheal intubation for severe bronchospasm

- 1 patient with an allergic reaction (cutaneous rash) during induction
- 8 patients with nerve damage during surgery
- 1 patient missing the surgery date
- 1 patient needing reintervention for early recurrence.

Excluding dropouts and operative complications, 67 men were included on final analysis (group 1= 20, group 2=22 and group 3=26). Mean follow up time was 29.38 months.

When we analysed the profile of our patients, the mean age was 55 years old (min 52; max 78) and 52.2% of all patients were non-qualified workers, according to Table 1 and as expected. However, we must emphasise that our centre is a public hospital, so we might have a selection bias since the most differentiated patients may choose to drop out our long waiting list and be operated on a private care facility. Therefore, we cannot conclude that there is an association between non-qualified workers and the occurrence of hernia.

**Table 1** Patients' Professional Group.

Professional Group <sup>1</sup>	Frequency	Percentage (%)
Scientific and intellectual activity	3	4.5
Intermediate level technicians	2	3.0
Administrative personnel	1	1.5
Personal service and protection workers	2	3.0
Farmers and rural workers	3	4.5
Industry workers	14	20.9
Non-qualified workers	35	52.2
Non-available	7	10.4
<b>Total</b>	<b>67</b>	<b>100%</b>

<sup>1</sup>According to CPP - Classificação Portuguesa das Profissões 2010 (Portuguese Professional Classification 2010) by INE Statistics Portugal [5]

The mean Body Mass Index was 25.32 (mín 19.72; max 32.41) and the main co-morbidities are registered on Table 2, based on what we may conclude that our patient profile is similar to the Portuguese general population.

**Table 2** Patients Co-morbidities (NYHA=New York Heart Association; COPD = Chronic Obstructive Pulmonary Disease; BPH= Benign Prostatic Hyperplasia).

Co-morbidities	Frequency	Percentage
Type II Diabetes	3	4.4
High Blood Pressure	30	44.1
Heart Failure NYHA I	1	1.5
COPD	1	1.5
Smoking	21	30.9

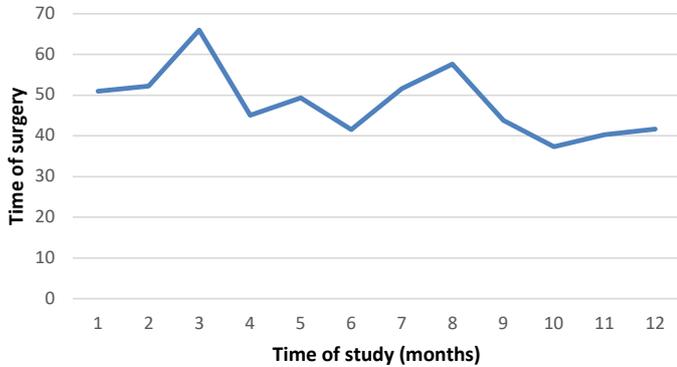
### Duration of surgery and recovery

The mean operating time was significantly shorter on group 1, as showed on Table 3 (p value 0.013 Confidence Interval 95%) and also globally decreased as the study progressed (Figure 1).

The mean time from skin closure and entering the recovery room was 15 minutes (minimum 4 minutes, maximum 40 minutes). The mean time of phase 1 recovery was 1h37 minutes (min 20, max 3h). The mean time of phase 2 recovery was 1h20 minutes (min 30, max 2h40).

**Table 3** Duration of surgery.

Group	Mean (minutes)	Median	Standard deviation (minutes)	Confidence interval for a 95% average		Minimum (minutes)	Maximum (minutes)
				Lower limit	Upper limit		
1	43.9	44	8.66	39.8	47.9	32	69
2	51.4	51.5	10.22	46.8	55.9	24	70
3	52	44.5	36.74	37.1	66.8	31	226



**Figure 1** Duration of surgery during the study.

### Acute pain

Most of the patients did not feel any pain during the recovery phase (1-4h after surgery), as showed on Figure 2. The majority of patients referred only a slight discomfort on the inguinal area. One patient needed rescue analgesics (tramadol) due to inguinal pain. We also had one case of partial motor blockage resolved spontaneously after a few waiting hours.

Mean VAS at 24h was slightly higher with sutured mesh as showed on Table 4, but there was no significant difference between the three groups (p value=0.634).

Mean VAS at 10/15 days was lower on group 3 (group 1=1, group 2=0.96, group 3=0.4) as showed on Table 5 but there was no significant difference between the three groups (p value=0.241). We also registered that most of the patients took all the analgesics prescribe at home but they did it as a preventive measure, not because they had pain.

### Chronic Pain

During the long time follow-up we had no cases of chronic pain.

### Recurrence Rate

We had one case of early recurrence (group 3), noticed at the first month appointment. The patient had a inguinal indirect hernia and received the PHS mesh. On the first appointment we noticed a crural hernia that was he had not at pre-operative examination. Ultrasound confirmed the crural hernia, correct positioning of the mesh and no inguinal hernia so probably this recurrence was due to wrong surgical technique rather than mesh failure.

### Other outcomes

We registered 5 cases of seroma (group 1=2; group 2=1; group 3=2) and 14 cases of superficial hematoma (group 1=5; group 2=2; group 3=7). None of them needed other intervention than surveillance and analgesia.

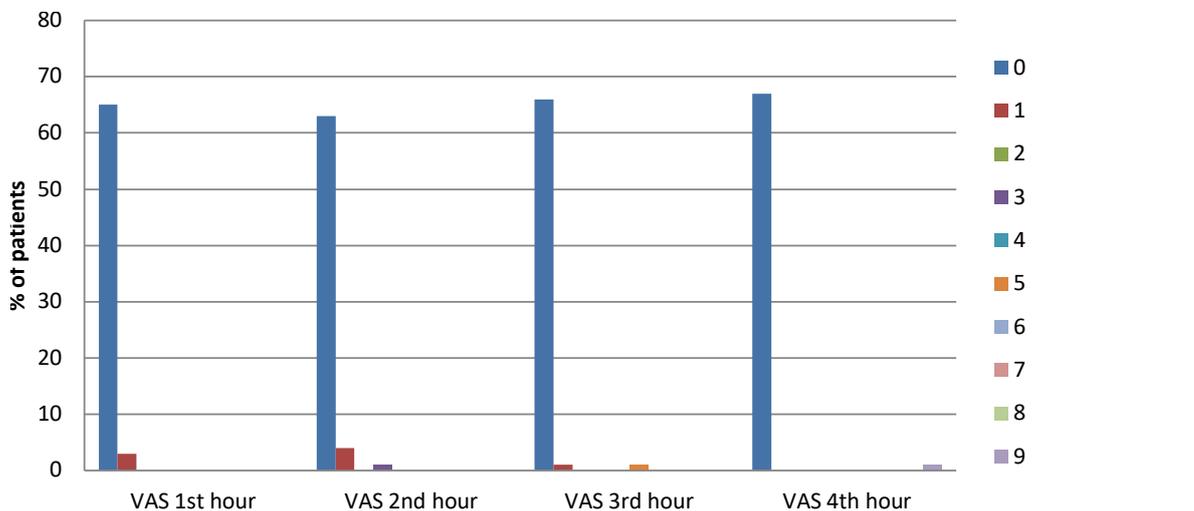
We had no cases of wound infection/mesh rejection.

### Conclusion

In our study, the choice of the mesh for open inguinal hernia repair didn't affect patient outcome regarding post-operative pain (acute or chronic) and occurrence of seroma, hematoma or infection.

Chronic pain poses a major health issue since there are few effective therapeutic options and it implies a social and economic burden. Pain is a subjective feeling and the fear of pain enhances this feeling, so it is very important to get the most effective early postoperative pain control in order to give confidence to the patient that the procedure went well. In that way, we believe that an ilioinguinal/iliohypogastric nerve block associated to an appropriate multimodal analgesic protocol is the best option to achieve this goal, since most of our patients had minimal or no pain after the procedure.

The risk for chronic pain depends not only on the type of mesh and its fixation technique (lightweight meshes are associated with less



**Figure 2** VAS 1st-4th hour (VAS =Visual Analogic Scale).

**Table 4** VAS at 24h (VAS = Visual Analogue Scale).

Group	Mean VAS	Median VAS	Standard deviation	Confidence interval for a 95% average		Minimum VAS	Maximum VAS
				Lower limit	Upper limit		
1	2.75	2.0	2.53	1.57	3.94	0	8
2	2.99	2.0	2.68	1.77	4.13	0	7
3	2.31	2.0	2.02	1.49	3.12	0	7

**Table 5** VAS at 10/15 days (VAS = Visual Analogue Scale).

Group	Mean VAS	Median VAS	Standard deviation	Confidence interval for a 95% average		Minimum VAS	Maximum VAS
				Lower limit	Upper limit		
1	1.00	0	1.747	0.182	1.818	0	6
2	0.96	0	1.496	0.292	1.618	0	5
3	0.42	0	1.102	0.022	0.868	0	5

chronic pain and foreign body feeling) but also with the dissection in a neuralgic plane, thus the importance of nerve preservation. Other studies that had a higher incidence on chronic pain leave to the surgeon the choice to preserve or not the iliohypogastric and ilioinguinal nerves. In our study we excluded all the patients who had nerve damage or non-visualization in order to exclude that bias. Nerve injury during fixation of the mesh is an important determinant for pain so their mobilization and security during positioning of the mesh is important, despite whatever the mesh is chosen.

Recurrence is also an important endpoint since it implies pain and psychological discomfort for the patient, costs for the health and social system. We also have to consider that a reintervention (even by laparoscopy) poses more risks than a primary intervention. These premises enlighten the importance of a correct surgical technique that ensures that the space adjacent to the pubic tubercle and the new deep inguinal ring (the two main places of recurrence) are properly covered.

The only endpoint with a significant difference among the 3 groups was the duration of surgery, which was lower for the self-gripping mesh. The main advantage of the self-gripping mesh is thus the reduction of the operative time but we cannot say that it has a significant economical impact, because cost-effectiveness studies still need to be developed. In our study, time savings were not enough to schedule an additional patient to the OR period, so the higher price of self-gripping meshes may not justify its usage.

We also found that the resident's skills increased with the number of surgeries performed, leading us to emphasize that surgeons should be familiar with all kind of meshes and residents should learn several techniques in order to achieve proficiency in hernia surgery.

We recognize that this study has some limitations as it is underpowered because enrolled less than 100 patients and we couldn't complete the 3 years follow up as recommended by European Hernia Society to determine long term outcome for pain and recurrence rate. We also didn't perform an analysis of preoperative pain, so baseline comparison was not achieved.

Yet, we believe that our results show that independent of the mesh type, it is of paramount importance that surgeons develop skills that spare nerve injury during hernioplasty and anesthesiologists have multimodal analgesic protocols that include loco-regional techniques.

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## Appendix 1: Anaesthetic technique:

- **Pre-op:**
  - IV infusion 1000 ml of a 5% glucose polyelectrolyte solution
  - Standard ASA monitorization and Bispectral Index (BIS)
  - Pre-medication with 1 – 1.5 mg of midazolam iv
  - Ilioinguinal nerve block with 20 ml of a local anaesthetic mixture (10 ml of ropivacaine 0.75% + 10 ml of lidocaine 2%)
- **Peri-op:**
  - Induction with fentanyl (2 mcg/kg) and propofol (2mg/Kg)
  - Airway Management: laryngeal mask according to weight and size of the patient;
  - Pressure controlled Ventilation (max 20cmH20);
  - Maintenance with Air/O2/Sevoflurane titrated to BIS between 40 and 70
  - Fentanyl iv bolus (0.5mcg/Kg) if Blood Pressure or Heart Rate 20% above the mean baseline measured at pré-op
  - Nausea and vomiting prophylaxis: dexamethasone iv(0,15mg/Kg up to 8mg) and droperidol iv (0,625mg/Kg up to 1,25mg)
  - Analgesia: Acetaminophen 1000mg iv and Ketorolac 30 mg iv
- **Post-op:**
  - Rescue antiemetic if nausea or vomiting: ondansetron 2 mg iv
  - Rescue analgesia: fentanyl 25 mcg iv if severe pain or tramadol 1 mg/ Kg if moderate pain
  - Take-home analgesia: acetaminophen 1 g PO 8/8h and ibuprofen 400 mg PO 8/8h

## Appendix 2: Surgical Technique:

- Pre-op:**
  - Low transverse inguinal incision (about 5 cm) 2 minutes after ilioinguinal blockage with a 24 blade.
  - Open and dissection until exposure of the external oblique muscle, which is then sectioned following the orientation of their fibres, exposing the spermatic cord
  - Isolating the spermatic cord until the pubic tubercle and mobilization of the proximal 3 cm.
  - Visualisation and preservation of ilioinguinal and iliohypogastric nerves
  - Exploration of deep inguinal ring with minimal dissection of the cremaster muscle
  - Identification of hernia type:
    - If indirect hernia: liberation of hernia sac and ligation with 2-0 vycril
    - If direct hernia: sac imbrication with 2-0 vycril
  - Reinforcement of fascia transversalis with 2-0 vycril
  - Choose the size of the random mesh accordingly
    - Group 1: Progrid mesh
    - Group 2: Sutured mesh with 2-0 vycril anchored at the pubic tubercle without entering the periosteum, fixation of the superior margin with separated stitches and the inferior margin with continue suture; suture of the two margins in order to create the new deep inguinal ring
    - Group 3: Bilayered mesh, whose inferior part is placed after exposure of Bogros space and the superior part is sutured with 2-0 vycril, reinforcing the floor of the inguinal canal and creating a circular opening forming the new deep inguinal ring and fixating the mesh to the pubic tubercle without hitting the periosteum
  - Closure of external oblique muscle aponeurosis with 0 vycril (continuous suture)
  - Closure of the subcutaneous cellular tissue with 3-0 monocryl suture
  - Closure of skin with 3-0 monocryl intradermic suture.

**NOTE:** All patients received prophylactic antibiotherapy with 2g of cefazolin 30 min previous to surgery. All patients with allergy to cefazolin were excluded from the study.

# Reasons for Same-day Cancellation in a Dedicated Day Surgery Hospital

Alan Askari, Rebecca Nunn, Wasim Hajuthman, Khalid Shehzad & Amjid Riaz

## Abstract

**Introduction:** Thousands of elective day-case procedures are cancelled in the National Health Service (NHS) annually on the day of surgery resulting in significant financial loss. The aim of this study is to determine the rate of cancellations and identify contributing factors in order to minimise and the number of cancellations

**Methods:** Hospital data were collated on all patients undergoing elective-day case surgery across all surgical specialties at our institution over a 2-year period from September 2015 to August 2017. Reasons for cancellation were categorised as due to patient factors, hospital, administration/organisational factors.

**Results:** Over this time period, a total of 1,692 cases were cancelled, giving a cancellation rate of approximately 8.0%. The majority of these were Orthopaedic (32.1%, n=543/1,692), Ophthalmology (26.4%, n=446/1,692) and General Surgery cases (14.9%, n=252/1,692).

**Keywords:** Day case surgery, Cancellations, Reasons.

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The median number of cancellations were 75 cases per month. Cancellations appeared to be lower in the summer months of July and August (112 and 134 respectively, p=0.03). The majority of patients were cancelled due to patient reasons (49.1%, n=831/1,692). A further 33.4% (n=565/1,692) were due to medical reasons and 17.5% (n=296/1,692) were due to hospital/ administrative reasons.

**Conclusions:** The majority of same-day cancellations are due to patient factors, although a substantial proportion is due to hospital and medical reasons which can and should be pre-empted. Robust measures are required to address the multi-factorial nature of the problem and although internationally there is substantial variation in healthcare systems, sharing experiences can provide insight and enhance quality improvement strategies that could be locally adapted.

## Introduction

Cancellations on the day of surgery have been shown to can adversely affect the patient experience, as well as having a significant financial cost implication to hospital providers [1, 2]. A recent UK-based prospective observational cohort study by Wong et al (2018), suggests that 13.9% of planned National Health Service (NHS) cases are cancelled on the day of surgery [3]. Although a small proportion of these cancellations may be due to overrunning lists, the reality is that case cancellation can result in the under-utilization of theatres; with an average cost of £1,200 per hour to run an operating theatre [4], the financial implications cannot be ignored are significant.

A recent review of the literature reveals that same-day cancellations appears to be an issue on an international scale, with a number of recurring explanations cited for these cancellations, despite a large number of different and the variety of healthcare systems and differences in local providers [5–9]. These underlying fundamental reasons for Same Day cancellations are often sub-divided into patient versus administrative/ hospital factors or avoidable versus unavoidable factors [6]. One UK-based study by Griffin et al (2006) in 2006 found that despite a 10-year interval at the same institution, the most common reason for the cancellation of elective surgery, was the lack of an available hospital beds on the planned day of admission [10]. With the well-publicised pressures of increasing numbers of emergency admissions in NHS Trusts [10], one strategy to minimise the competition for bed availability, is to have a separate hospital/Unit site dedicated to elective procedures- so called 'ring fenced beds'.

This current study focuses on the same-day cancellation rates of operations at St Albans City Hospital (SACH). This is a dedicated elective Day Surgery Hospital with six theatres (including one procedure room for Ophthalmology), 40 beds, inpatient, outpatient and diagnostic services, and a Minor Injuries Unit. SACH forms

part of the West Hertfordshire NHS Trust and serves a population catchment area of approximately half a million people. Within the Trust, higher risk elective cases, and emergency procedures, take place at Watford General Hospital (which has an Emergency Department and Intensive Care facilities). There is an established pre-operative assessment clinic service staffed by nurses and anaesthetists.

This is one of the first studies to exclusively report the on same-day cancellation rates for a dedicated Day Surgery Hospital Unit, analysing the reasons cited for cancellation, with the aim of identifying contributing factors that could be addressed to minimise these rates in the future.

## Methods

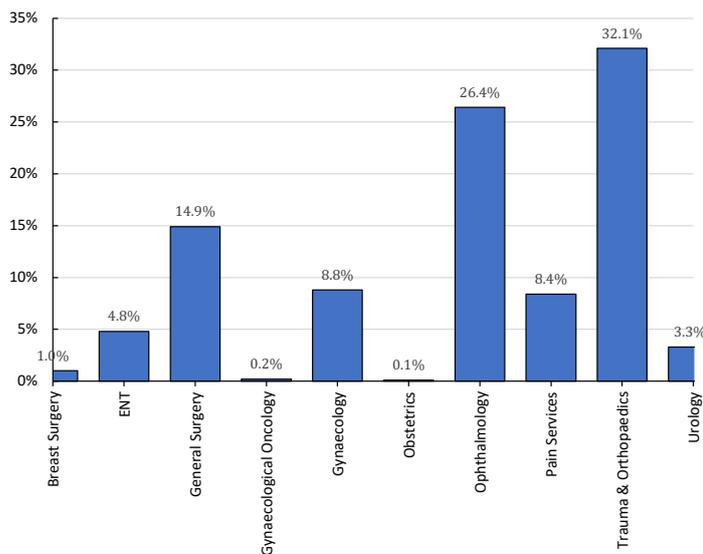
Data regarding the same-day cancellation rates for elective Day Case Surgery from a single centre (St. Albans City Hospital) was collected retrospectively over a 2-year period from 01/09/2015 to 31/08/2017. Theatre records detailing information such as operation name, speciality, date, list, patient hospital number, date and time of cancellation, cancellation reason and who by, are entered electronically into a database by members of staff in real time. An electronic search of this database was carried out to identify all same-day cancellations pan specialty at this centre during the time specified. Due to multiple similarly worded codes for identical reasons for cancellation, these were grouped together for presentation and ease of analysis. The reasons for cancellation cited were reviewed by the authors and assigned to three broad categories: patient factors, medical factors and hospital factors.

Patient factors were cancellations felt to be largely due to patient-specific reasons such as non-attendance or changing their mind about undergoing surgery or if the patient was suffering from an acute

illness (such as current viral upper respiratory tract, urinary tract or skin infections). Medical factors included long-term medical issues or situations where there was a need for further investigations relating to the surgery or anaesthetic pre-assessment. Hospital factors were cancellations felt largely to be resource or planning-related issues such as lack of available beds or suitable staff, non-functioning equipment, or patient being inappropriately booked for day surgery. Owing to the confidentiality of the system, data on person specific variables such as gender and age were unavailable and as the data utilised was not patient identifiable, ethical approval was not deemed necessary.

## Results

The database search found that between 01/09/2015 and 31/08/2017 1,692 cases were recorded as 'on the day cancellations', giving a cancellation rate of approximately 8.0%. The median number of cancellations were 75 cases per month. Cancellations appeared to be higher in the Summer months of July and August (112 and 134 respectively,  $p=0.03$ ). Analysis across the different specialties revealed that Orthopaedic Surgery had the highest same-day cancellation rate (32.1%), followed by Ophthalmology (26.4%) and then General Surgery (14.9%, Figure 1). Regarding the reasons for cancellation; 49.1% ( $n=831/1,692$ ) were considered to be primarily due to patient reasons. A further 33.4% ( $n=565/1,692$ ) were due to medical reasons and 17.5% ( $n=296/1,692$ ) were due to hospital/administrative reasons.



**Figure 1** Proportion of day-case cancellations according to each sub-specialty.

### Patient Reasons

A total of 831 cases over this 2-year period were cancelled owing to patient issues (Table 1). By far the biggest cause of this was that the patient simply did not attend on the day of surgery ( $n=413/831$ , 49.7%) followed by the patient cancelling on the day ( $n=239/831$ , 28.8%) or the patient was acutely unwell and was either hospitalised with the illness or was deemed on the day not to be well enough to undergo general anaesthetic owing to an infection of the respiratory/urinary tract or skin ( $n=114/831$ , 13.7%). A smaller proportion of patients did not follow the pre-operative advice they were given (such as smoking cessation, weight loss, dietary advice, wearing of certain medical devices) and were therefore deemed not suitable to undergo the planned surgery on that particular day.

### Medical Reasons

The second largest cause of reasons for same-day cancellations were medical reasons, accounting for 565 cancellations (Table 2). Within

**Table 1** Reasons for same day cancellation.

Patient Reasons	n	%
Patient Acutely Unwell	114	13.7%
Patient Cancelled	239	28.8%
Patient Did Not Attend	413	49.7%
Patient Did Not Follow Pre-Op Guidance	59	7.1%
Patient Pregnant Recently	6	0.7%
<b>TOTAL</b>	<b>831</b>	

**Table 2** Reasons for same day cancellation.

Medical Reasons	n	%
Operation Not Necessary	97	17.2%
Postponed on Clinical Grounds	13	2.3%
Requires Additional Investigations	64	11.3%
Requires Another Clinic Appointment Prior to Surgery	3	0.5%
Unfit for Surgery/Anaesthetic	388	68.7%
<b>TOTAL</b>	<b>565</b>	

this group, over 2/3 of cancellations were due to the patient being medically unfit for either the type of anaesthetic or surgery they were listed for ( $n=388/565$ , 68.7%) followed by an operation being deemed unnecessary ( $n=97/565$ , 17.2%) or the patient requiring additional investigations prior to undergoing surgery ( $n=64/565$ , 11.3%).

### Hospital Reasons

Table 3 shows that a total of 296 cancellations were due to hospital related issues ( $n=296/1,692$ , 17.5%). Amongst these reasons for cancellations, the most commonly occurring were medical/nursing staffing issues ( $n=82/296$ , 11.8%) and unavailability of or failure of medical equipment ( $n=40/296$ , 13.5%). A smaller proportion of patients were cancelled due to over-running lists or disruptions to the list due to unforeseen emergencies ( $n=35/296$ , 11.8%). Booking and administration error was responsible for 10.8% of cancellations ( $n=32/296$ ).

**Table 3** Hospital reasons leading to same day cancellations.

Hospital Reasons	n	%
Bed Issues	1	0.3%
Booking/Admin Error	32	10.8%
Cancelled/Postponed	20	6.8%
Equipment Unavailable/Failure	40	13.5%
Estates Issue	27	9.1%
Medical Notes Unavailable	15	5.1%
Over-running Lists/Emergency Case Disruption	35	11.8%
Patient Unsuitable or Unfit for Day-Case	22	7.4%
Staffing Issue	82	27.7%
Unavailable/Inadequate Investigations	22	7.4%
<b>TOTAL</b>	<b>296</b>	

## Seasonal Variation

Month by analyses were also carried out and revealed that the lowest rates of on the day cancellation occurred in the summer month of July (6.6%) whilst they were considerably higher in October (9.2%,  $p=0.030$ ). Further analyses were carried out by grouping the months into their respect seasons to assess potential seasonal variation (spring: March-June, summer: July – August, autumn: September – November, winter: December – February). The season with the lowest cancellations were the spring (7.7%) and summer seasons (7.9%) compared with the autumn (9.2%) and winter (9.0%,  $p=0.007$ ). The greatest number Patient Reason cancellations occurred in the winter (27.6%) and autumn seasons (27.1%) compared to the summer (22.5%) and spring seasons (22.9%, Table 4,  $p=0.046$ ).

## Discussion

In our study, 1692 cases were cancelled on the day of surgery- giving a cancellation rate of 8% over the 2-year period of data collection. This is one of the first studies to report day of surgery cancellation rates at a dedicated day surgery hospital in the UK. The majority of last-minute cancellations were found to be within Orthopaedic Surgery; followed by Ophthalmology and General Surgery. Analysis of the reasons for inter-specialty variation in cancellation rates is beyond the scope of this study. The most common reason for day of surgery cancellation was patient non-attendance (24.4%), followed by lack of fitness for surgery/ anaesthesia (22.9%), and patient self-cancellation (14.1%). Cancellation due to acute illness was considered separately. When divided into patient-factors, medical-factors and hospital/ administrative factors, the cancellation rates were 49.1%, 33.4% and 17.5% respectively. Cancellation due to 'bed issues' was 0.06%.

According to the literature, day of surgery cancellations can vary between <2% and >30% [1,2]. Typically, higher cancellation rates are reported in developing countries, however there is overlap in the ranges reported[2]. With a cancellation rate of 8%, our centre appears to perform better than the average NHS figure of 13.9% suggested by Wong et al [3], however there is room for improvement- a cancellation rate of 5.19% was reported across two NHS hospitals by Dimitriadis et al [4]. Internationally, cancellation rates < 2% have been reported in the USA[1], 4.7% in Finland [5]. and 14.3% [6] have been reported by units in Australia,

However, due to the significant differences in healthcare systems and populations on an international level, not to mention the differences in local characteristics of the centres included, and study design, there are limitations to the conclusions which can be made by drawing direct comparisons. None-the-less, there remains a number of common reasons for same-day cancellation such as patient non-attendance (patient-related factor), unfitness for anaesthesia (medical-related factor), or overrunning lists (hospital-related factor). A number of studies have used similar means of categorising cancellation reasons into broader groups, and then dividing these further into avoidable and unavoidable reasons for cancellation. In our study, the hospital-related and medical related reasons for cancellation, were judged as potentially avoidable, whereas the patient-related reasons, were felt to be unavoidable. This results in a rate of 51% avoidable, and 49% unavoidable reasons for day of surgery cancellation. This is similar to the rates found in the US single centre study by Trenteman et al, which found a 47% rate of avoidable cancellation [1]. However, in this study, the 'avoidable' reasons for cancellation included 'patient related' reasons, and they found no cancellations due to patient non-appearance (contrary to our findings).

In the literature, there are a number of strategies that have been considered to reduce the rates of same day cancellations- some of

which will be more or less applicable, depending upon the local centre characteristics. For many hospitals, the pre-operative pathway includes the decision for operation; booking the patient for surgery; pre-operative investigations and optimisation; communication of the date of surgery and relevant preparatory information with the patient; and planning an appropriate selection of cases, which will use the available theatre time to its full potential. Issues can occur at any of these steps and have been reported in the literature as reasons for same-day cancellations. Despite no change in the cancellation rates of patients for reasons of unfitness for anaesthesia over a 10-year period (during which Pre-operative assessment clinics were introduced) in a UK centre study by Griffith et al, on balance, pre-operative assessment clinics are one such intervention which can be used to reduce the risk of day of surgery cancellations by focusing on ensuring appropriate pre-operative tests and optimisation, starving instructions and medication instructions [7]. Patients undergoing a GA at our centre will attend a nurse-led pre-operative assessment clinic, with anaesthetic support available as required. There is no fixed model for the delivery of pre-operative assessment clinics, which varies across the UK [8].

Although in our study we have classified patient non-attendance as 'unavoidable', it could be argued that with better communication, the rates of cancellation due to this reason could be reduced. This includes initiatives such as calling patients to remind them of their surgery date a couple of days before- and also provides the opportunity for any acute illness (again considered unavoidable), to be flagged up, and providing the possibility of cancelling prior to the day of surgery and scheduling in cases at the last minute to avoid wastage of theatre [6,7,9]. Within our trust, a text message alert system has been developed to remind patients of their surgery date. Other strategies to target non-attendance include penalties, which are used by some US centres, but are unlikely to be adopted in the NHS [10].

The 'overbooking' of theatre lists can result in cancellations (overrunning) or wasted resources through lack of theatre utilisation. However, there are a number of factors at play, and sometimes cases can be more or less difficult than anticipated, requiring deviation from the 'average' time taken for that procedure by that particular surgeon. Some centres employ mathematical tools to evaluate surgeon's lists and to try and make the planning of lists more efficient. However, it is suggested that some centres deliberately 'overbook lists' to minimise the impacts of non-attendees on theatre utilization [11]. Another way to tackle the unpredictability of lists is to use expandable block systems (such as those in the US) rather than fixing theatre times and cancelling any cases that fall outside the fixed session time [1]. Analysis of an individual centre's non-operative time is another way hospitals can scrutinise their efficiency and see if there are ways to reduce non-operative time and therefore reduce the risk of overrunning and cancelling for this reason [6].

Post-operative planning (i.e. availability of appropriate beds- ward or higher level of care) is another common reason for cancellation. We found our rate of cancellation due to the lack of beds was only 0.06%, which is much lower than other studies- for example Griffin et al (2006) report that 70% of same day cancellations in 2003 were due to a lack of ward beds, and Dimitriadis et al report a rate of 21.7% [4,12]. However, both studies by Griffin et al and Dimitriadis et al were carried out in a District General Hospital with an emergency department. Therefore, it is expected that the proportion of cancellations due to bed availability would be much lower in our study- a dedicated Day Surgery Hospital for low risk operations, without an Emergency Department. Interestingly the reason for cancellations due to lack of beds is not eliminated in our study. This is likely to be due to a number of factors including the late start and subsequent finishing of GA operations necessitating an overnight stay

due to the time required for safe recovery from anaesthesia, and the closure of the Day Surgery Unit in the evening; planned admission for social reasons (i.e. lack of available responsible adult to collect the patient after GA) and the unpredicted need for inpatient stay after routine surgery. Strategies that other centres discuss to minimise the impact of bed availability is to 'ring-fence' surgical ward or ICU beds.

This study found a same-day cancellation rate of elective day surgery cases at a dedicated Day Surgery Unit to be approximately 8%. Although there are likely to be significant financial implications (waste of resources) where this results in underutilised theatre capacity, a more detailed cost analysis was beyond the scope of this study. Studies, such as the Australian-based paper by Keller et al (2014) which focus on theatre utilization and analyse the use of time during the theatre list, are a useful adjunct when considering strategies to improve efficiency and reduce day of surgery cancellations where due to overrunning lists [6].

Whilst it is difficult to extrapolate figures across different healthcare systems, countries, and currencies; these studies highlight the complexity of calculating such costs to individual units, and the number of interacting factors at play. Similar to the study by Turunen et al, it is unclear in our study as to whether or not costs of same-day cancellations were offset by recruiting patients at short notice to replace them [5]. Also, costs from cancellations due to overrunning lists (a small percentage) have not been separated from other reasons for cancellations as the former may not result in under-utilisation of theatre time. Therefore this, coupled with the fact that, on average, different procedures can vary significantly in the duration of time, it can be somewhat misleading to assume the exact extent of the financial costs of same day cancellations purely based on the number of cancellations. However, as a crude estimate of financial cost at our unit, we have calculated the average time for each case to be 1 hour across the different specialties. With an average cost of running a theatre for an hour in the UK being £1,200, the estimated cost of these cancelled 1,692 cases may potentially be upwards of £2 million pounds, or £1 million a year. A substantive sum for any hospital in any system. Whilst some cancellations will inevitably occur regardless of the robustness of the system, it is clear that mitigating measures which are effective in reducing the number of cancellations, however small, is likely to be beneficial and worthwhile both from a systems point of view as well as financially.

An interesting, yet difficult to explain finding of this study was the seasonal variations in cancellation rates and reasons. In our study, we found that the largest proportions of cancellations occurred in the winter and autumn months. This has been previously reported although (not fully explained) by the Nuffield Trust in 2017 where they also found a higher proportion of cancellations in the winter months [13]. It is unlikely that this higher rate of cancellation is solely due to adverse weather conditions, higher rates of staff shortage or equipment failure during the winter months as in our study, the data demonstrated no significant difference amongst the seasons in terms of hospital and administrative causes of cancellations. In fact, in the present study, the highest proportion of hospital and administrative reasons contributing to cancellation were in the spring months.

One of the limitations of this study is the retrospective collection of data from electronic coding databases- here a number of the pre-coded reasons for cancellation appear ambiguous when it comes to ascertaining the reasons for cancellation, and so prospective data collection with clear definitions and pre-allocation to 'hospital/administrative factors' versus 'patient factors' from the outset, may prove more reliable. Ultimately deciding as to whether reasons for cancellation are primarily 'patient'- related or 'hospital/administrative' related is subjective, which one should bear in mind when attempting to make direct comparisons between other units.

Also relying on coding for the reason for cancellation- in the raw electronic data, there were multiple similarly worded codes, for the same reason. Some codes appear ambiguous, and you have to rely on people assigning the most appropriate code (when some reasons could potentially fit in to more than one code). Relying on a code could give a simplistic overview and not necessarily provide the root cause analysis (i.e. hypothetically a patient may have not attended, because they did not receive a letter from the hospital confirming the date of surgery. this would therefore need to be reassigned as a 'hospital related' reason for cancellation, not patient related. Another limitation is the subjectivity of assigning the reasons to patient related, hospital and medical. A consensus between the three authors was used (similar methods have been used in other papers), however this process could be improved to be more reliable [7,14]. Other factors to consider would be a more in-depth financial analysis or to consider cancellation rates in terms of minutes rather than absolute numbers (which can be skewed by high numbers of shorter cases) [7].

This is the first UK-based study reporting day of surgery cancellation rates at a dedicated day surgery hospital. It incorporated two-years of data collection, resulting in large numbers, and accounting for seasonal variability. It provides an insight into the reasons for same day cancellation, many of which are shared by other centres both within the UK and internationally, which may cater for different services and healthcare systems. It would be interesting to compare our data with other dedicated day surgery units. Analysis of local system processes, and communication between clinicians, patients and administrative staff, may help to reduce day of surgery cancellation rates in the future. Reducing the number of coded reasons for same day cancellation, and detailed prospective data collection may help improve the reliability of data for future studies.

## Conclusion

Rates as low as 2% for day of surgery cancellation have been reported in the literature (although this particular study includes both elective and emergency, inpatient and outpatient operations at US-based institution). However, despite the variation in the local set up of single-centre reported same-day cancellation rates, it is clear that there are common issues on an international scale, particularly when it comes to avoidable reasons largely due to poor communication between parties. Although some of these studies are based in different healthcare systems, or include emergency and inpatient operations, sharing experiences can provide insight and enhance quality improvement strategies that could be locally adapted.

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## Funding & Conflict of Interest

The authors declare that they do not have any conflict of interests and no funding was sought for this study.

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# Factors Contributing to Re-Admission after Elective Day Surgery in a Dedicated Day Surgery Unit

Alan Askari, Ibrahim El-Daly, Ratner Makker & Amjid A Riaz

## Abstract

**Introduction:** Readmission following elective day-case surgery remains an ongoing issue in the NHS. The aim of this study is to determine which factors are associated with an increased likelihood of readmission following elective day-case surgery

**Methods:** All patients undergoing elective day-case surgery under General Anaesthesia across all surgical specialties at our institution over a 2-year period were included in this study. Data on gender, age, American Society of Anesthesiologists (ASA) grade, smoking status and Body Mass Index (BMI) were analysed.

**Results:** A total of 4,254 patients with relevant data were identified, of whom 37% (n=1,589) were Male. The vast majority of patients (68.9%, n= 2,930/5,254) had a BMI over 25. Nearly a third (32.3%, n= 1,375) were classified as obese with a BMI over 30. The overall

readmission rate was 8.9% (n=379). There was a significant difference with increasing age (>75 years: 13.0%, 15-25 years old: 6.0%,  $p<0.001$ ). ASA was also associated with a higher readmission rate (ASA I: 7.0%, ASA>I: 10.1%,  $p<0.001$ ) however obesity was not (BMI >30: 9.7%, BMI 20-25: 7.9%,  $p=0.231$ ). There was also no difference in readmission rates based on gender (Male: 9.8% vs Female: 8.4%,  $p=0.109$ ) and smoking status.

**Conclusions:** Increasing age, ASA grade and type of surgical procedure are factors associated with a higher readmission rate, obesity itself however is not. Concerns over obese patients undergoing day-case surgery appear to be unjustified as they did not experience a higher rate of admission than the non-obese population.

**Keywords:** Ambulatory surgery, Readmission, factors.

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## Introduction

Hospital inpatient length of stay following surgical procedures has progressively declined over the last two decades due to a host of reasons. The mainstream use of minimally invasive procedures (arthroscopic, ureteroscopy, cystoscopic, hysteroscopic, laparoscopic surgery) has in some ways led to enhanced recovery pathways, permitting earlier discharge. Lack of availability of in-patient beds and perhaps most importantly, the increased use of Day Surgery Units has led to a dramatic reduction in length of stay, allowing hospitals to perform higher volumes of procedures. This, alongside increasing demands placed upon the National Health Service, the role of Day Surgery Units has become even more prevalent from a low of around 7 per cent in 1974 to more recent data from 1998 onwards suggests day cases as a proportion of elective activity have increased from 67 per cent to 78 per cent in 2013 [1]. Patient selection for Day case surgery has been a contentious issue with several different agencies advocating different guidelines based on patient age, comorbidities, complexity of procedure and more recently Body Mass Index (BMI) [2,3].

The United Kingdom has one of the highest rates of obesity worldwide with approximately 25% of adults suffering from Class I Obesity [4,5]. Not only does obesity substantially increase the risk of developing a variety of medical conditions such as Type 2 diabetes, coronary artery disease, hypertension, osteoarthritis and some forms of cancer [6] but they are also at a higher risk of complications following surgery such as wound infections, pain, longer recovery, cardio-respiratory and thrombo-embolic complications [7]. Patients suffering from obesity have been perhaps controversially included by certain guidelines as possibly unsuitable for day-case surgery. However, guidelines are varied in their recommendation as to what BMI or class of obesity is permissible for day-case surgery. For example, the guidelines of the Royal College of Surgeons of England

recommend that only patients below a BMI of 30 would be suitable candidates for Day-Surgery whilst the by the United Kingdom's National Health Service (NHS) Modernisation Agency mentions in their guidelines that patients below a BMI of <40 would be suitable. Such varied recommendations within a single country, let alone variations arising across nations and continents are concerning. More recently, these preconceptions (which are not always based on robust evidence) have come under increasing scrutiny and challenge.

Recent guidelines published jointly by the British Association of Day Surgery (BADs) and the Association of Anaesthetists 2019 suggested that day-surgery should be considered as the default position for most surgical procedures and that refusal of patients to undergo day-surgery must be based on sound clinical reasons. As yet, BADs have not set any specific restriction on BMI, however they have suggested that specialists experienced in dealing with obese patients should assess patients with high BMI prior to any day-surgery.

One of the concerns surrounding obese patients undergoing day-surgery is that they may potentially have a higher rate of readmission. Hospital readmissions have been reported to have an adverse effect on healthcare providers in terms of financial and reputational costs as well as patients themselves [8]. Data from the USA suggests that 20% of patients return to hospital within 30 days of discharge, of which 90% are unplanned admissions with the estimated cost to the extent of US\$ 30 billion [9]. Given that readmissions are a considerable financial burden for hospitals and adverse outcomes for patients, hospital readmissions are increasingly used as quality indicators for institution's performance benchmark with a risk of reduced reimbursements for poorly performing hospitals [10].

To characterise the population of patients who are at risk of readmission following Day-Surgery, we performed a retrospective review of patients readmitted to a dedicated Day-Surgery Unit over

an 9-month period. Specifically, this study aimed to determine what factors namely BMI, ASA grade, smoking, age and co-morbidities are associated with an increased likelihood of readmission following elective day case surgery and whether this can be minimised.

## Methods

Data regarding the readmission rates for elective Day Case Surgery from a single centre (St Albans City Hospital) was collected retrospectively over a 9-month period from 01/01/2014 to 31/01/2014. Theatre records detailing information such as operation name, speciality, date, list, patient hospital number, date and time of cancellation, cancellation reason and who by, are entered electronically into a database (Theatreman) by members of staff in real time. An electronic search of this database was carried out to identify re-admissions per specialty at this centre during the time specified. Due to multiple similar codes for identical reasons for cancellation, these were grouped together for presentation and ease of analysis. The readmission cited were reviewed by the authors. All patients throughout the study period who had a general anaesthetic at the St Albans City Hospital Day Surgical Unit, elective day case procedure across all specialities, and aged 18 years and older were initially included in the study.

A total of 8,096 patients were collated, of those, 6,266 had recorded BMI scores. A further 2012 patients had incomplete/ missing data required (such as demographic data as well as readmission and data on BMI, Smoking, Age, ASA and Co-morbidities), and were thus excluded (Figure 1). Once the cases had been stratified by the NHS treatment function codes, 4,254 cases were viable to analyse and were included in the study. Body Mass Index was grouped into six categories; <20, 20-24, 25-29, 30-34, 35-39, and >40 and case records were examined to determine the number of re-admissions post-operatively. Statistical analysis was carried out to identify factors linked to a higher risk of re-admission. The factors considered were age, sex, BMI, smoking status, American Society of Anesthesiologists (ASA) grade and type of procedure. The number needed to treat (NNT) was calculated to establish how many patients with a BMI of >30 would need to undergo surgery as inpatients rather than day cases to prevent one re-admission.

Exclusion criteria included patients under the age of 18 years, admissions for day-case endoscopy and other LA/sedation procedure including bowel preparation, readmissions for planned interventions (e.g. elective operations, blood transfusion, endoscopy), erroneous discharges on the electronic system and patients who self-discharged against medical advice.

## Results

### Demographics

A total of 4,254 patients undergoing surgical day case procedures were included in the analysis. These fell within 10 NHS treatment function codes, namely General Surgery, Urology, Breast Surgery, Colorectal Surgery, Trauma & Orthopaedics, ENT, and Gynaecology. Of these 4,254 patients with the relevant data were identified, of whom 37% (n=1,589) were male (Table 1). The 35-44 and 45-54 age groups were the most populous, contributing to 19.7% (n=838) and 19.8% (n=842) of the total population each. The least populous age group was the 75+ age group with 341 patients, accounting for just 8.0% of the total study population. The majority of the population were either overweight or obese and 2.9% (n=124) were underweight (BMI <20). Less than a third (27.9%, n=1,186) had a BMI in the normal range (20-24). Most patients fell in the overweight

**Table 1** Population demographics of patients in the study.

		Total (n)	30-day Readmission	
			(n)	%
<b>Gender</b>	Male	1,589	156	9.8%
	Female	2,665	223	8.4%
<b>Age</b>	15-24	355	22	6.2%
	25-34	598	40	6.7%
	35-44	838	68	8.1%
	45-54	842	67	8.0%
	55-64	703	61	8.7%
	65-74	562	61	10.9%
<b>Current Smoking</b>	75+	341	59	17.3%
	Yes	916	64	7.0%
<b>ASA</b>	No	3,279	309	9.4%
	I	1,640	115	7.0%
	II	2,290	233	10.2%
	III	307	30	9.8%
<b>BMI</b>	IV	2	0	0.0%
	<20	138	14	10.1%
	20-24	1,186	94	7.9%
	25-29	1,555	138	8.9%
	30-34	938	91	9.7%
	35-39	352	35	9.9%
	40+	85	7	8.2%

(BMI 25-29, 27.2%, n=1,155) or Obesity Class I (BMI 30-34, 22.0%, n=938).

Being a day-case elective surgery unit, the majority of the patients were in the ASA I (38.6%, n= 1,640) and II categories and (53.8%, n=2,057).

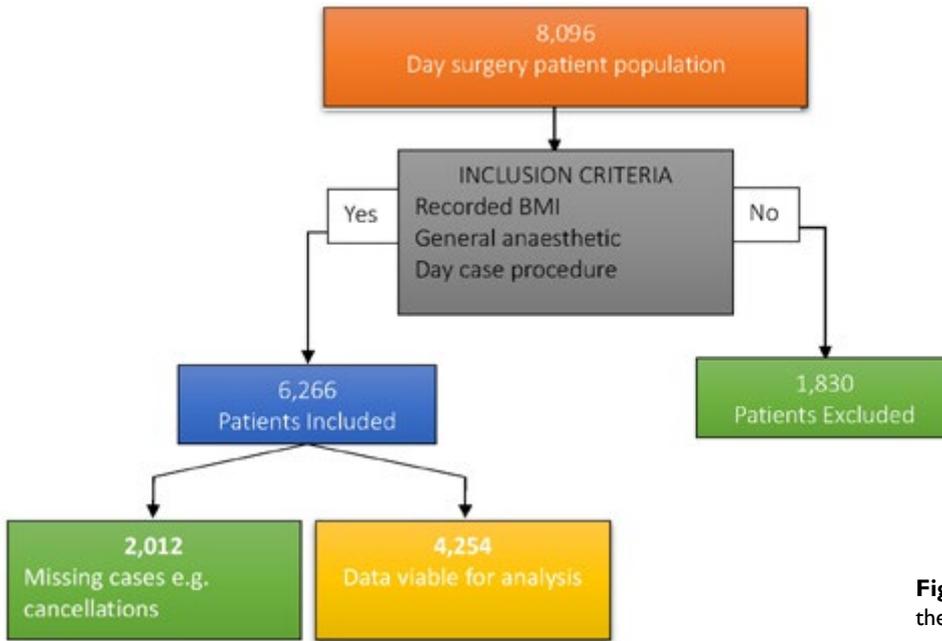
### Readmission

The overall 30-day readmission rate was 8.9% (n=379/4,254) and analysis demonstrated certain groups of patients to be at higher risk of readmission than others (Figure 2). The most elderly group (75+ year age group) contributed to 13.0% of the readmission, even though they made up just 8.0% of the population. This rate of readmission was much higher compared to the youngest group (15-24 years old) who made up 8.3% of the population but had half the rate of readmission (6.0%, p<0.001). Readmission was higher in patients with ASA>1 compared with patients with ASA 1 (ASA 1: 7.0%, ASA>1: 10.1%, p<0.001)

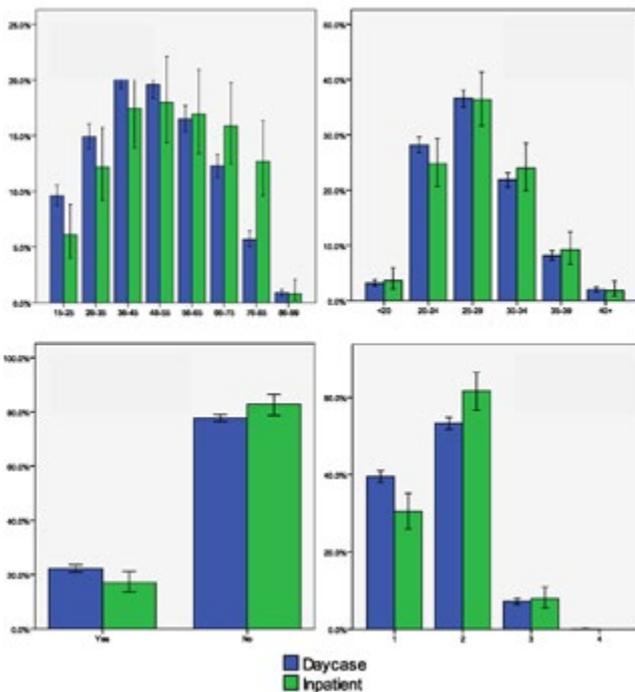
Similarly, the type of procedure the patient was undergoing was found to impact on their likelihood of re-admission post-operatively. As a proportion, General Surgery procedures accounted for 17.0% of the day-case workload however, 42.1% of 30-day readmission were after a General Surgical procedure (Figure 3). Notably Gender and smoking did not significantly affect readmission rates (Smokers: 9.4%, Non-Smokers: 7.0%).

## Discussion

This study investigated several important factors that could potentially impact re-admission rates following surgical day-case procedures. We examined all the different surgical specialities, BMI, Smoking, Age, ASA and co-morbidities and explored their potential effect on readmission following a day-case procedure in a dedicated hospital. The main factors associated with a higher risk of readmission



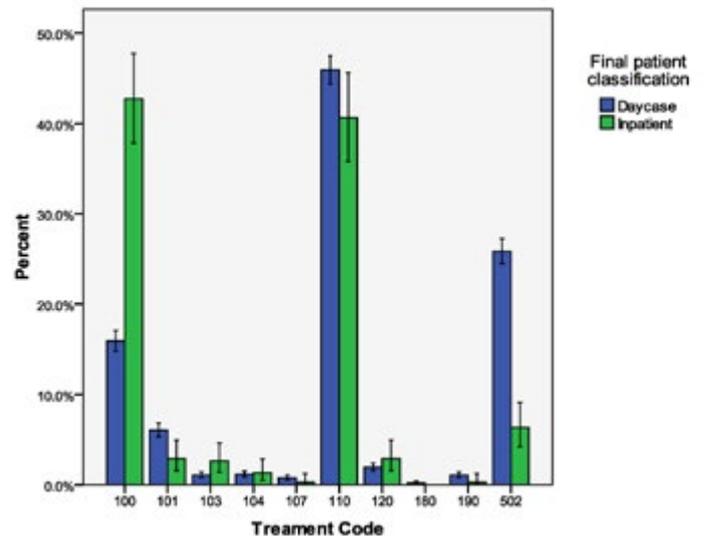
**Figure 1** Flow chart demonstrating the included population.



**Figure 2** Graphs demonstrating the composition of the population who underwent day-case surgery (labelled 'Daycase') and the population who had a readmission within 30-days of surgery (labelled 'Inpatient').

were advancing age, ASA status and the nature of the procedure. BMI in itself did not significantly impact whether a patient was likely to be readmitted within 30-days of their index day-case procedure. A high BMI is often one of the factors cited to disqualify a patient for day-case surgery in some hospitals. However, in our study (we did not restrict eligibility due to BMI) we did not find that a high BMI significantly increases readmission rates, making the exclusion of patients from day-case surgery based on BMI questionable. Of note, our study found that if we treated all patients with a BMI >30 as an inpatient rather than day-cases, 33 inpatients would be needed to be treated in order to prevent one day-surgery readmission (NNT=33).

Unfortunately, complications are an unpleasant reality of surgery. Over the recent past Day Surgery has become the main resource for a timely throughput and completion of routine cases across all



**Figure 3** Demonstrating readmission rates according to different surgical specialties. The codes are as following: General Surgery (100), Urology (101), Breast (103), Colorectal (104), Vascular (107), Trauma and Orthopaedics (110), ENT (120), A&E (180), Anaesthetic (190) and Obstetrics & Gynaecology (502).

specialities. In such a climate it is imperative that this process is risk averse and safe. Hence, we must have robust policies and procedures in place where patients are made aware and educated on what to expect and do if they require readmission. Patient information sheets, a strict protocol of who to call and where to go should be made available to all patients prior to discharge. Currently, there is no consensus on acceptable readmission rates after day-surgery procedures but rates of 1.1%-10.0% have been suggested as acceptable [11, 12]. A Scottish study by Bain and colleagues quoted a readmission rate of 7.8% which is similar to that of the current study [13]. Aside from the index procedure, these variations in readmission rates are dependent on a multitude of factors including, type of specialty, age of patients, level of primary care support and support in the community such as district nurses and other allied healthcare support (dressing clinics, nutritionists, podiatrists). As we continue to push the barriers of what is possible in the day-surgery setting, it could be argued that a readmission rate of under 10% is acceptable. It

is noteworthy that there is a huge difference in the procedures that are currently performed in day-surgery units today than that of 20 years ago. In the absence of any “gold standards” for readmission rates, it is difficult to decide what is an acceptable level of readmissions.

In line with the current study, Kohlnhofer et al collected data on patients undergoing general surgery procedures, as part of an institutional National Surgical Quality Improvement Project (NSQIP) database from 2006 to 2011 [14]. The authors reported that 9% of patients undergoing day-case surgery were readmitted within 30 days after discharge. Similar to the current study, multivariable analysis demonstrated that age, dyspnoea, and ASA grade to be independent risk factors for readmission [12]. Indeed, Lauren et al found that five specialties with the highest number of outpatient surgical procedures were General surgery, orthopaedic, gynaecologic, urologic, and otolaryngologic surgery; their unplanned readmission rates ranged from 1.21% to 3.73% [14].

The current study noted that 8.9% of Day Surgery cases were subsequently readmitted across all specialties with General Surgery being increasingly involved. This was supported in a retrospective study by Coley and colleagues who investigated they looked at the outcome of 20,817 patients who underwent a Day surgery procedure. They found that 5.7% (1,195) of these returned to the hospital within 30 days or were readmitted directly after surgery. Like the current study they also showed that General Surgery procedures had the highest rate of unanticipated admissions or readmissions [15]. More recently, Friedlander in 2019, investigated 73,724 patients who underwent hernia repair, thyroidectomy, laparoscopic cholecystectomy, or laparoscopic appendectomy in either the inpatient or ambulatory care setting [16]. The vast majority (87%) of procedures were performed in the day-surgery setting. The study reported that readmission rates for thyroidectomy, hernia repair, laparoscopic cholecystectomy were significantly lower in the ambulatory setting compared with the inpatient setting.

Readmissions after elective day-case surgery conjure up a variety of issues for both patients and healthcare providers including personal/social and financial costs for the patient as well as service provision and health economic issues for healthcare providers. However, attempts at tackling the problems of readmission can at times have unintended consequences. The Hospital Readmissions Reduction Program (HRRP) was set up in the USA as part of the Affordable Care Act. It aimed to reduce readmissions after day-case surgery, however after implementation, the 30-day post discharge mortality rose for patients with certain conditions [17,18]. Overall, readmission rates did indeed improve, however given the worsening of other (more important) outcomes, one must question whether readmission in itself is a true and genuine metric of quality healthcare provision and whether more importantly efforts to prevent readmissions compromise patient safety [19]. In the UK a similar scheme to reduce readmissions in the National Health Service (NHS) called ‘payment by results’ (PBR) was introduced in 2011. Hospitals with high readmission rates were financially penalised such that payments for the initial procedure were withheld. If fully implemented it could have potentially saved the NHS up to half a billion pounds [20].

In recent years, obesity has become a serious healthcare and societal issue, costing the NHS in the UK billions of pounds both directly and indirectly. In our study, 22% of the population suffered from Class I obesity (BMI 30-34), 8% from Class II (BMI 35-39) and 2% from Class III or severe obesity (BMI >40), thus approximately one third of our patients has a BMI if greater than 30. In fact, only a third of patients had a BMI within what is considered to be the normal range (BMI 20-24). Traditionally patients with high BMI have been deemed ineligible for day-case surgery and this has been reflected in local and national guidelines. However, this has been challenged and recently

guidelines published jointly by the British Association of Day Surgery (BADs) and the Association of Anaesthetists 2019 suggested that there should be no limitations on high BMI patients undergoing elective day-case surgery based solely on the patient’s BMI. In other words, BMI alone is not a reason to prevent overweight or obese patients from having day-case surgery. The only provision is that the specialists who are part of the day-case surgery team should be experienced in dealing with obese patients [21]. Further support that high BMI patients can be safely treated in the Day Surgery setting is provided by Vertosick et al who looked at 13,957 overweight and obese patients undergoing ambulatory cancer surgery procedures and concluded that patients with BMI up to 50 or more can be treated safely in an ambulatory setting [22].

The main limitation of this study is its retrospective nature and as such, suffers from the usual criticisms inherent to such methodology. Data collection from electronic coding database is always problematic in that it relies on the accuracy of the data input in the first instance and the accuracy of its retrieval. There are also issues with the codes themselves, i.e. whether each code accurately reflects that particular patient episode. In our healthcare system, each reason for readmission is coded by a specific code. Unfortunately, more than one code can be used to describe the same reason for readmission and in this study a number of pre-coded reasons for readmission appeared ambiguous as there were multiple similarly worded codes for the same admission reason. Another limitation is the subjectivity of assigning the reasons for readmissions and how related to the initial surgery these readmissions. Other factors to consider would be a more in-depth financial analysis or to consider readmission rates in terms of length of stay and pathology rather than absolute numbers of readmissions. Furthermore, we have not been able to capture all patients that may have been readmitted within 30-days, as inevitably, some patients would attend other hospitals nearby and we would have no knowledge of this readmission. There is no way for us to follow these patients and they have ultimately not been included. A way to capture the entire population is to contact every patient who was initially included in the study and either telephone interview or write to them with a questionnaire. It should be appreciated that in our study a significant proportion of patients were excluded due to missing data. It is also important to remember that only associations can be made between factors and the outcome and not causation.

In the current study we have found that BMI, age and co-morbidities did not have a statistically significant effect on readmission following a Day case procedure in a dedicated unit across all surgical specialties. However, it highlights that the risk of admission after a day-surgery procedure were statistically significant for advanced age (75+ years old), ASA and the nature of the procedure, that is General Surgery procedures were associated with statistically significant higher rates of readmission. In the current study General surgery (excluded Breast, Vascular and Colorectal) included significant numbers of laparoscopic cholecystectomy, laparoscopic hernia repairs and incisional hernia repairs. Notably, a high BMI was not associated with a statistically significant higher rate of readmission and of note the NNT for treating patients with a BMI >30 as inpatients rather than day cases in order to prevent re-admissions were 33. Thus, patients with advancing age and undergoing a General surgery procedure should be counselled about the higher risk of being readmitted and a high BMI in itself should not serve as a basis to refuse day-surgery to patients.

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# Does Preoperative Rehabilitation give Better Short Term Results in Anterior Cruciate Ligament Reconstruction?

D.V.S. Reddy, S.U. Kamath, R. Annappa, S.L. Krishnamurthy, K. Kamath & S. Mallya

## Abstract

**Introduction:** To compare the results of preoperative rehabilitation group and standard rehabilitation protocols in anterior cruciate ligament reconstruction in a day care unit.

**Materials and Methods:** 41 patients with anterior cruciate ligament tear were randomly assigned to either standard or preoperative rehabilitation group. Follow up done after 3, 6, 12 and 24 weeks after reconstruction. Outcome measures included, Lysholm score, IKDC scale and range of motion. Data analysed with SPSS software version 13.1. A probability level of  $p < 0.05$  was considered significant.

**Keywords:** Anterior cruciate ligament tear; Arthroscopic reconstruction; Preoperative rehabilitation.

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**Results:** Out of 41 patients, 21 patients were under standard and 20 were under preoperative group. There was significant difference in range of motion at 3 and 6 weeks in preoperative rehabilitation group compared to standard group but no difference at 3 and 6 months.

**Conclusion:** Rehabilitation before surgery is advocated to improve the early functional outcomes at 3 and 6 weeks.

## Introduction

Anterior cruciate ligament (ACL) is injured commonly in athletes involved in pivoting sports [1]. Arthroscopic ACL reconstruction is the standard treatment of care offered in these patients as a day care and restores knee anatomy and stability. The timing of surgery after injury and preoperative knee function is often evaluated for optimal postoperative results. Postoperative rehabilitation under guidance of an orthopaedic surgeon and trained physiotherapist is key to return to sports. There have been great advances in recent years in postoperative rehabilitation after ACL reconstruction [2]. Aggressive rehabilitation has been employed these days to improve the functional outcome with stress being laid on, not only on post-operative rehabilitation but also on an aggressive preoperative rehabilitation which has been well documented in the various studies and research articles. Preoperatively an exercise program is done to prepare the patient under reconstruction surgery for improved outcomes. [3]

Preoperative quadriceps strength correlates with postoperative functional outcomes in ACL reconstruction. Preoperative exercise program results in improved quadriceps strength and better single leg hop distance compared to patients who did not do any exercises preoperatively [4,5]

The aim of this study was to compare the results with or without preoperative rehabilitation followed by standard rehabilitation protocols in ACL reconstruction.

## Material and Methods

The present prospective randomised study was conducted at our institution, from June 2014 to June 2017. Ethical clearance was obtained before the start of the study. A total of 41 patients were included in this study. Patients between 18 to 50 years of age who presented with clinical evidence of ACL deficiency and underwent reconstruction were included in the study. All patients were examined in outpatient department. A thorough history was taken and knee

examined clinically and documented. Associated injuries of meniscus & collateral ligaments were looked for and documented. X-ray of affected knees was taken to rule out any fractures. MRI was done to confirm the diagnosis. Patients who were randomly assigned into standard rehabilitation program were named Group S and those in preoperative group were named Group P. For Group S patients exercises were started only after the surgical procedure. Group P patients were taught exercises which they had to do at home for 3 weeks and later immediately after surgery. Surgical treatment was arthroscopic ACL reconstruction with quadrupled hamstring graft fixed with endobutton on femoral side and interference screw in the tibial tunnel. On the first post-operative day, exercises were started as per rehabilitation protocol. We emphasized the need about rehabilitation and need for regular follow-up at the time of inclusion into study. Given below are the two types of rehabilitation protocols that have been adopted (Table 1).

Assessment of functional outcome was done at 3 weeks, 6 weeks, 3 months, 6 months. Evaluation is based upon Lysholm scale and International Knee Documentation Committee (IKDC) subjective knee form [7]. Initial subjective scoring is done using Lysholm scoring system. It is a subjective scoring based on questionnaire containing- support (5 points), limping (5 points), restraining (20 points), instability (25 points), pain (25 points), climbing stairs (10 points), squatting (5 points), swelling (10 points). It is calculated as a score of 100 based upon the patient answers.

IKDC form is one page of documentation has a qualification section, & an evaluation section. The IKDC has been shown to be reliable and valid for a number of pathologies, including ACL injury, meniscal injury, articular cartilage injury, patella-femoral pain syndrome, and knee osteoarthritis. The IKDC represents a clear and concise assessment tool for knee-related research that can be applied across pathologies and population characteristics. The documentation section is for recording patient's name, age, and record number, date of examination, date of injury, cause of injury, side involved and diagnosis. The major part of sheet consists of qualification section.

**Table 1** Rehabilitation Protocol followed in both groups.

<p><b>Preoperative rehabilitation</b><sup>6,10</sup></p> <p>This includes preoperative rehabilitation and standard regimen after surgery.</p> <p>Pre-operative phase</p> <ul style="list-style-type: none"> <li>• Quadriceps strengthening exercises</li> <li>• Mini Squats</li> <li>• Straight leg raising</li> <li>• Hamstring stretches</li> <li>• Ankle pumps</li> <li>• Ice application after exercises</li> </ul> <p>Goals:</p> <ul style="list-style-type: none"> <li>• To decrease pain, swelling and inflammation.</li> <li>• Restore range of motion (ROM).</li> <li>• Restore muscle strength.</li> </ul> <p><b>Standard Rehabilitation</b></p> <p>Post-operative till 3 weeks:</p> <ul style="list-style-type: none"> <li>• Knee in Motion control brace (MCB) with extension locked at 300 increased every week by 300.</li> <li>• Knee flexion in brace till tolerated.</li> <li>• Isometric quadriceps strengthening exercises</li> <li>• Hamstring stretches</li> <li>• Straight leg raising exercise</li> <li>• Ankle pumps</li> <li>• Full weight bearing as tolerated with brace locked in full extension.</li> <li>• Ice application after exercises.</li> </ul>	<p>Goals:</p> <ul style="list-style-type: none"> <li>• To relieve pain, swelling and inflammation due to surgery.</li> <li>• Knee ROM 0° - 100°.</li> <li>• Good quadriceps contraction.</li> </ul> <p><b>3 weeks to 6 weeks:</b></p> <ul style="list-style-type: none"> <li>• Previous exercises plus</li> <li>• Weight bearing allowed as earlier</li> <li>• Knee in brace with full flexion and extension as tolerated.</li> <li>• Hamstring squats</li> <li>• Hamstring curls</li> <li>• Side to side walking.</li> <li>• Ice application after exercises.</li> </ul> <p>Goals:</p> <ul style="list-style-type: none"> <li>• Full range of flexion and extension.</li> <li>• Maximize muscle strength.</li> </ul> <p><b>6 weeks to 3 months:</b></p> <ul style="list-style-type: none"> <li>• Continue above exercises.</li> <li>• Brace free full weight bearing mobilization.</li> <li>• Knee mobilization full range</li> <li>• Hip abduction &amp; adduction</li> <li>• Hip flexion &amp; extension</li> <li>• Lateral lunges</li> <li>• Cycling</li> <li>• To walk on toes.</li> <li>• Stair climbing.</li> <li>• Backward walking.</li> </ul>
<p><b>3 months to 6 months:</b></p> <ul style="list-style-type: none"> <li>• Continue all exercises</li> <li>• Stair climbing.</li> <li>• Backward walking.</li> <li>• Running</li> </ul>	<p>Goals:</p> <ul style="list-style-type: none"> <li>• Full range of movements.</li> <li>• Maximum muscle strength.</li> <li>• Return to sports.</li> </ul> <p><b>6 months to 1 year:</b></p> <ul style="list-style-type: none"> <li>• Continue all exercises</li> </ul>

Each parameter is qualified as normal, near normal, abnormal, severely abnormal. The parameters are incorporated in problem areas which are 1. Range of motion, 2. Ligament examination, 3. Compartmental findings, 4. Harvest site pathology. 5. X-ray findings.

### Statistical Analysis

A prior statistical power analysis was performed and sample size of 20 in each group was estimated. For comparison between groups Independent t test was used and Mann-Whitney test was used when parametric assumptions were not fulfilled. Data was analysed with SPSS software version 13.1. A probability level of  $P < 0.05$  was used to show statistical significance.

### Results

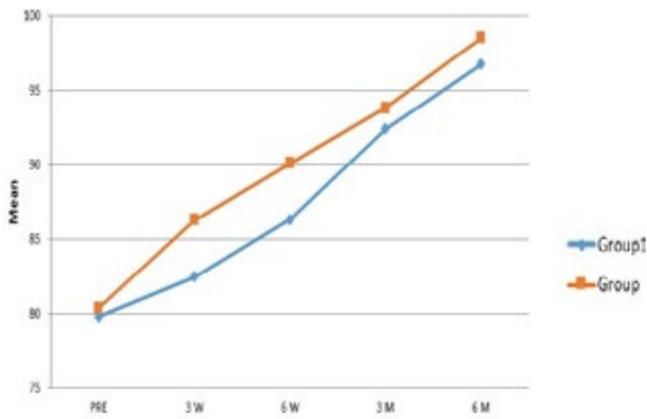
A total of 41 patients with ACL tear were included in the study out of which 21 (51.2%) patients were under standard group and 20 (48.8%) were under preoperative group. The mean age under standard group was 27.48 years and under preoperative group was 28.17 years. There were 38 (92.7%) males and 3 (7.3%) females. In group S among 21 patients 19 (90.5%) were males and 2 (9.5%) were female. In group P among 20 patients 19 (95%) were males and 1 (5.0%) was female. In this study majority of injuries were related to sports injuries (73.1%) and 14.6% were related to road traffic accidents. In group S 13 patients were affected on right side and 8 on left side. In group P among 20 patients 10 were right and 10 were left side. 22 (53.6%) patients had meniscal injury. Medial meniscal tear noted in 15 (36.6%) and lateral meniscus in 7 patients (17.1%).

The mean Lysholm score pre-operative in group S was 78.809 and group P was 80.412 which was not statistically significant. But the mean score was better in group P at 3 and 6 weeks as compared to group S. There was no statistical significance in Lysholm score between two groups. The difference between the scores decreased at 3 and 6 months (Table 2, Figure 1).

**Table 2** Comparison of Lysholm score between two groups.

	Group 1	Group 2	t test, p value*
PRE Operative	79.809	80.412	0.611:Not Significant
3 Weeks	82.476	86.312	0.416:Not Significant
6 Weeks	86.333	90.109	0.509:Not Significant
3 Months	92.428	93.856	0.586:Not Significant
6 Months	97.761	98.558	0.462:Not Significant

Range of Motion: Is a component of IKDC knee rating system which has both subjective and objective components. In range of motion – lack of extension and lack of flexion are estimated. Estimated as Normal, Nearly normal, Abnormal and severely abnormal depending on loss of movements. In our study before surgery in group S, 9 (42.9%) patients had ‘normal’ (IKDC Grade I) knee extension and 12 (57.1%) had ‘nearly normal’ (IKDC Grade II) whereas group P had 11 (55%) patients normal and 9 (45%) near normal knees. At 3 weeks in standard group 6(28.6%) patients had abnormal (grade III) and 15 (71.4%) were nearly normal and in preoperative group, 2 (10%) had abnormal and 18 (90%) had near normal which was statistically



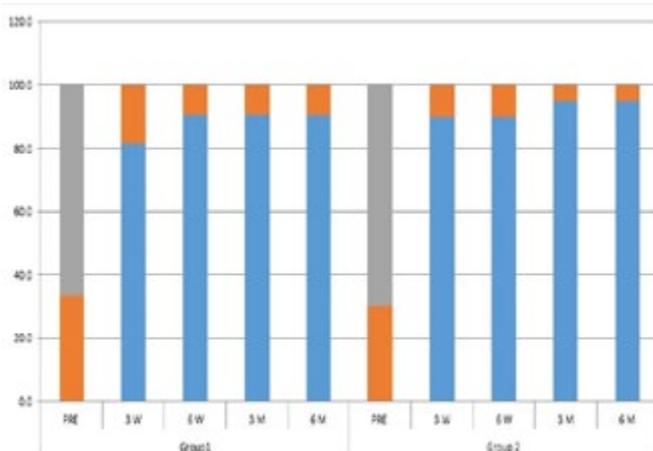
**Figure 1** Lysholm scores in both groups.

significant ( $p = .014$ ). At 6 weeks knee extension was nearly normal in 10 (47.6%) and normal in 11 (52.4%) patients in standard group whereas it is 4 (20%) and 16 (80%) in preoperative group which was statistically significant ( $p = 0.037$ ) between two groups. At 3 months all were normal in preoperative group whereas 95.2% were normal in standard group and 4.8% had near normal. At 6 months all had normal knee extension. At start of our study 71.45% of group S and 85% of group P patients had grade II (16-250) lack of flexion. Immediate post-operative analysis showed 'severely abnormal' (Grade IV) knee in all groups of patients. At 3 weeks among standard group, 13 (61.9%) patients had grade IV (>250) whereas in preoperative group it was only 8 (40%). This improvement in preoperative group was statistically significant ( $p = .0017$ ). At 6 weeks follow up knee flexion in preoperative group was improved to abnormal in 1 (5%), nearly normal in 11 (55.0%) and normal in 8 (40.0%). This was not statistically significant between two groups. Further analysis of the results showed relative improvement in the grade in preoperative group over the standard group at 3 months and 6 months, however this improvement was not statistically significant. By the end of 6 months all patients had normal knee flexion.

Lachman Test: There was no statistical significant difference between two groups (Table 3, Figure 2). At the end of 6 months 90.6% of patients in both group S had grade I (1-2mm) and 9.4% had group II (3-5mm) and 95% in group P had grade I and 5% had grade II.

**Table 3** Lachman test comparison between two groups.

Lachman test	p value*	Significance
Preoperative	0.821	NO
3 Weeks	0.867	NO
6 Weeks	0.898	NO
3 Months	0.969	NO
6 Months	0.969	NO



**Figure 2** Lachmann test results.

Harvest Site Pathology at 3 weeks 61.9% of patients in standard group 39.1% had grade II and had grade I whereas in group P, 70% had grade I and 30% had grade II. At 6 weeks 90.6% of patients in standard group had grade II and had 9.4% grade I whereas in other group, 95% had grade I and 5% had grade II. By the end of 6 months 20 patients in standard group had grade I and 1 patient grade II whereas in group P all patients had grade I.

Complications in our study were 1 (2.4%) patient standard group had infection following reconstruction for which arthroscopic lavage and parenteral antibiotic administration needed. 2 (4.8%) patients had harvest site infection which was superficial skin infection healed by 3 weeks. One (2.4%) patient had re-rupture in the same knee after 1 year of reconstruction.

## Discussion

The success of reconstructing anterior cruciate ligament is not just placing graft in anatomic location but, in turn help patients succeed in activities which they demand. The goals of preoperative rehabilitation is to decrease pain, swelling, eliminate antalgic gait, restore range of motion, improve muscle strength and neuromuscular control. This helps in preparing the patient for surgery and better post-operative outcomes. [9, 10] Better IKDC and Knee injury and Osteoarthritis Outcome Score (KOOS) scores were found in preoperative rehabilitation group and higher return to sport rates 2 years after ACLR in study of international cohort with preoperative rehabilitation with neuromuscular training and without preoperative rehabilitation [11]. A 4 week rehabilitation program before surgery significantly improved knee extensor muscle strength post-operatively and improved knee function, improving single-legged hop test (SLHT) distance [5]. Age, preoperative rehabilitation, full knee extension and neuromuscular control are factors which influence postoperative recovery and return to play in athletes following ACL reconstruction. Preoperative rehabilitation improves ROM which reduces the risk of arthrofibrosis postoperatively. Aggressive preoperative rehabilitation is advised in athletes for early gain of motion and early surgery [10].

Although there is differing opinion regarding the optimal preoperative rehabilitation program and time before surgery, few studies have highlighted these aspects. Twenty volunteers who had gym and home based rehabilitation program for 6 weeks resulted in SLHT test results and Quadriceps strength with better muscle cross sectional area in MRI an self-assessment using the modified Cincinnati scores [12]. Even though there has been no conclusion on aspect of rehabilitation for consideration (progressive strengthening, neuromuscular training) patients should be given exercises more than just quiet knee ie painless knee, complete range of motion with quadriceps activation [11-15].

In a review of more than 500 studies with 8 studies meeting inclusion criteria it was found that preoperative rehabilitation was beneficial to patients undergoing ACLR with better outcomes, better knee related function and improved muscle strength [16]. A review of literature suggests patients with a 3 to 6 weeks of rehabilitation results in better quadriceps activation and functional outcomes. Although there is no optimal preoperative functional level suggested it is recommended that patients should attain limb symmetry index (LSI) of 90% and hop performance before surgery [4, 5, 13, 14, 15].

The patients will be accustomed to the exercises in preoperative group and continue after surgery and were ahead of standard group who had to start exercises after surgery. The compliance to exercises in preoperative group it was better at 3 weeks than standard group. So it is to emphasise pre-operative exercise regimen to improve the early results after surgery such that patient rehabilitation is faster and early return to sporting activities. Hence accelerated rehabilitation can be

implemented to young athletics who can return to sports early.

Limitations of our study: The sample size was small. A larger sample size and return to sports assessment would have added more details to the study. During the rehabilitation program, we had problems in calculating regarding the number of physical therapy visits and time spent at the rehabilitation facilities. This was only a short time outcome requires further follow up at 1 and 2 years to evaluate the long term functional outcomes. Further studies are required to assess the duration of rehabilitation required and precise exercises to be done before surgery.

## Conclusion

By this study we can conclude that early rehabilitation before surgery is advocated to improve the early functional outcomes at 3 and 6 weeks.

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