



ORIGINAL SCIENTIFIC ARTICLE

PATTERN OF ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION (ACLR) AMONG ATHLETES IN MALAYSIA BETWEEN 2015 AND 2020

Fairus Fariza Zainudin^{1ABCDE}, Siti Aisyah Ibrahim^{1ABCD}, Ali Md Nadzalan^{1ADE}, Badrul Akmal Hisham Md. Yusoff^{2ABD}, Norlelawati Mohamad^{2ABD}, Efri Noor Muhamad Hendri^{2ABD}, Deepashini Harithasan^{3ABD}, Ruaibah Yazani Tengah^{1ABCD} and Nor Azlin Mohd Nordin^{3ABD}

¹Universiti Pendidikan Sultan Idris

²Pusat Perubatan Universiti Kebangsaan Malaysia

³Universiti Kebangsaan Malaysia

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Corresponding Author: Fairus Fariza Zainudin, E-mail: fairus.fz@fsskj.upsi.edu.my

Accepted for Publication: September 14, 2022

Published: November 30, 2022

DOI: 10.17309/tmfv.2022.3s.07

Abstract

Background. Individual involvement in sports activity is rising and thus increases the risk of knee injury. Anterior Cruciate Ligament (ACL) rupture is the most common knee injury requiring ACL reconstruction (ACLR). However, limited evidence is available to date on ACLR characteristics in Malaysia for comparison with Western countries.

This study aims to describe the epidemiological characteristic of ACLR surgery and the trend of pre-operative physiotherapy (pre-habilitation).

Materials and methods. ACLR cases recorded in a tertiary hospital database between January 2015 and December 2020 were extracted and reviewed. This retrospective study was approved by the hospital's Research Ethics Committee (UKMPPI/111/8/JEP-2020-500). All ACLR cases involving sports injuries were included with the exclusion of non-sports related injuries. Yearly ACLR cases were retrieved using an Injury Information form containing variables namely age, gender, type of ACL tear, accompanying meniscus injury, duration from injury to surgery and pre-habilitation details. Descriptive statistics were used to summarize the sample data.

Results. A total of 131 ACLR cases were reported between 2015 and 2020 (Male, n = 122; Female, n = 25). The number of ACLR cases fluctuated during the observed years, with a maximum of 30 cases reported in a year and 98% of the cases were represented by the youth age group (15 – 47 years old). The average age at time of surgery was 27.1 (± 7.79). On an average, 80% of athletes stated no history of previous knee injury. The most common type of ACL injury was a complete tear (88%), followed by partial tear (9%), and re-rupture (3%). A meniscus injury was noted in 61% of cases. The time from injury to surgery was 15 weeks. The study found low percentage of the ACLR patients who received pre-habilitation prior to surgery (<20%).

Conclusions. ACLR cases are showing a fluctuating trend every year. Despite the majority of the ACL cases being a complete tear, the participants waited more than four months to undergo ACLR, with only a quarter of them had pre-habilitation prior to surgery. The reasons for these situations require investigation. Future research inclusive of a larger database is also desirable to develop a better insight into ACL injury pattern.

Keywords: ACL reconstruction, descriptive epidemiology, pre-operative physiotherapy, knee injury.

Introduction

Anterior Cruciate Ligament (ACL) injury is among the most common knee injury associated with individuals who

are actively participating in sports activity. The annual occurrence of ACL isolated injuries is 68.6 per 100,000 person per year, and the incidence of ACL with concomitant injury is higher than isolated injury. The current systematic literature review reported one in 29 female athletes and one in 50 male athletes ruptured their ACL, with amateur female athletes remained at a higher risk of ACL compared to their male counterparts. However, in the general population, the incidence of ACL injuries were significantly higher in males

- © Fairus, F.Z., Ibrahim, S.A., Nadzalan, A.M., Md Yusoff, B.A.H., Mohamad, N., Hendri, E.N.M., Harithasan, D., Tengah, R.Y., & Mohd Nordin, N.A., 2022.



than in females (81.7 vs 55.3 per 100,000 person per year). In addition, the rate of performed ACLR surgery also increased significantly over time in all age groups (Rowntree, 1942). Due to the increase rate of ACL injury, the injury pattern in active general population needs to be examined. Moreover, until now it is indistinct if the profiles of ACLR cases which comprises gender, age, injury, surgery and rehabilitation history among the Malaysian population is parallel to that reported in previous literatures.

ACLR surgery is a common medical management following ACL injury, aiming to restore the knee function, minimising the symptoms and therefore improving patients' quality of life (Dhillon, 2014). Usually, the ACLR surgery is recommended for patients who have recurrent knee instability during activities of daily living and sports which involved pivoting movements. However, various secondary issues may arise following the surgical procedure including requirement for long term rehabilitation and subsequent revision surgeries, financial burden, and the occurrence of post-traumatic early osteoarthritis (PTOA) (Rothrauff et al., 2020). In addition, the ACLR surgery generally does not guarantee a return to sports (RTS) activity to the pre-injury level. Literature has established that the success of RTS among ACLR patients depends on numerous factors such as the patient's psychological state, muscle strength, score of functional test, and score of self-reported knee function. It was also reported that ACLR patients with short waiting time from the initial injury to surgery and those received preoperative physiotherapy are more likely to achieve better functional outcomes and early RTS activity (Giesche et al., 2020; King et al., 2020). However, these factors are still under-reported in the Asian populations and general ACLR epidemiological literature. Moreover, most ACLR epidemiological studies were conducted based on the previously developed ACLR registries.

The identification of ACLR cases using ACL registries provide a mechanism for prospective surveillance of targeted population. This facilitates for long term follow-up of patients, provides continuous feedbacks to surgeons and therapists for patient safety and the improvement of patients' quality of life (Rothrauff et al., 2020). Besides, the ACLR registries offers identification of best clinical practices and trends over time. This subsequently enables the evaluation of patients' characteristics, injury profiles, surgery techniques, the risk affecting the clinical and functional outcomes following ACLR surgeries which includes the RTS outcome and the presence of secondary complications. Although many western countries have reported ACLR profiles based on their developed ACLR registry, the generalisability of their findings to the eastern populations is not possible due to the differences in population lifestyle, and surgical and rehabilitation approaches (Prentice et al., 2018). While there are few studies which reported the occurrence of ACLR surgeries in Malaysia, none of them explored the waiting time from initial injury to surgery, the preoperative physiotherapy data and their influence on functional outcome including return to sport. In addition, epidemiological data on ACLR related injuries are still lacking in the Asian region (Tabben et al., 2022).

Literature documented that the ACLR rate in the Asian countries is generally higher compared to the European regions. In Malaysia, a study reported a dramatic increase in

ACLR surgical procedures, and further investigations for epidemiological data on ACLR surgery were required (Dhillon, 2014). Therefore, the main purpose of this research is to describe the epidemiological characteristics of ACLR surgery in the country. This study also aims to evaluate the time factor for ACLR surgery and preoperative physiotherapy in order for comparison with previous studies.

Materials and methods

Study Design and Sampling Frame

A descriptive retrospective epidemiological survey was utilized for this research. This study adhered to the guideline of the Declaration of Helsinki and the study protocol was reviewed and approved by the Research Ethics Committee of the National University of Malaysia (UKM PPI/111/8/JEP-2020-500). All information regarding ACLR patients were treated as confidential to preserve patient privacy. The ACLR surgery cases were identified from the registry of patients from a tertiary public hospital for the period beginning January 2015 until December 2020. Patients' characteristics, injury and surgical details, time from injury to surgery, and their pre-operative physiotherapy information were retrieved and summarised. Each reviewed ACLR case was documented into a proforma designed for this study.

Variables Definition

This study used variables definition based on definitions described from a previous study (Rothrauff et al., 2020). These include: 1) ipsilateral operation: any non-revision procedure on the injured knee; 2) contralateral ACLR knee: any procedure performed on the contralateral side following primary ACLR; 3) the revision ACLR: a procedure in which the graft has been replaced; 4) recreational athletes: general population who are active in sports activity; and 5) the ACLR patient: patient who ruptured their ACL while playing sports for recreational or high performance purpose. The injury to the cartilage involved in this study considered all severity levels without any grade classification. The age categorisation followed the World Health Organization (WHO) guideline which indicated the age between 5-17 years old as children and adolescent, 18-64 years old as adult and 65 years old and above as elderly. There was a small difference noted between the age categorisation of WHO (2020) and Department Statistic of Malaysia.

Study Procedure

Upon identification of potential ACLR cases from the registry, a request to review the patients' medical record was submitted to the medical records department of the hospital. Selection of cases was then made by a trained therapist based on specified inclusion criteria, namely: (1) all age groups and gender; (2) Malaysian citizens; (3) ACL injuries due to any involvement in physical or sports activity; (4) Both types of injuries either contact or non-contact; (5) having concomitant meniscal tears and chondral lesions; and (6) ACLR surgery done between 1st January 2015 and 31 December 2020. The exclusion criteria were: (1) ACL injury due to motor vehicle accident (MVA) or (2) non-sports activities. Medi-

cal records of eligible cases were reviewed comprehensively and essential data were retrieved through the utilization of a proforma. Collected data included patients' demographic details, injury details, surgical information and preoperative physiotherapy management.

Statistical analysis

In this research, descriptive statistics (frequency, percentage, mean & standard deviation) were used to describe each variables of interest. The statistical analysis for the study was executed using the SPSS software. The level of significance value was pre-set at $p < 0.05$.

Results

Patients Characteristics

The primary cases search from the hospital registry determined that a total of 181 elective ACLR surgeries were performed between the year 2015 to 2020. However, only 150 medical records were able to be retrieved. The remaining 31 records were not found possibly due to several reasons such as records in use at others specialties at the time of retrieval; staffs unable to locate; or the files have been transferred to different facility. Second attempt for records retrieval for the remaining 31 records were done again to ensure maximum record availability before decisions of exclusion were made. After excluding 19 cases of ACL injury due to non-sports activities, a total 131 cases were reviewed and analysed which included 17 ACLR cases of national athletes. Generally, the mean age of the patients at the time of surgery was 27.1 years (± 7.79), with 109 of them were male (83.21%) and 22 were female patients (16.79%). Twelve cases (9.2%) represent ACLR among children and adolescent age (5-17 years old), and 119 cases (90.8%) involving adults (18-64 years old), while there was no case involving elderlies (65 years and above) (WHO,2020; <https://www.dosm.gov.my>). The distribution of ACLR cases according to age and performance category are as in Fig. 1.

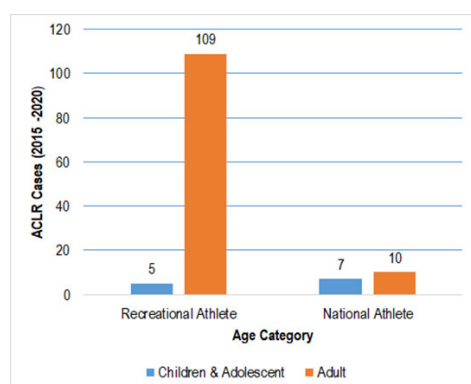


Fig. 1. Frequency of ACLR cases in recreational and national athletes group according to age category of children and adolescent (5-17 year old) and adult (18-64 year old), N=131

The frequency of ACLR cases reported fluctuated every year but presented a trend of increment among adult (Fig. 2).

The total sample distribution based on the type of graft used for ACLR surgery was hamstring in 93 (71.0%) proce-

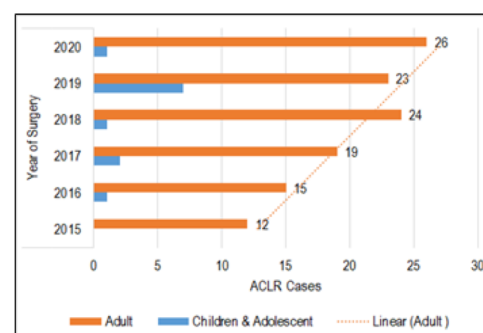


Fig. 2. frequency of reported Anterior Cruciate Ligament Reconstruction (ACLR) cases according to age categorisation from 2015 - 2020

dures, and BPTB used in 30 (22.9%) procedures. The other types of graft used includes 1 (0.8%) peroneus longus and 3 (2.3%) for Tendon Achilles (TA), while 4 (3.1%) cases have not reported on this. All ACLR cases was performed using anatomical ACLR. The ACLR injury and surgery details for overall cases and national athletes are presented in Table 1.

Time from Injury to ACLR Surgery

In 114 recreational athletes, the waiting time for ACLR surgery ranged between 1 week and 192 weeks, with the median waiting time being 15 weeks. Further classification of time from injury to ACLR surgery revealed that a total of 76 (66.7%) ACLR procedures were conducted within 6 months and 22 (19.3%) procedures were conducted after 6 months. Only 9 (7.9%) ACLR procedures were conducted after 1 year post-injury and the remaining 7 (6.1%) ACLR cases were performed more than 2 years post-injury. However, among the 17 national athletes, the ACLR procedures were mostly conducted within 6 months post-injury (16 ACLR cases, 94.1%) and only one case was performed after 6 months of injury. Overall, the national athletes received ACLR procedure within 7.59 ± 6.69 weeks (Table 2).

Pre-operative Physiotherapy (Prehabilitation)

Among the 114 recreational athletes who underwent ACLR procedures, only 24 (21.1%) of them received pre-operative physiotherapy and the remaining 90 (78.9%) athletes did not receive pre-operative physiotherapy prior to ACLR surgery. All national athletes (17 ACLR cases) received pre-operative physiotherapy following the ACLR reconstruction surgery (Fig. 3).

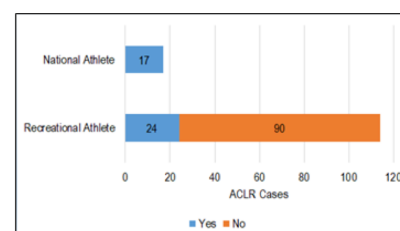


Fig. 3. The frequency of ACLR cases that receive pre-operative physiotherapy management prior to ACLR surgery

Table 1. Demographics and Profiles of Anterior Cruciate Ligament Reconstruction (ACLR), 2015-2020 in all cases (n=131)

Variables	n (% of Total ACLR Cases)
No. of tears, n	131
Recreational / National Athletes	114/17
Age, mean $\pm$ SD (years)	27.1 $\pm$ 7.79
Sex	
Male / Female	109 (83.21)/ 22 (16.79)
Age Group (years)	
Child and Adolescent (5-18)	12 (9.16)
Adult (18-64)	119 (90.84)
Elderly (≥ 64)	0 (0)
History of Previous Knee Injury	
Yes / No	26 (19.8) / 105 (80.2)
ACLR Knee	
Right / Left	70 (53.4) / 61 (46.6)
Confirmatory of ACL Tear (Surgical Record)	
Partial Tear	12 (9.2)
Complete Tear	115 (87.8)
Re-rupture Tear	4 (3.1)
Type of ACL Tear	
Isolated ACL	29 (22.1)
ACL with concomitant injury	102 (77.9)
Tear Occurrence	
Primary injury	112 (85.5)
Secondary (Ipsilateral)	12 (9.2)
Secondary (Contralateral)	7 (5.3)
Duration (week) from injury to surgery, mean $\pm$SD	
(Minimum 1 week – Maximum 192 weeks)	23.02 $\pm$ 31.77
Meniscus Injury	
Yes / No	80(61.1) / 51 (38.9)
Meniscus Injury Location	
Lateral	30 (22.9)
Medial	33 (25.2)
Lateral and Medial	17 (13.0)
Not Related	51 (38.9)
Other Concomitant Injuries	
Yes / No	52 (39.7) / 79 (60.3)
Bone Injuries	
Yes / No	4 (3.1) / 127 (96.9)

* Values are expressed as n (%) unless otherwise specified.

Discussion

The findings of this research emphasize the profile and trend of ACLR surgeries performed in the recent years. A total of 131 ACLR surgeries were performed between the year of 2015 to 2020 which was related to sports activity, with an increasing trend in the number of surgery performed every year. This data is consistent with the results of earlier studies which documented the increasing occurrence of ACLR every year (Costa et al., 2018; Mall et al., 2014; Sanders et al., 2016). This study showed that ACLR surgeries were performed mainly among males than female patients

Table 2. Demographics and Profiles of Anterior Cruciate Ligament Reconstruction (ACLR), 2015-2020 among National Athletes (n=17)

Variables	n (% of Total ACLR Cases)
No. of tears, n	17
Recreational / National Athletes	19.41 $\pm$ 4.19
Age, mean $\pm$ SD (years)	12 (70.6)/5(29.4)
Sex	
Male / Female	12 (70.6)/5(29.4)
Age Group (years)	
Child and Adolescent (5-18)	7 (41.18)
Adult (18-64)	10 (58.82)
Elderly (≥ 64)	0 (0)
History of Previous Knee Injury	
Yes / No	3 (17.7) / 14 (82.4)
ACLR Knee	
Right / Left	9 (52.9) / 8 (47.1)
Confirmatory of ACL Tear (Surgical Record)	
Partial Tear	3 (17.6)
Complete Tear	13 (76.5)
Re-rupture Tear	1 (5.9)
Type of ACL Tear	
Isolated ACL	4 (23.5)
ACL with concomitant injury	13 (76.5)
Tear Occurrence	
Primary injury	15 (88.2)
Secondary (Ipsilateral)	1 (5.9)
Secondary (Contralateral)	1 (5.9)
Duration (week) from injury to surgery, mean $\pm$SD	
(Minimum 1 week – Maximum 192 weeks)	23.02 $\pm$ 31.77
Meniscus Injury	
Yes / No	11(64.7) / 6 (35.3)
Meniscus Injury Location	
Lateral	4 (23.5)
Medial	7 (41.2)
Lateral and Medial	0 (13.0)
Not Related	6 (35.3)
Other Concomitant Injuries	
Yes / No	4 (23.5) / 13 (76.5)
Bone Injuries	
Yes / No	0 (0) / 17 (100)

and is parallel with that reported in ACLR literatures which stated the cases were likely related to higher sports involvement among male athletes than their female counterparts in Malaysia. Besides, the occurrence of ACL injuries are also higher in males than females as well in the context of general population who are active in sports activity (Prentice et al., 2018; Sanders et al., 2016). In this study, the average age of patients undergoing ACLR surgery is 27 years old, with the higher percentages of individuals being under 47 years old. This finding is similar with literature by Mall et al. (2014). This is reasoned due to the higher level of physical activities to remain socially active, either during high school, college years and early working years and the higher needs to live a

healthy lifestyle. Sanders et al. (2016) also reported a peak incidence of ACL tear at the age of 19 to 25 years in male patients. Although there was inconclusive evidence of history of knee injury as predictor for ACL injury, interestingly in this study, 19% of ACLR cases reported a history of previous knee injury before ACL tear. Further research using a national ACL database will be necessary to determine the trend of ACLR incidence in Malaysia in order to better comprehend the ACLR epidemiology.

In this study, the confirmations of ACL tear were taken from surgical records as a mean of confirming the pathology of knee injury. More than 75% of patients in this study experienced a complete ACL tear, with less than 10% of cases experienced a partial tear. The inclusion of this ACL partial tear for reconstructive surgery was decided by a surgeon to facilitate ligament healing ability and increase post-injury knee function. Another important finding in this study was about the meniscal lesion that was identified in more than 60% of ACLR patients. This percentage is considered higher when compared to certain previous studies (Costa et al., 2018) but similar to the study by Church and Keating, (2005) which reported 71% of meniscal tear incidence among ACLR patients undergoing reconstruction after 12 months of injury. The high occurrence of meniscal tear in the current study is highly likely due to the longer time taken from injury to surgery which exceeded 12 months in this study. Literatures documented that any ACL injuries that are related with meniscal or any condral injury has been associated with an increase in risk in developing early post-traumatic osteoarthritis (PTOA) (Spahn et al., 2016). In this study 77% of ACLR cases with concomitant injuries have higher risk of developing PTOA later in life within 5 to 10 years following reconstruction surgery. There are several risk factors associated with meniscus injury which has been identified in the literature such as time to surgery, male gender, age below 30 years old, revision ACLR, chronic injuries, pre-operative side to side laxity > 6mm and the presence of concomitant tear at the lateral meniscus region (Sonnery-Cottet et al., 2018).

Injury to surgery time interval has been associated with expectation of successful return to sports (RTS) activity. The time interval from injury to ACLR surgery can also be classified according to acute ACLR reconstruction (≤ 16 weeks) or delayed ACLR surgery (≥ 16 weeks). Based on a systematic review study by Fabricant et al. (2016), they found 78% -100% of returning rate to baseline pre-injury level for athletic participation among young athletes who received acute ACLR reconstruction, with some incidence of graft rupture. As established in this study, almost all of the national athletes received acute ACLR surgeries (below than 6 months). This is due to their average age which were relatively younger compared to the recreational athletes. Also, the expectation of return to sports activity among them will be higher which is within 1 year following complete ACLR post-operative rehabilitations (Fabricant et al., 2016). A recent systematic review with meta-analysis which involved 2093 patients documented that there were no difference in clinical and functional outcomes between those receiving early or delayed (3 and 6 weeks cut-off) ACLR surgery for isolated ACL injury (Vermeijden et al., 2022). However, despite this report, the question on the success of return to sports remains unanswered. Unfortunately, this study could not fur-

ther clarify on this issue. The lack of available published data for Malaysian recreational athletes and high performance athletes warrants more studies to address this concern in the near future.

It is recommended to conduct ACLR reconstruction within the first year from injury incidence (Kennedy et al., 2010). This is in order to minimise the risk of further damage to the meniscus and thus lead to early joint degenerative changes (Church & Keating, 2005). Studies have also shown that the time from injury to ACLR reconstruction is associated with a better objective performance and functional outcomes (Bieri et al., 2017). As ACLR injuries are commonly linked with a meniscus tear, a study by Yeo, Suhaimi and Parker (2019) reported that good patient-reported outcome measures (PROMs) can be obtained and failure rates after arthroscopic meniscal repair can be reduced when the patient received treatment within 3 months following the initial ACL injury involving meniscus tear. In this study, more than 60% of ACLR cases were treated less than 6 months and approximately 20% were done after more than 6 month but within a year following the injury. The practice of early ACLR surgery timing lead to a better knee function, reduced knee laxity and better scoring in subjective knee evaluation with improved early return to sports activity (Kennedy et al., 2010). In addition, early ACLR surgery is also beneficial in reducing the individual physiology inactivity among the ACLR patients (Bieri et al., 2017; Fabricant et al., 2016; Grindem et al., 2015). However, data in this study also presented that fewer than 10% of ACLR cases had their surgeries after more than 1 year (Kennedy et al., 2010). This group of patients could have preferred conservative management and only decided to undergo surgery when failed to achieve satisfactory knee outcomes and functional performance. The ACLR surgeries among national athletes were performed less than 6 months of post-injury. The practice of early ACLR surgery timing among this group of patients follows the practice as suggested in literature and this will aid in faster recovery and early return to sports (Yeo et al., 2019). Contrary to this, Fabricant et al. (2016) reported that acute or delayed surgeries produce an equal rate of return to sports, although with a varying degree of time of recovery for each individuals. It is recommended that future researches should consider to include the time to surgery and time to return to sports activity as appropriate predictor and outcome variables. Recent literature also suggested an acute ACLR surgery (received ACLR surgery within 16 week prior to time of injury) may be performed safely without the increased risk in developing arthrofibrosis. This could also prevent secondary injury associated with meniscus and cartilage lesions, in which the patients' age and sports activity level are key factors to review when considering timing for surgery (von Essen et al., 2020).

The significance of preoperative physiotherapy management (prehabilitation) prior to ACLR surgery cannot be questioned. In the orthopaedic field, the concept of prehabilitation has gained attention as it has been found to improve the outcome following surgery (Gränicher & Scherr, 2021). The benefits of prehabilitation has been explained previously (Giesche et al., 2020; Gränicher & Scherr, 2021) and comprises reduced post-operative pain, length of stay in the hospital, and post-operative complications, while it increases knee functions and have early return to sports rate. Better ACLR rehabilitation results can be attained by a struc-

tured preoperative physiotherapy management (Grindem et al., 2015). In this study, the percentage of ACLR patients receiving preoperative physiotherapy prior to surgery is low in both recreational and national athletes. This scenario needs to be explored since the benefits of prehabilitation in orthopaedic surgery has been well accepted and documented since 1942 (Rowntree, 1942).

A survey by Carter, Webster, and Smith (Carter et al., 2021) among 122 physiotherapists worldwide established that 84% of the respondents reported many ACLR patients who were waiting for ACLR did not receive prehabilitation. However, this study did not report the reasons on why preoperative physiotherapy was omitted. A systematic review found little variation in the content of prehabilitation and in general, the protocol consist of exercises including muscle control and co-contraction of the knee muscle specifically the quadriceps and hamstring (Giesche et al., 2020). Previous studies recommended that prehabilitation protocols should consist of strengthening and stretching exercises of the lower limb (4 to 6 weeks with 2 to 4 times per week) with considerations to include advanced neuromuscular (perturbation, balance, stability, proprioceptive exercises) and plyometric exercises (Carter et al., 2021; Wilk & Arrigo, 2016). As recent literature highlights that there is no specific evidence-based guidelines for strength and neuromuscular training in the early stage after ACL injury (Giesche et al., 2020), further research exploration in this area is recommended. Although this study found a very low percentage of patients who received prehabilitation, the prehabilitation protocol in standard of care for ACLR patient is recommended to be increased to maximize the functional outcome following surgery (Ebrahimi Atri & Taghizadeh, 2021). Additionally, it is predicted that with progressive structured prehabilitation, it will provide a better functional outcome following surgery and increase the chance of early and safe return to sports activity at pre-injury level. While the effects of prehabilitation prior to ACLR surgery seem beneficial in improving the ACLR recovery rate, more research are also required here to identify the correct exercises dosage (duration, intensity, frequency) and optimal exercise protocol (Carter et al., 2021; Ebrahimi Atri & Taghizadeh, 2021; von Essen et al., 2020).

There are a few limitations in this study. Firstly, the data were collected from a single hospital representing the central region of Malaysia. In future, inclusion of ACLR registry from each region in Malaysia will be necessary to enable better understanding on the outcome of surgery including return to sports. This include long term monitoring of the status of HR-QOL, secondary complications such as post-traumatic osteoarthritis and level of physical activity. In addition, as no standard online registry system was available, the reporting on ACLR outcome following surgery were varied across surgeons. Also, essential information may be missed out and less documented. Future research initiatives should be taken on developing the standard ACLR registry system for better monitoring of ACLR outcome.

Conclusion

Anterior cruciate ligament reconstruction (ACLR) is the most common procedure conducted in sports injury field. This study reports the rise of ACLR procedures performed annually in Malaysia with low number of ACLR patient re-

ceiving preoperative physiotherapy. Further studies should emphasis on larger samples and assess the consequences of preoperative physiotherapy management on functional outcomes post ACLR surgery.

Acknowledgement

This paper is based on the research project entitled "Profiling of Anterior Cruciate Ligament Reconstruction (ACLR) Injury Pattern and Return to Sports Outcome within 2-5 years After ACLR Surgery". The authors would like to extend their gratitude to the Malaysia Ministry of Higher Education and Universiti Pendidikan Sultan Idris (UPSI) for the FRGS-RACER Grant (Code: 2019-0173-105-62) that facilitated to fund the research activity.

References

- Rowntree, L. G. (1942). Rehabilitation and Prehabilitation. *Journal of the American Medical Association*, 119(15), 1171-1175. <https://doi.org/10.1001/jama.1942.02830320017004>
- Dhillon, K. (2014). 'Doc'do I need an anterior cruciate ligament reconstruction? What happens if I do not reconstruct the cruciate ligament? *Malaysian orthopaedic journal*, 8(3), 42. <https://doi.org/10.5704/moj.1411.010>
- Rothrauff, B. B., Jorge, A., de Sa, D., Kay, J., Fu, F. H., & Musahl, V. (2020). Anatomic ACL reconstruction reduces risk of post-traumatic osteoarthritis: a systematic review with minimum 10-year follow-up. *Knee Surgery, Sports Traumatology, Arthroscopy*, 28(4), 1072-1084. <https://doi.org/10.1007/s00167-019-05665-2>
- Giesche, F., Niederer, D., Banzer, W., & Vogt, L. (2020). Evidence for the effects of prehabilitation before ACL-reconstruction on return to sport-related and self-reported knee function: A systematic review. *PLoS One*, 15(10), e0240192. <https://doi.org/10.1371/journal.pone.0240192>
- King, E., Richter, C., Jackson, M., Franklyn-Miller, A., Falvey, E., Myer, G. D., Strike, S., Withers, D., & Moran, R. (2020). Factors influencing return to play and second anterior cruciate ligament injury rates in level 1 athletes after primary anterior cruciate ligament reconstruction: 2-year follow-up on 1432 reconstructions at a single center. *The American Journal of Sports Medicine*, 48(4), 812-824. <https://doi.org/10.1177/0363546519900170>
- Prentice, H. A., Lind, M., Mouton, C., Persson, A., Magnusson, H., Gabr, A., Seil, R., Engebretsen, L., Samuelsson, K., & Karlsson, J. (2018). Patient demographic and surgical characteristics in anterior cruciate ligament reconstruction: a description of registries from six countries. *British Journal of Sports Medicine*, 52(11), 716-722. <https://doi.org/10.1136/bjsports-2017-098674>
- Tabben, M., Eirale, C., Singh, G., Al-Kuwari, A., Ekstrand, J., Chalabi, H., Bahr, R., & Chamari, K. (2022). Injury and illness epidemiology in professional Asian football: lower general incidence and burden but higher ACL and hamstring injury burden compared with Europe. *British Journal of Sports Medicine*, 56(1), 18-23. <https://doi.org/10.1136/bjsports-2020-102945>
- Costa, L. A., Foni, N. O., Antonioli, E., Teixeira de Carvalho, R., Paião, I. D., Lenza, M., & Ferretti, M. (2018). Analysis of 500 anterior cruciate ligament reconstructions from a private institutional register. *PLoS One*, 13(1), e0191414. <https://doi.org/10.1371/journal.pone.0191414>

- Mall, N. A., Chalmers, P. N., Moric, M., Tanaka, M. J., Cole, B. J., Bach Jr, B. R., & Paletta Jr, G. A. (2014). Incidence and trends of anterior cruciate ligament reconstruction in the United States. *The American Journal of Sports Medicine*, 42(10), 2363-2370. <https://doi.org/10.1177/0363546514542796>
- Sanders, T. L., Maradit Kremers, H., Bryan, A. J., Larson, D. R., Dahm, D. L., Levy, B. A., Stuart, M. J., & Krych, A. J. (2016). Incidence of anterior cruciate ligament tears and reconstruction: a 21-year population-based study. *The American Journal of Sports Medicine*, 44(6), 1502-1507. <https://doi.org/10.1177/0363546516629944>
- Church, S., & Keating, J. (2005). Reconstruction of the anterior cruciate ligament: timing of surgery and the incidence of meniscal tears and degenerative change. *The Journal of bone and joint surgery. British volume*, 87(12), 1639-1642. <https://doi.org/10.1302/0301-620x.87b12.16916>
- Spahn, G., Schiltenswolf, M., Hartmann, B., Grifka, J., Hofmann, G., & Klemm, H. (2016). The time-related risk for knee osteoarthritis after ACL injury. Results from a systematic review. *Der Orthopäde*, 45(1), 81-90. <https://doi.org/10.1007/s00132-015-3170-4>
- Sonnery-Cottet, B., Praz, C., Rosenstiel, N., Blakeney, W. G., Ouanezar, H., Kandhari, V., Vieira, T. D., & Saithna, A. (2018). Epidemiological evaluation of meniscal ramp lesions in 3214 anterior cruciate ligament-injured knees from the SANTI study group database: a risk factor analysis and study of secondary meniscectomy rates following 769 ramp repairs. *The American Journal of Sports Medicine*, 46(13), 3189-3197. <https://doi.org/10.1177/0363546518800717>
- Fabricant, P. D., Lakomkin, N., Cruz Jr, A. I., Spitzer, E., & Marx, R. G. (2016). ACL reconstruction in youth athletes results in an improved rate of return to athletic activity when compared with non-operative treatment: a systematic review of the literature. *Journal of ISAKOS*, 1(2), 62-69. <https://doi.org/10.1136/jisakos-2015-000013>
- Vermeijden, H. D., Yang, X. A., Rademakers, M. V., Kerkhoffs, G. M., van der List, J. P., & DiFelice, G. S. (2022). Early and Delayed Surgery for Isolated ACL and Multiligamentous Knee Injuries Have Equivalent Results: A Systematic Review and Meta-analysis. *The American Journal of Sports Medicine*, 03635465211069356. <https://doi.org/10.1177/03635465211069356>
- Kennedy, J., Jackson, M., O'Kelly, P., & Moran, R. (2010). Timing of reconstruction of the anterior cruciate ligament in athletes and the incidence of secondary pathology within the knee. *The Journal of bone and joint surgery. British volume*, 92(3), 362-366. <https://doi.org/10.1302/0301-620x.92b3.22424>
- Bieri, K. S., Scholz, S. M., Kohl, S., Aghayev, E., & Staub, L. P. (2017). Dynamic intraligamentary stabilization versus conventional ACL reconstruction: a matched study on return to work. *Injury*, 48(6), 1243-1248. <https://doi.org/10.1016/j.injury.2017.03.004>
- Yeo, D. Y., Suhaimi, F., & Parker, D. A. (2019). Factors predicting failure rates and patient-reported outcome measures after arthroscopic meniscal repair. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*, 35(11), 3146-3164. e3142. <https://doi.org/10.1016/j.arthro.2019.06.016>
- Grindem, H., Risberg, M. A., & Eitzen, I. (2015). Two factors that may underpin outstanding outcomes after ACL rehabilitation. *British Journal of Sports Medicine*, 49(22), 1425-1425. <https://doi.org/10.1136/bjsports-2015-095194>
- von Essen, C., Eriksson, K., & Barenius, B. (2020). Acute ACL reconstruction shows superior clinical results and can be performed safely without an increased risk of developing arthrofibrosis. *Knee Surgery, Sports Traumatology, Arthroscopy*, 28(7), 2036-2043. <https://doi.org/10.1007/s00167-019-05722-w>
- Gränicher, P., & Scherr, J. (2021). Do athletes benefit from preoperative physical therapy before ACL-reconstruction? *Sports Orthopaedics and Traumatology*, 37(2), 126-131. <https://doi.org/10.1016/j.orthtr.2021.04.038>
- Carter, H. M., Webster, K. E., & Smith, B. E. (2021). Current preoperative physiotherapy management strategies for patients awaiting Anterior Cruciate Ligament Reconstruction (ACLR): A worldwide survey of physiotherapy practice. *The Knee*, 28, 300-310. <https://doi.org/10.1016/j.knee.2020.12.018>
- Wilk, K. E., & Arrigo, C. A. (2016). Preoperative phase in the rehabilitation of the patient undergoing anterior cruciate ligament reconstruction. *Operative Techniques in Sports Medicine*, 24(1), 12-20. <https://doi.org/10.1053/j.otsm.2015.10.003>
- Ebrahimi Atri, A., & Taghizadeh, M. (2021). The Effect of Prehabilitation on the Self-Reported Outcomes of Anterior Cruciate Ligament Reconstruction: A Systematic Review. *Iranian Journal of Health Sciences*, 9(1), 45-55. <https://doi.org/10.18502/jhs.v9i1.5972>

КАРТИНА ВИПАДКІВ ХІРУРГІЧНОГО ВІДНОВЛЕННЯ ПЕРЕДНЬОЇ ХРЕСТОПОДІБНОЇ ЗВ'ЯЗКИ У СПОРТСМЕНІВ: 2015–2020 У МАЛАЙЗІЇ

Файрус Фаріза Зайнудін^{1ABCDE}, Сіті Айся Ібрагім^{1ABCD}, Алі Мд Надзалан^{1ADE}, Бадрул Акмаль Хішам М. Юсофф^{2ABD}, Норлелаваті Мохамад^{2ABD}, Ефрі Нур Мухамад Хендрі^{2ABD}, Діпашіні Харітхасан^{3ABD}, Руайба Язані Тенгах^{1ABCD}, Нор Азлін Мохд Нордін^{3ABD}

¹Університет освіти імені Султана Ідріса

²Медичний центр Національного університету Малайзії

³Національний університет Малайзії

Реферат. Стаття: 8 с., 2 табл., 3 рис., 24 джерела.

Історія питання. Рівень особистого прилучення до занять спортом зростає, тим самим підвищуючи ризик травмування колін. Розрив передньої хрестоподібної зв'язки (ПХЗ) є найпоширенішою травмою коліна, яка

потребує хірургічного відновлення ПХЗ (ХВПХЗ). Однак на сьогодні існує обмежена кількість документальних фактів про характеристики ХВПХЗ в Малайзії для порівняння з країнами Заходу. Метою цього дослідження є опис епідеміологічних характеристик ХВПХЗ та загального напрямку передопераційної фізіотерапії (передопераційної реабілітації).

Матеріали та методи. Було зроблено витяги та проведено аналіз випадків ХВПХЗ, зареєстрованих у базі даних закладу третинної медичної допомоги в період від січня 2015 року до грудня 2020 року. Це ретроспективне дослідження було схвалене Комітетом з етики наукових досліджень при цьому медичному закладі (дозвіл UKMR-PI/111/8/JEP-2020-500). До розгляду були включені всі випадки ХВПХЗ, пов'язані зі спортивними травмами, крім травм, не пов'язаних зі спортом. Вибірку випадків ХВПХЗ з розподілом за роками здійснювали за допомогою форми «Інформація про травми», яка містить такі змінні, як вік, стать, тип розриву ПХЗ, супутня травма меніска, тривалість періоду від моменту травмування до проведення операції та докладний опис передопераційної реабілітації. Для узагальнення даних вибірок використовували описову статистику.

Результати. У період 2015-2020 рр. було зареєстровано загалом 131 випадок ХВПХЗ (чоловіки, $n = 122$; жінки, $n = 25$). Протягом спостережуваних років кількість випадків ХВПХЗ коливалася, при цьому за один рік було зареєстровано максимум 30 випадків, а 98% випадків були представлені молодіжною віковою групою (віком 15–47 років). Середній вік на момент операції становив $27,1 (\pm 7,79)$ року. У середньому 80% спортсменів заявили про відсутність попередніх травм колін у минулому. Найпоширенішим типом травми ПХЗ був повний розрив (88%), за яким ідуть частковий розрив (9%) і повторний розрив (3%). Травму меніска було констатовано в 61% випадків. Тривалість періоду від моменту травмування до проведення операції становила 15 тижнів. За результатами дослідження було встановлено низький відсоток пацієнтів із ХВПХЗ, які отримували передопераційну реабілітацію до операції (<20%).

Висновки. Випадки ХВПХЗ щороку показують мінливу тенденцію. Незважаючи на те, що більшість випадків ПХЗ становила повний розрив, учасники очікували на проведення ХВПХЗ понад чотири місяці, причому лише чверть із них отримувала передопераційну реабілітацію до операції. Причини таких ситуацій потребують розслідування. Також вважається доцільним проведення подальшого дослідження з використанням більшої бази даних для поглиблення розуміння картини травм ПХЗ.

Ключові слова: хірургічне відновлення ПХЗ, описова епідеміологія, передопераційна фізіотерапія, травма коліна.

Information about the authors:

Fairus Fariza Zainudin: fairus.fz@fsskj.ups.edu.my; <https://orcid.org/0000-0001-9969-8573>; Faculty of Sports Science and Coaching, Universiti Pendidikan Sultan Idris, 35900, Tg Malim, Perak, Malaysia.

Siti Aisyah Ibrahim: sitiaisyahibrahimupsi@gmail.com; <https://orcid.org/0000-0002-3315-0000>; Faculty of Sports Science and Coaching, Universiti Pendidikan Sultan Idris, 35900, Tg Malim, Perak, Malaysia.

Ali Md Nadzalan: ali.nadzalan@fsskj.ups.edu.my; <https://orcid.org/0000-0002-0621-2245>; Faculty of Sports Science and Coaching, Universiti Pendidikan Sultan Idris, 35900, Tg Malim, Perak, Malaysia.

Badrul Akmal Hisham Md Yusoff: badortho@gmail.com; <https://orcid.org/0000-0001-7794-2707>; Faculty of Medicine, Universiti Kebangsaan Malaysia, Level 2, Kompleks Pendidikan Perubatan Canselor Tuanku Jaafar, Jalan Yaacob Latif, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia.

Norlelawati Mohamad: lelamohamad80@gmail.com; <https://orcid.org/0000-0002-0993-0349>; Faculty of Medicine, Universiti Kebangsaan Malaysia, Level 2, Kompleks Pendidikan Perubatan Canselor Tuanku Jaafar, Jalan Yaacob Latif, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia.

Efri Noor Muhammad Hendri: efri061@gmail.com; <https://orcid.org/0000-0003-4541-6053>; Department of Physiotherapy, Hospital Canselor Tuanku Muhriz UKM, Jalan Yaacob Latif, Bandar Tun Razak, 56000 Cheras, Kuala Lumpur, Malaysia.

Deepashini Harithasan: deepa@ukm.edu.my; <https://orcid.org/0000-0003-2359-0720>; Faculty of Health Science (Physiotherapy Program), Universiti Kebangsaan Malaysia, Kuala Lumpur, Wilayah Persekutuan Kuala Lumpur, Malaysia.

Ruaibah Yazani Tengah: ruaibah@fsskj.ups.edu.my; <https://orcid.org/0000-0002-0272-7954>; Faculty of Sports Science and Coaching, Universiti Pendidikan Sultan Idris, 35900, Tg Malim, Perak, Malaysia.

Nor Azlin Mohd Nordin: norazlin8@ukm.edu.my; <https://orcid.org/0000-0002-0038-1670>; Faculty of Health Science (Physiotherapy Program), Universiti Kebangsaan Malaysia, Kuala Lumpur, Wilayah Persekutuan Kuala Lumpur, Malaysia.

Cite this article as: Zainudin, F.F., Ibrahim, S.A., Nadzalan, A.Md., Yusoff, B.A.H.Md., Mohamad, N., Hendri, E.N.M., Harithasan, D., Tengah, R.Y., & Nordin, N.A.M. (2022). Pattern of Anterior Cruciate Ligament Reconstruction (ACLR) among Athletes in Malaysia between 2015 and 2020. *Physical Education Theory and Methodology*, 22(3s), S51-S58. <https://doi.org/10.17309/tmf.2022.3s.07>

Received: 09.07.2022. Accepted: 14.09.2022. Published: 30.11.2022

This work is licensed under a Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0>).