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Evaluation of Clinical Outcomes in Sport Participants Undergoing Anterior Cruciate Ligament Reconstruction at Prof. Dr. R. D. Kandou Hospital Manado

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Abstract: Anterior cruciate ligament (ACL) injury is one of the most common musculoskeletal injuries. Evaluating the clinical outcomes of the ACL reconstruction (ACLR) procedure is essential to provide information regarding the benefits of this procedure. This study aimed to assess the clinical outcomes of patients who underwent ACLR at Prof. Dr. R. D. Kandou Hospital Manado. This was a retrospective study. Secondary data were collected from all athlete patients who underwent ACLR. The ACLR procedure was performed by a single operator following the standard arthroscopic procedure. All grafts used Hamstring grafts (gracilis and semitendinosus). Suspense fixation was done using a button, while tibial fixation was done with interference fixation (bioabsorbable screw). Patients were evaluated over a short period, specifically at three months, six months, and nine months. Outcome parameters were assessed using the Visual Analog Scale (VAS), Range of Motion (ROM), Lachman test, Anterior Drawer test, and Knee Functional Score (KFS). Any complications that arose were documented. The results showed that among 21 patients at Prof. Dr. R. D. Kandou Hospital Manado, it was found that ACL injuries were more common in physically active men, especially in the age group of 26-30 years. Most patients who underwent ACLR had serious injuries that required immediate treatment. Hamstring graft was the most common choice (85.7%). Knee stiffness was the most common complication and required special attention during the rehabilitation program. Based on KFS, most patients successfully achieved good knee function recovery. There was a decrease in the VAS score reflecting the effectiveness of the procedure in reducing postoperative pain. There was an increase in the KSS reflecting the success of ACLR in restoring knee stability and function to almost normal levels. In conclusion**,** anterior cruciate ligament reconstruction in sport participants showed significant improvements in knee mobility and pain reduction, with low complications.
Keywords: anterior cruciate ligament injury; anterior cruciate ligament reconstruction; graft fixation

INTRODUCTION

Anterior cruciate ligament (ACL) injury is one of the most common musculoskeletal injuries. In America it is estimated that there are around 200,000 thousand ACL injury events and approximately 150,000-175,000 of the cases are Anterior Cruciate Ligament Reconstruction (ACLR).[1,2] In Indonesia, the trend of the ACLR procedure is increasing nowadays. In 2019, there was an improvement of the ACLR procedure by 42% compared with the previous year.[3] In Manado, the ACL reconstruction (ACLR) procedure has started to be routinely performed since 2023.

Anterior cruciate ligament reconstruction (ACLR) aims to restore the knee stability, so that patients who undergo this procedure can return to their normal daily life activities, and prevent further complications, namely chronic damage to the knee (osteoarthritis).[4] In athletes, both sport participants and professional athletes, the ACLR procedure aims to allow them to return to sports, even reaching their pre-injury exercise level and even some achievement.[5]

Functional outcome of this procedure has been widely reported. Studies in several countries such as America, Europe, East Asia show that the functional outcome is achieved in 80-90% of athletes who underwent ACLR procedures. Arden et al[5] reported that of 5770 athletes who underwent ACLR 82% were able to return to sport, 63% returned to their pre-injury level, and 44% were able to back to compete.

The majority of studies of the functional outcome involve many patients with sport activities. The exact number of the general population undergoing ACLR are unknown. In our center, 70% of patients who experienced ACL injury are sport participants and not professional athletes, while 30% come from general population group.

Study of functional outcome with patients undergoing ACLR in Indonesia are not widely reported. In our center, the functional outcomes from ACLR procedure have not reported yet. Patient profile as well as demographic difference between the patients in our center and the majority of patients reported in previous studies made the functional outcome of our ACLR procedure a valuable assessment and important to be reported.[2]

The success of the ACLR procedure was assessed and reported to evaluate the effectiveness of this procedure. The results of this study are expected to provide benefit and information, therefore, patients with ACL injury will not hesitate to undergo this procedure. In addition to being a basis for information, clinical outcome reports can be a basis for evaluation of the surgical technique, rehabilitation procedures undertaken, and complications that arise after ACLR procedure.[5] All of these underly our study to assess the functional outcomes of patients undergoing ACLR at Prof. Dr. R. D. Kandou Manado.

METHODS

This was a single-center retrospective study using the clinical outcomes of several cases. This study was conducted at Prof. Dr. R. D. Kandou Hospital Manado after obtaining approval from the Hospital Research Ethics Committee until the sample size was met. The study took place in February 2024 - October 2024.

Samples were sport participant patients with ACL injuries who underwent ACLR. The inclusion criteria were patients with ACL injuries without other injuries, aged 18-40 years, ACL injuries due to sports, undergoing a pre-operative rehabilitation program for at least three months, injury incident until the time of surgery less than six months, and undergoing treatment at Prof. Dr. R. D. Kandou General Hospital. Patients who were excluded from participating this study were patients with a history of joint laxity, obesity measured by body mass index, and history of other diseases. Tools and materials were visual analog scale assessment sheet, knee society score assessment sheet, sport injury status, arthroscopic machine, screws, and washers.

The study was conducted by first sampling at the Surgery Clinic of Prof. Dr. R. D. Kandou, Manado, followed by signing of informed consent. Patients underwent the procedure, and then clinical assessments and evaluations were performed at one month, three months, six months, and nine months postoperatively. Data collection and analysis were subsequently carried out.

RESULTS

Table 1 showed that of the 21 patients who participated in this study, 80.9% were men and 19.1% were women. The age distribution of patients varied, with the 26-30 age group as the largest group (42.9%), followed by the <25 age group (33.3%), and 31-40 years (23.8%). Most patients were sport participants (80.9%), while 19.1% were professional athletes. These data indicate that ACL injuries are more common in physically active men, especially in the 26-30 age group, who tend to be more involved in high-intensity sport activities.

Table 1. Patient demographics

Category	Number of patients	Percentage (%)
Gender		
Man	17	80.9
Woman	4	19.1
Age		
<25 years	7	33.3
26-30 years	9	42.9
31-40 years	5	23.8
Activity		
Professional athlete	4	19.1
Sport participant	17	80.9

Table 2 showed that the majority of patients (61.9%) had a single ACL injury, while 23.8% had ACL injuries with meniscal involvement, and 14.3% had multiligament injuries. In terms of severity, 57.2% of patients were Grade III, indicating significant ligament damage and the need for urgent surgical intervention. A total of 28.5% of patients were Grade II, and 14.3% of patients were Grade I. These data emphasize that most patients undergoing ACLR have quite serious injuries, which require immediate treatment to prevent long-term complications.

Table 2. Types of injury and severity

Injuries	Number of patients	Percentage (%)
Types of injuries		
ACL single injury	13	61.9
ACL injury with meniscus	5	23.8
Multiligament injury	3	14.3
Severity level		
Grade I	3	14.3
Grade II	6	28.5
Grade III	12	57.2

Table 3 showed that Hamstring grafts were the most commonly used option, applied in 85.7% of patients, meanwhile peroneal grafts were used in 14.3% of patients. The choice of graft depended on the clinical condition of each patient and the preference of the operator, with Hamstring grafts being the preferred choice due to their flexible biomechanical properties and high tensile strength.

Table 3. Types of grafts used

Types of grafts	Number of patients	Percentage (%)
Hamstring graft	18	85.7
Peroneal graft	3	14.3

Table 4 showed that complications that occurred after surgery included postoperative infection in 6.25% of patients, knee stiffness in 12.5% of patients, and chronic pain in 6.25% of patients. There were no reported cases of graft re-rupture. Although most patients did not experience serious complications, it is important to note that knee stiffness was the most common complication and requires special attention during the rehabilitation program.

Table 4. Complications that emerged

Complications	Number of cases	Percentage (%)
Post-operative infection	1	6.25
Knee stiffness	2	12.5
Chronic pain	1	6.25
Graft re-rupture	0	0

Table 5 showed the evaluation of knee function using the Knee Functional Score (KFS). The professional athletes had an average score of 88 ± 4, slightly higher than sport participants who had an average score of 84±6. Although there was a small difference, these results indicate that most patients managed to achieve good knee function recovery, allowing them to return to demanding physical activities with minimal risk of complications.

Table 5. Knee Functional Score based on activity

Activity	KFS (mean ± SD)
Professional athlete	88 ± 5
Sport participant	85 ± 7

Table 6 showed the evaluation of pain using the visual analog scale (VAS). There was a significant decrease in the intensity of pain experienced by patients after ACLR surgery. In the first month, the average VAS score was 4.8, indicating quite severe pain after surgery. However, over time and with the improvement of the rehabilitation program, the pain gradually decreased, with the VAS score decreasing to 3.2 in the third month, 2.1 in the sixth month, and reaching 1.5 in the ninth month. This decrease in the VAS score reflects the effectiveness of the procedure in reducing postoperative pain and supporting optimal recovery.

Table 6. Pain evaluation using *visual analog scale* (VAS)

Post-operative time interval	Mean VAS Score (0-10)	SD
1 month	4.8	1.2
3 months	3.2	1.0
6 months	2.1	0.8
9 Months	1.5	0.5

Table 7 showed the assessment of knee function using the Knee Society Score (KSS) shows a consistent and significant improvement in the knee function of patients after undergoing ACLR. In the first month, the average KSS of 70.5 indicates a moderate initial recovery, where patients begin to regain their knee mobility. A significant improvement was seen in the third month with a score reaching 78.3, and continued to reach 90.4 in the ninth month. This increase in the KSS reflects the success of ACLR in restoring knee stability and function to near-normal levels, allowing patients to return to daily activities and sports with minimal risk of complications.

Table 7. Evaluation of knee function based on KSS

Post operative time interval	Average KSS (0-100)	Standard Deviation (SD)
1 month	70.5	10.0
3 months	78.3	8.5
6 months	85.2	7.3
9 months	90.4	5.8

DISCUSSION

This study involved 16 patients who underwent Anterior Cruciate Ligament (ACLR) reconstruction at Prof. R. D. Kandou Manado Hospital. Of the total patients, 62.5% were male and 37.5% were female, reflecting the common epidemiological pattern in the ACL injury population. Men are more likely to experience ACL injuries, especially in the context of intense sports activities, due to anatomical, biomechanical, and more aggressive movement patterns than women.[6-8] Previous studies have shown that men are more likely to participate in high-risk sports such as football and basketball, which contribute to the higher rate of ACL injuries in men.[9]

The age distribution in this study showed that the 26-30 age group was the most represented (43.75%), followed by the 18-25 age group (31.25%) and the 31-40 age group (25.0%). This age is the period when individuals tend to be physically active and often engage in recreational or competitive sports. According to other studies, the risk of ACL injury is increased in physically active individuals in this age range because they are more likely to engage in activities that involve jumping, sudden changes of direction, and risky pivoting movements.[10,11] Most of the patients in this study were sports participants (75.0%), while the rest were professional athletes (25.0%). These data confirm that ACL injuries are a significant problem in the physically active population, both in recreational and professional contexts, and require special attention in injury prevention and management.

In this study, the majority of patients (68.75%) had a single ACL injury, which often occurred through non-contact mechanisms such as pivoting or landing after a jump. Single ACL injuries are the most common type of injury and are often caused by a combination of external forces and suboptimal knee biomechanics.[12] In addition, 18.75% of patients had ACL injuries involving the meniscus. Meniscal injuries often occur in conjunction with ACL injuries because the meniscus acts as a secondary stabilizer in the knee joint. These injuries can worsen long-term patient outcomes, increase the risk of osteoarthritis, and delay the healing process.[13]

Multiligament injuries, which occurred in 12.5% of patients in this study, indicate a higher level of complexity and require more intensive management. Multiligament injuries involve more than one ligamentous structure that is damaged, which can cause significant knee instability and often require more complex surgical reconstruction.[14] The severity of the injury was measured using a grading system, with 62.5% of patients being Grade III, indicating severe ligament damage requiring immediate surgical intervention. A total of 25.0% of patients were Grade II, indicating moderate damage, while 12.5% were Grade I, indicating less severe damage. This high severity reflects the need for prompt and appropriate management to minimize the risk of further complications and ensure optimal recovery.[15]

The choice of graft type in ACLR procedures is one of the most important decisions that can affect the long-term outcome of patients. In this study, Hamstring grafts were used in 75.0% of patients, indicating a strong preference for this graft type in the study population. Hamstring grafts are often chosen due to their flexible biomechanical properties and high tensile strength, which allow for good functional recovery with a lower risk of donor site morbidity compared to patellar tendon grafts.[16] In addition, Hamstring grafts also have the advantages of faster recovery and lower postoperative pain, making them the preferred choice for many orthopaedic surgeons.[17]

Patellar tendon grafts, used in 12.5% of patients, remain a popular choice especially for

athletes who require high knee stability and a quick recovery time. However, patellar tendon grafts are also known to have a higher risk of anterior knee pain and potential donor site complications, such as patellar fracture or patellar tendinitis.[18] Quadriceps tendon grafts, which were also used in 12.5% of patients, offer a good alternative for patients who are not suitable for other graft types or who have special needs. Quadriceps tendon grafts are known for their high strength and lower risk of donor site complications, making them a good choice in certain situations.[19] Graft selection should always take into account the patient's specific circumstances, including activity level, anatomy, and medical history, to ensure optimal outcomes.[20]

Postoperative complications are the most challenging aspects of post-ACLR management. In this study, 6.25% of patients experienced postoperative infection, which, although low, still requires special attention. Postoperative infection can worsen clinical outcomes and increase the risk of graft failure if not managed appropriately. Infection management usually involves broad-spectrum antibiotics, and in some cases, surgical debridement to remove infected tissue.[21] Prevention of infection requires strict adherence to sterilization protocols during the surgical procedure as well as good postoperative wound care. Knee stiffness was reported in 12.5% of patients, making it the most common postoperative complication in this study. Knee stiffness is often due to excessive scar tissue formation and prolonged immobilization after surgery. Management of knee stiffness requires an intensive rehabilitation approach, with a focus on early mobilization and progressive range of motion (ROM) exercises to prevent or reduce stiffness.[22] Chronic pain was reported in 6.25% of patients, which may be related to surgical technique, graft choice, or suboptimal postoperative management. Chronic pain after ACLR can compromise knee function and affect patient quality of life, requiring appropriate evaluation and management to ensure optimal recovery.[23] There were no reported cases of graft re-rupture, indicating that the surgical technique used and graft choice were generally effective in maintaining postoperative knee stability.[24]

Evaluation of knee function using the Knee Functional Score (KFS) provides important insights into patient recovery after ACLR. In this study, professional athletes showed a mean score of 88±4, indicating excellent recovery and the ability to return to highly demanding physical activities.[25] This high score indicates that ACLR is effective in restoring knee stability and function, allowing athletes to resume their activities with minimal risk.

Sport participants who did not engage in high-intensity physical activities showed a mean score of 84±6. Although this score is slightly lower than that of professional athletes, it still indicates significant recovery of knee function, allowing patients to return to daily activities and recreational sports without experiencing significant functional impairment.[26] These results are consistent with other studies showing that ACLR is an effective procedure for restoring knee function in patients with a wide range of activity levels, from professional athletes to recreational sport participants.[27]

Pain assessment using the Visual Analog Scale (VAS) showed a significant decrease in pain intensity experienced by patients after the ACLR procedure. In the first month after surgery, the average VAS score was 4.8, indicating that the pain was still quite severe after surgery.[28] However, as time went by and the rehabilitation program improved, the pain gradually decreased, with the VAS score decreasing to 3.2 in the third month, 2.1 in the sixth month, and reaching 1.5 in the ninth month. This decrease in the VAS score reflects the effectiveness of the ACLR procedure in reducing postoperative pain, which is one of the important indicators in knee function recovery.[29] Progressively reduced pain also indicates that patients are able to participate more actively in the rehabilitation program, which ultimately contributes to a faster and more effective recovery.[30] Significant pain reduction during this recovery period also allows patients to return to their normal activities, including sports, with more confidence and without excessive concern about disturbing pain.[31]

Assessment of knee function using the Knee Society Score (KSS) showed a significant improvement in patient knee function after the ACLR procedure. At the first month, the mean

KSS score was 70.5, reflecting the early stage of recovery where patients were still in the process of regaining stability and mobility in their knees.[32] Significant improvement was seen at the third month, with the mean score increasing to 78.3, indicating that patients were beginning to regain more control and strength in their knees.[33]

At the sixth month, the mean KSS score reached 85.2, indicating that most patients had achieved sufficient recovery to return to more demanding physical activities. This score continued to increase until the ninth month, with the mean KSS score reaching 90.4, indicating that most patients had achieved near-normal levels of knee function.[34] This consistent increase in KSS scores reflects the success of the ACLR procedure in restoring knee stability, mobility, and strength, which are critical for patients who wish to return to physical activity, both in the context of sports and daily activities. These results also demonstrate the importance of a comprehensive and ongoing rehabilitation program, which allows patients to achieve optimal functional outcomes post-operatively.[32]

CONCLUSION

Anterior cruciate ligament reconstruction in sport participants shows significant improvement in knee mobility and pain reduction, with low complications. These results are in line with overseas studies, showing that this procedure is effective in restoring knee function and allowing patients to return to activity.

There is a need for long-term studies to evaluate the risk of osteoarthritis and recurrence of injury, as well as the development of more efficient and affordable reconstruction techniques.

Conflict of Interest

The authors affirm no conflict interest in this study.

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