Study on Types of Anterior Crucial Ligament (ACL) Remnants in Patients with ACL Injuries

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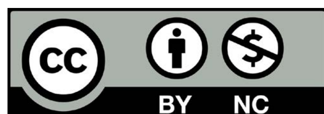


ABSTRACT

Background: ACL injuries account for global burden of knee injury. Anatomic ACL reconstruction using grafts is widely used modality, however tissue bridging between tibia and femur is growing recently despite fact that intrasubstance ACL injuries do not heal. ACL injury patients may have thick ACL remnants with mechanoreceptors contributing to knee proprioceptive functioning and may aid in knee stability. This study aimed to find out the prevalence of types of ACL remnants in ACL injured patients.

Methods: A retrospective cross sectional study was conducted in Pokhara Academy of health Science for 1 year where a total of 23 patients who had undergone arthroscopic ACL reconstruction with or without meniscus injury . Dignostic arthroscopy was done to find out ACL remnant type. Results were expressed as percentages, mean +/- standard deviation and median for variables. P-value of <0.05 was taken as statistically significant at confidence interval of 95%.

Results: Majority of the participants were male (73.9%) and age group of 20-40 year was predominant with 82.6%. Type 4 ACL remnants were predominant type with 65.2% and type 3 and type 2 were equal with 17.4% each and type 1 remnant was not found.

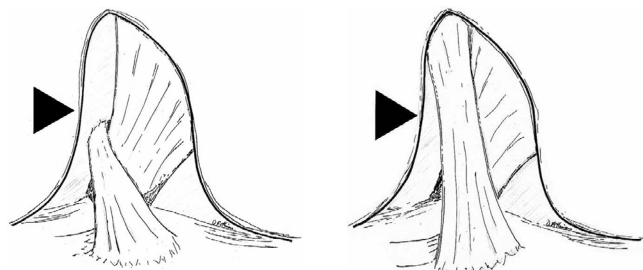
Conclusion: As ACL injuries account for major burden of knee injury, Crain type 4 ACL remnant was the most common type. ACL remnant in our study was due to delay in diagnosis and treatment of ACL injurie

Keywords: ACL injuries ;ACL remnants.

INTRODUCTION

Anterior cruciate ligament (ACL) is the most often injured and rebuilt ligament in the knee, providing rotational and antero-posterior stability at the knee joint.[1] Over the past ten years, there has been an increase in the frequency of ACL injuries. Road traffic accidents are the most frequent cause of a rise in ACL injuries. Increased involvement in sports and other activities has also been connected to a potential rise in ACL injury.[2]

ACL injuries account for 50% of all knee injuries worldwide, and 86% of all knee injuries in India are caused by this injury. Among patients with knee injuries in Nepal, the incidence of ACL injury is 85.82%. Most ACL injuries occur in people between the ages of 20 and 40.[2-3] Sports-related injuries were the most common source of injuries in the past; now, non-sporting activities are the main cause of ACL injuries.[2–5] here have been claims that tissue bridging between the femur and tibia can resemble an intact ligament[6,7] despite the fact that it is widely acknowledged that intrasubstance ACL injuries do not heal.[8–10] On arthroscopic examination, a thick scar may occasionally be visible inside the intercondylar notch.[7] The sporadic reports of "spontaneous healing" of the ACL following rupture may be explained by the presence of this tissue. Studies[7,11] have stated that this tissue might aid in stabilizing the knee deficient in the ACL. ACL injury patients may have thick ACL remnants with mechanoreceptors potentially contributing to knee proprioceptive functioning.[12] Configuration of the ACL remnant and its attachments to the femur and tibia was classified into one of four types according to Crain's method of classification as provided in the Figure 1. This study aimed to find out the prevalence of types of ACL remnants in ACL injured patients presenting to OPD and emergency of Pokhara Academy of Health Sciences, Pokhara ,Nepal .



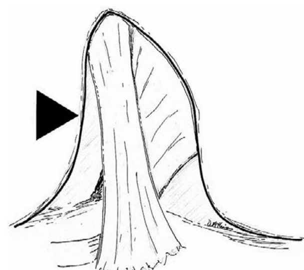
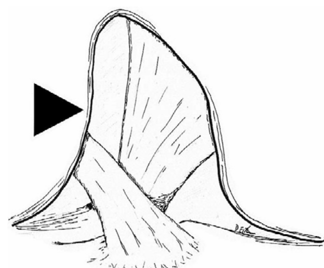


FIGURE 1. ACL scarring to the PCL: this patient's injured ACL wrapped around the PCL. The normal ACL attachment on femur is empty (arrowhead).

FIGURE 2. ACL healing to roof of the notch. As in Fig 1, the lateral wall is empty (arrowhead).



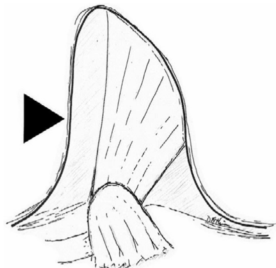


FIGURE 3. Attenuated ACL remnant healed to the lateral wall more anterior and distal than its anatomic origin. Once again, the normal femoral attachment site (arrowhead) is empty.

FIGURE 4. Resorption of the torn ACL: the lateral wall is completely empty (arrowhead).

Figure 1 : Crain's Method of Classification of ACL remnant configuration

METHODS

A retrospective cross sectional study was conducted in Department of Orthopedics, Pokhara Academy of Health Sciences, Nepal from June 2022 to May 2023 for 1 year. A total of 23 patient who underwent ACL reconstruction with peroneus longus or hamstring graft for complete ACL tear during the period of study were taken for the study. Adult patients aged 20-64 years age who underwent arthroscopic ACLR, Isolated ACL injuries or associated meniscus injuries were included in the study whereas patient with history of previous knee injury and underwent ACLR, Multi-ligamentous injuries and concomitant intra-articular fracture were excluded.

Ethical approvalwas obtained from institutional review committee (IRC) of Pokhara Academy of Health Sciences, Pokhara, Nepal. Written consent taken from patients after explaining the type of procedure, possible complications, and the aim of the study. After consent, a thorough history obtained from the patient and physical examination performed. The collected data will be entered, cleaned and coded in Microsoft Excel 2010 and then exported to Statistical Package for the Social Sciences (SPSS) version 23 for statistical analysis. Results will be expressed as percentages, mean +/- standard deviation and median for variables. P-value of <0.05 will be taken as statistically significant at confidence interval of 95%.

RESULTS

A total of 23 patients undergoing arthroscopic ACL reconstruction were included in this study. Following were the results found during our study. The demographic profile revealed a predominance of young adults, with 82.6% (19/23) in the 20-40 years age group. The mean age was 30.96 ± 8.92 years, ranging from 20 to 50 years. Males accounted for 73.9% (17/23) of patients, while females comprised 26.1% (6/23), resulting in a male-to-female ratio of approximately 2.8:1(Table 1)

Table 1 : Socio demographic and clinical character of study participants

Characteristics		Frequency(%)
Age	20-40 Years	19 (82.6%)
	40-60 years	4 (17.4%)
Gender	Male	17 (73.9%)
	Female	6 (26.1%)
Side Involved	Left	10 (43.5%)
	Right	11 (47.8%)
	Bilateral	2 (8.7%)
Mechanism of injury	Fall Injury	5 (21.7%)
	Road Traffic Accident (RTA)	6 (26.1%)
	Sports Injury	11 (47.8%)
	Others	1 (4.3%)

In this study, around half of the cases 11 (47.8%) had their right knee involved whereas 10 (43.5%) patients had their left knee involved, and only 2 (8.7%) patients had bilateral knee involved. The most common mode of injury was sports-related activities (47.8%, 11 cases), followed by road traffic accidents (RTA, 26.1%), falls (21.7%), and other causes (4.3%). This distribution aligns with other studies indicating higher ACL injury rates among active, sports-involved populations.

The clinical limp score averaged 2.83 ± 0.65, with the majority presenting a moderate limp (Score 3 in 56.5%). The distribution of limp severity suggests significant functional impairment among the patients post-injury. Arthroscopic examination classified the ACL remnants according to Crain's classification. The majority displayed Type 4 remnants (65.2%, 15/23), characterized by the absence of any identifiable ligamentous tissue bridging the tibia and femur. Type 3 remnants were observed in

17.4% (4/23), indicating a scarred remnant with some tissue continuity. Similarly, Type 2 remnants, representing tissue attached to the lateral wall of the notch, were present in 17.4%. Notably, no Type 1 remnants were identified.

Table 2: Limp Score & Remnant Types of ACL

Variable	Type	Frequency(%)
Limp Score	2	7 (30.4%)
	3	13 (56.5%)
	4	3 (13%)
ACL Remnant	Type 1	0 (0%)
	Type 2	4 (17.4 %)
	Type 3	4 (17.4 %)
	Type 4	15 (65.2 %)

DISCUSSION

This study was conducted among twenty-three patients with Anterior cruciate ligament (ACL) deficient knees who had undergone single-bundle reconstruction were evaluated and included for the study of type of ACL remnant. There were 17 (73.9%) male and 6 (26.1%) female patients with an average age of 30.96±8.916 years and most common age group was 20 to 40 years of age. It was similar to the study done by Joshi et al14 with mean age of 32.3 +/- 10.5 years, ranging from 15 to 67 years, 173 (73%) were male, and 64 (27%) were female, with a male to female ratio of 2.7:1. It was also similar to the study done by Pokharel et al[2] with mean age of 30.28±9.65 years where 31 (28.44%) females and 78 (71.56%) males. The most affected group was 20-40 years of age, young people around this age group are often more active and engaged in sports and out door activities, which can increase the risk of ACL injuries. Males were predominantly involved than females in our study which in line with other studies might be due tendency of males to participate in physically active and more risk taking behaviors.

There was no significant difference on side affected, in our study right knee was affected in 11, the left in 10 and bilateral in 2 patients. In our study, sports injury (11 cases, 47.8%) was most common cause of ACL injury, followed by RTA (6 cases, 26.1%), fall injury (5 cases, 21.7%) and by others mode (1 case, 4.3%). It was similar to the study done by Geraets et al.[4], MH Arastu et al.[5], Gianotti et al.[15] where sports injury was most common case of ACL injuries. This could be because of the fact that the population under the present study are likely to adopt sports and recreational activities. However, the study was in contrary to the study done by Joshi et al.[14], where RTA was the most common cause of ACL injury (38.8%), followed by sports-related injuries in 33.3% and falls in 16.5% of patients. All the cases in our study had at least two of the studied history features present at the time of trauma. In our study 7 cases had limp score of 2, 13 cases had score of 3 and 3 cases had limp score of 4. On arthroscopic evaluation, the ACL remnants were assessed and were evaluated into four groups according to the Crain's classification. In 15 cases (65.2%) there was no identifiable ligament tissue spanning even the short gap between the tibial stump and the PCL; i.e, Crain type 4 ACL remnant. In 4 cases (17.4%), the remnant healing was to the lateral wall of the notch or the medial aspect of the lateral femoral condyle in a position anterior and distal to the ACL anatomic foot print; i.e, Crain type 3 ACL remnant. It was similar to the study by Crain et al.[13] reported that the pattern of scar formation after types 1, 2, 3, and 4 ACL rupture was 38%,8%,12%, and 42%, respectively. According to Crain et al.[13] the time between injury and surgery (TBIS) was 78 weeks. TBIS may be higher in developing country like Nepal. because of limited access to specialized care, inadequate diagnostic resources, and lack of awareness. Several studies have described the rapid degeneration and resorption of the ACL after acute rupture.[10,16–18]

The findings in our study demonstrate a high prevalence of Type 4 ACL remnants (65.2%) among patients presenting late for surgical intervention. This indicates that delayed diagnosis and treatment contribute to extensive tissue degeneration and resorption, resulting in absent or severely debrided remnants at the time of surgery. These results are consistent with prior literature, notably Crain et al., who reported that the pattern of scar formation after ACL rupture varies with time, with Type 4 remnants being most common in chronic or untreated cases.

CONCLUSION

Anterior Crucial Ligament injuries account for major burden of knee injury. The Crain type 4 ACL remnant is most common ACL remnant in our study due to delay in diagnosis and treatment of the ACL injuries.

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