

Evaluation of Knee Joint after Open Reduction and Internal Fixation Surgery of Posterior Cruciate Ligament in Patients with Avulsion Fracture

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Abstract

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BACKGROUND: The posterior cruciate ligament is one of the important tissues and structures sustaining the knee joint, and its rupture or detachment may lead to joint instability or destruction.

AIM: The present study aimed at investigating the Open Reduction and Internal Fixation surgery of posterior cruciate ligament and comparing it to the normal knee of the same side.

METHODS: In this study, 25 patients with avulsion fracture at the PCL joint were treated with open surgery and screw fixation. The patients were followed up by Lysholm knee score for at least 12 months after surgery.

RESULTS: All patients were male with an average age of 25 years over the years 2010-2018. The common mechanism of injury in these patients was motorcycle-car accident. In the study with Lysholm knee score, 21 patients (80%) obtained the good score of 60-90 while 20% of patients were placed in the fair group (30-59). The average score was 86.

CONCLUSION: The obtained score of knee function questionnaire in this study had no significant difference from other similar studies, and most patients achieved a good and acceptable score after the surgery. There was no knee instability and functional impairment in the patients compared to the normal knee. Considering the clinical results after the fixation of the PCL avulsion fracture causing a significant improvement in patients, the surgery could be considered as an acceptable and effective method for treating such impairment and fracture.

Introduction

The knee joint plays an important role in the function of various lower limbs. Posterior Cruciate Ligament (PCL) prevents posterior displacement of the tibia about the femur and causes knee posture stability and knee strength. It acts as a posterior knee stabiliser and has a restrictive role in front of the tibia to the posterior [1], [2]. The posterior cruciate ligament is one of the important tissues and structures sustaining the knee joint, and its rupture or detachment may lead to joint instability or destruction [3]. The PCL is very tight, so more impairments occur at the attachment to tibia that the trunk. tibial avulsion is a special kind of the PCL impairments. In fact, PCL avulsions often occur from the tibia side. The tibial

avulsion of PCL can cause knee instability and lead to knee degeneration in the long term. The cut piece can be fixed by screw or stitch either during open surgery or by arthroscopy. The larger pieces can be fixed by a screw and a posterior approach. In addition, several methods proposed for stitch fixation [3]. With a detailed overview of the previous studies, it can be found that the surgeries for the PCL avulsion often show a good functional success and good objective [4], [5].

The present study aimed at investigating the Open Reduction and Internal Fixation surgery of posterior cruciate ligament and comparing it to the normal knee of the same side.

The normal recovery rate of knee and the effect of fixation surgeries on the daily routine of these

individuals is a topic that can be used for identifying the defects of these surgeries and resolving them. In this study, the knee function of individuals was examined from two subjective and objective approaches. Lysholm Knee Scale is a standard scale that can estimate the success rate of surgery and postoperative complications based on the patient's symptoms (can be completed and filled by the patient or therapist).

The present study aimed at examining the function of the knee joint after the reconstruction surgery of Posterior Cruciate Ligament Avulsion and comparing it to the normal knee joint in the patients went under surgery in Shahid Beheshti Hospitals during 2010-2018 by using the Lysholm Knee Scale.

Methods

Summary of the used methodology and techniques

In this study, 25 patients undergoing PCL fixation at least 12 months ago were included. The inclusion criteria included the fixation surgery for PCL avulsion at least 12 months ago and completion of treatment, follow-up, physiotherapy course, having no other ligament problems in the knee during or before the surgery, having a problem in one side and having a normal knee with no ligament problem. However, the exclusion criteria included leaving the study unfinished and incomplete for any reason. All participants in the study presented their written consent on participation in the study.

Surgical technique

The patients with avulsion fracture at the tibial side of PCL diagnosed by radiographic and three-dimensional CT.SCAN went under general anaesthesia or spinal anaesthesia according to the anaesthesia physician after being prepared in the operating room (within a maximum of one week of the trauma). Clinical examination was performed under anaesthesia before placement of the patient in the prone position and the results were recorded. In all patients, the tourniquet was closed, and the fracture site was opened from the middle of the medial gastrocnemius and semitendinosus by the posterior approach. Then, the open reduction and fixation were conducted by a distal thread screw. After closing the wound and doing the dressing, the long leg splint was used in the knee flexion of 15-20 degrees and physiotherapy for strengthening the quadriceps femoris muscle was taught to the patient. After 4 weeks, the splint is removed, and the knee brace was given, and simultaneously the muscle physiotherapy started for the knee [3], [7].

Each subject in the study was followed up during 2, 6, 12 weeks and 6 and 12 months after the surgery through knee radiography, physical examination, and completion of the Lysholm knee scale. In this scale, the parameters such as limping, need or lack of need to support while standing and bearing weight, the ability of stair climbing, the ability to bend the knee gradually in the standing position, the knee stability and instability, swelling, and pain were evaluated. Also, some comments were left based on the obtained score on the success of surgery [6]. Physical examination was associated with scoring including posterior drawer and sag test and pain while moving the knee patios move. The collected data were analysed by statistical tests. Significant level was considered as $P < 0.05$.

Calculation of the sample size and sampling method:

Considering the descriptive and prospective study of all patients who went under the fixation surgery of Posterior Cruciate Ligament avulsion in Shahid Beheshti Hospital in Yasuj from the beginning of 2010 to 2018, 25 patients having the inclusion criteria were included in the study.

Inclusion criteria: The patients with isolated PCL avulsion fracture having no other impairments in their affected limbs and a history of surgery or knee degenerative disease with normal opposite lower limbs and no motion limitation.

Exclusion criteria: the patients having multiple fractures in the affected or opposite limb, having no continuous postoperative follow-ups, and refused from continuing the study. The patients with the degenerative disease, motion limitation in the knee, or knee surgery were excluded.

The statistical methods of result analysis

The quantitative data were displayed in terms of mean and standard deviation while the qualitative data were shown as frequency.

Results

In a descriptive study from 2010 to the end of 2018, the patients who referred to Shahid Beheshti Hospital with a diagnosis of posterior cruciate ligament avulsion fracture and were eligible for inclusion in the study went under the open reduction internal fixation (ORIF). Some 20 patients were excluded from the study for a variety of reasons such as the lack of regular referral or lack of medical file, and finally, 30 patients were evaluated. All patients were examined by an orthopaedic surgeon at the clinic under the supervision of the relevant instructor.

The average patient's last visit was about 10 months after the surgery. The average age of patients during the surgery was 28 years (at least 18 years and maximum 50 years).

Table 1: Frequency of patients by age group

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< 20 y/o	1	4	4
	20-30 y/o	18	72	76
	30-40 y/o	4	16	92
	> 40 y/o	2	8	100
	Total	25	100	100.0
Missing	System	0	0	0
Total		25	100.0	

All the patients suffering from the disease were male. Among these patients, 15 subjects (60%) had right involvement, and 10 subjects (40%) had left involvement.

Table 2: Limping rate among the patients

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No limp	20	88	88
	Slight or periodical	3	12	100.0
	Total	25	100	100.0
Missing	System	0	0	0
Total		25	100.0	

Based on Lysholm criteria for assessing the performance of the patients who went under the surgery, those with a lysholm score of less than 65 were placed in the poor group, those with a score of 65-83 were in the fair group, those with a score of 84-94 were in the good group, and those with a score of 95-100 were in the excellent group.

Table 3: Knee locking rate among the patients

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No locking	13	50.0	53.3
	Catching sensation, no locking	11	40.6	96.7
	Locks occasionally	1	3.1	100.0
	Total	30	93.8	100.0

After the evaluations, the following results were obtained from the Lysholm criteria among the patients who went under the surgery.

Table 4: Stair climbing rate among the patients

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No problem	2	8	8
	Slight problem	23	92	100.0
	Total	25	100	100.0

After filling in the questionnaire and obtaining a biography, the patients underwent a general physical examination and knee-specific examination.

Table 5: Squatting rate among the patients

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No problem	2	8	8
	Slight	21	84	84
	Cannot beyond at 90°	2	8	100.0
	Total	25	100	100.0

Table 6: Giving way rate among the patients

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	25	100	100
	Only during vigorous activities	-	0	0
Total	25	100	100.0	

The knee examinations included the diagnostic tests for knee ligament injuries such as posterior and anterior drawer tests, Varus and Valgus stress tests, Luchman tests, and other examinations of knee stability.

Table 7: Swelling rate among the patients

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No swelling	5	20	20
	After vigorous activities	20	80	80
	Total	25	100	100.0

Pain: pain is one of the most important components of Lysholm.

Table 8: Pain rate among the patients

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no pain	1	4	4
	slight	21	84	88
	marked pain in vigorous activities	3	12	100.0
	Total	25	100	100

After performing the physical examination and grading the Lysholm criterion, these two results were compared to each other and analysed as follows.

Table 9: Lysholm knee scale

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Good	21	84	84
	Fair	4	16	100.0
	Total	25	100	100.0

A significant relationship was found between the results of the questionnaire and physical examination ($P_{\text{value}} < 0.05$).

Table 10: Lysholm scale

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	69.00	3	12	12
	71.00	3	12	24
	79.00	1	4	28
	84.00	5	12	40
	85.00	2	8	48
	86.00	9	36	84
	90.00	3	12	96
	91.00	1	4	100
	Total	25	100	100

Discussion

The posterior cruciate ligament is vital for normal knee function and is aimed at restoring the normal movement of the joint and returning the patient to previous activity to prevent the secondary arthrosis

[3]. The main objective of this study was evaluating the function of the knee of the patients with posterior cruciate ligament avulsion fracture went under the open surgery by distal thread screw No. 4 and comparing it to the normal knee of the same patient.

Table 11: Posterior drawer test

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Normal	4	16	16	16
	< 5 mm post translation	18	72	72	88
	5 mm-10 mm	3	12	12	100.0
	Total	25	100	100.0	

Since the most common cause of posterior cruciate ligament avulsion fracture is the motorcycle accidents and because women are less involved in these accidents, the gender distribution of this type of fracture was justified in this study [7]. In the study of Lysholm, 21 subjects (84%) gained a good score, and 4 subjects (36%) were relatively good (Tables 11 and 12). The posterior cruciate ligament avulsion fracture from the junction to tibia includes a subgroup of posterior cruciate ligament impairment.

Table 12: Comparison of clinical examination and Lysholm knee scale

		Lysholm score		Total
		good	fair	
Posterior drawer test	Normal	0	0	4
	< 5 mm post translation	12	3	15
	5 mm-10 mm	2	4	6
Total		18		25

$P_{value}=0/04^*$

The patients with posterior cruciate ligament avulsion fracture undergo non-surgical treatment if they have a small fragment while surgical treatment and fracture fixation will be used in the patients with large or displacements of more than 10 mm in width [8], [9]. The present study indicated no or very little instability after surgery and bone healing as well as the long-term functional capacity were satisfactory. Some 25 patients who referred to the orthopaedic unit of Shahid Beheshti Hospitals in Yasuj due to a knee injury during 2010-2018 were examined, and their posterior cruciate ligament avulsion fracture was diagnosed. These subjects were in the age range of 18 to 50 years old with an average age of 28.5 and a mean of 26. In the study of M Ali et al., in Bangladesh, the age range of patients was estimated from 19 to 35 years and an average age of 27 years [4]. In the study of Sergio Rocha Piedade et al in Brazil, the age range of patients was between 15 and 53 years old and the average age was 30 years [11] indicating that the average age of the patients in this study was significantly lower than the average age of these patients. This fact can be attributed to the prevalence of motorcycle use among young people as well as the prevalence of car accidents in this age range.

The degree of trauma to the affected limb showed that the incidence of posterior cruciate ligament avulsion fracture in the right limb was more than the left limb (60% vs 40%). Another study conducted in Tennessee, the USA showed the trauma

to the posterior cruciate ligament in the left limb more than the right limb (72% vs 28%) [12]. The statistics showed that 96.7% of the cause of posterior cruciate ligament rupture was due to trauma caused by accident or overturning of the vehicle which was reported as 100% in the study of Farzad Omidi et al. in Mashhad and 76% in the study of Sergio Rocha Piedade [8], [11]. According to the findings of this study, the incidence of limping among the patients was 12% while 88% of patients did not experience such a complication which was roughly equivalent to the study of Greyory et al., in the USA reporting this complication in 12% of patients [13]. The examination of patients for posterior drawer test showed that 88% of the tests were normal and close to normal, which was reported by Greyory and Lipscomb as 46% and 86% respectively [13], [12].

The present study showed that 12% of patients had severe pain when walking, and 88% of patients did not feel pain or had no significant pain in their knee that had gone under surgery. About 8% of the patients could not sit squatting, and the rest of the patients had no significant sign of being in this position. Also, the statistics showed that 8% of patients suffered from knee swelling and no one patient felt knee giving way while walking. In the study of Dandy and Pusey which was performed on the patients with posterior cruciate ligament trauma who had not undergone surgery and treated by long leg casting, 70% had early onset of pain while walking, 55% while squatting, 20% knee swelling and 95% knee giving way [10]. Lysholm knee scale is a standard scale that can be used to estimate the success rate of surgery and postoperative complications based on the patient's symptoms (can be completed and filled by patient and therapist). In this scale, the parameters such as limping, need or lack of need to support while standing and bearing weight, the ability of stair climbing, the ability to bend the knee gradually in the standing position, the knee stability and instability, swelling, and pain were evaluated. In the conducted survey, 84% of the patients had acceptable scores the majority of whom scored 86 points. The Lysholm score reported in Greyory et al., [13] was 91.2 while the score reported in Maiani et al., in Italy was 8 ± 94 , which was not significantly different from the present study [14]. In the conducted study, 100% of the patients did not complain about knee locking while moving and 43.3% of them had knee cramp without locking while no one person (4%) had knee locking at the time of walking.

Furthermore, 88% of patients had mild pain while climbing the stairs and the others climbed the stairs without any problems. In addition, 100% of the patients were able to move without the need for a cane or crutch. In the study of Katchuyi et al., in Mashhad, 58% of patients had no problems with postoperative problems which were not significantly different from the present study [9].

Positive posterior drawer test and the results

of the questionnaire (relatively good and close to normal) were one of the considerable issues in this study and other similar studies, such as the study by Rezazadeh et al., [15] or Sergio Rocha et al., in Brazil [11]. Such results were not expected by assuming that the present study investigated the posterior cruciate ligament avulsion considering the preliminary design of the study. For example, the patients who had positive or near-normal posterior drawer test results, in addition to the score of the relatively good, some of them also had a good score while it was expected to have fairly good and poor scores. Various reasons can be identified based on the results of this study and similar studies including the hidden trauma to the posterior knee capsule such as posterior knee ligament trauma, a disorder in distal junctions of semimembranosus muscle and some mild traumas in the meniscus. By considering these factors in future studies, the error probability can be minimised. The Lysholm knee score in the present study was not significantly different from other studies [11], [13], [15], [16], and most patients achieved a good and acceptable score after the surgery. The patients in this study had no problem with knee joint instability and disabling functional disorder compared to their normal knee. However, they had little disability in knee movements, especially in their exercises and activities which were more than usual.

In conclusion, considering the clinical results after the fixation of the posterior cruciate ligament avulsion fracture, which is significant, improved the patient's function, the surgical procedure can be considered as an acceptable and effective method for the injury and fracture. The clinical results obtained from the physical examination of the knee and the score of the questionnaire indicated that the trauma to the posterior cruciate ligament avulsion fracture is not merely a bone fracture and must be considered as a bone ligament trauma.

The relatively short-term follow-up of patients was one of the limitations of this study, and different results may be obtained in the long-term follow-ups. However, this issue was acceptable in a follow-up of at least 6 months because of this prospective study. The relatively low number of patients can affect statistical strength. However, the number of available patients was the same.

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