

Effect of the Rehabilitation Program on knee Range of motion and muscle power after Anterior Cruciate Ligament Reconstruction Surgery

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ABSTRACT

Aim: To examine the effects of rehabilitation on knee ranges of motion and muscle power after ACL reconstruction surgery.

Method: In this study, 40 participants were examined who had ACL reconstruction. Research data was collected from the records since 20th May 2022, 2022 to 10th November, 2022 from Jinnah Hospital, Lahore. An ordinary follow-up examination was conducted at 1st, 3rd and 6th week after procedure (Follow up rate was 90%). Range of motion were assessed and compared using statistical analysis. Level of significance was set at $p < 0.001$.

Results: The study revealed that out of 40 participants, 13 (32.5%) were in the age range of 18-25 years, 2 (5%) were in the age range of 26-33 years and 5 (12.5%) were in the age range of 34-40 years with minimum age of 18 years and maximum age of 40 years. Out of 40 Participants, 37(92.5%) were males and 3(7.5%) females were included in the study. Of 40 participants, 3(7.1%) had complications and difficulty in returning to healthy lifestyle after ACL surgery. There was significant difference between flexion and extension of knee across time. ($p < 0.001$)

Conclusion: The study reported that physical therapy rehabilitation post ACL reconstruction surgery greatly improved Knee flexion and extension range of motion. Post-operative complications were not reported in the majority of participants. Therefore, it is suggested that physical therapy rehabilitation is important for the return of knee function post ACL surgery.

Keywords: ACL reconstruction, Rehabilitation, Knee Ranges, Muscle Power

INTRODUCTION

The anterior cruciate ligament (ACL) is one of the primary knee stabilizing structures¹, functioning to prevent excessive anterior tibial translation and internal rotation². Sports competitions and recreational activities are enjoyed by more than 212 million people globally³. Annually, 3% of crude athletes tear their ACL, necessitating surgical repair⁴. These injuries are widespread in exercise and sports⁵. Rupture of the anterior cruciate ligament is a serious and life-threatening form of knee injury (ACL)⁶.

The anterior cruciate ligament is a crucial sensory organ that provides proprioception, sets off defence and muscle reflexes, and stabilizes the body⁷. ACL injuries are very common among athletes who compete in cutting, pivotal, or hopping sports like, soccer, team handball or basketball over the course of their careers⁸. Anterior cruciate ligament (ACL) rupture was traditionally believed to be infrequent events in young individuals, with tibial spine avulsion fractures presumably reflecting the similar damage in patients with open physes⁹. According to research, female athletes in basketball and soccer have a 3x higher incidence rate than male athletes, and the annual ACL injury rate might reach 5%⁸. ACL reconstruction (ACLR) and anterior cruciate ligament (ACL) injuries in young athletes have been rising significantly. Furthermore, and perhaps more concerning, adolescent athletes appear to be particularly vulnerable to subsequent ACL injuries upon returning to sports, with recorded reinjury rates as high as 30%¹⁰.

For anterior cruciate ligament tears, anterior cruciate ligament reconstruction is a frequent therapeutic option that can maximize recovery to the level before the injury⁷. Many people who have suffered an anterior cruciate ligament (ACL) damage have reconstructive surgery to help their knees regain stability and function, however even after an ACL reconstruction (ACLR), movement asymmetries persist for at least six to twelve months¹¹.

Approximately 175,000 anterior cruciate ligaments (ACL) reconstructions are carried out annually to restore the anatomy of the knee and enabling individuals to continue existing physical interests¹². Quadriceps inhibition and weakening are evident during anterior cruciate ligament (ACL) repair (ACLR)¹³.

Maximizing stability and functional capability while enabling a secure return to sport are the main objectives of anterior cruciate ligament restoration (ACLR)⁴. In order to help athletes successfully resume their pre-injury activities, address postoperative

neuromuscular impairments, address predictors of a second knee injury and enhance limb symmetry, the anterior cruciate ligament-specialized post-operative return-to-sports (ACL-SPORTS) training programme was created. The training programme was created using primary ACL injury prevention strategies that have been effective¹².

Postoperative rehabilitation is a vital part of healing from an ACLR, promoting positive outcomes by enhancing function and lowering the prevalence of adverse outcomes for secondary or recurrent ACL injuries¹⁰. The majority of Return to Sports discharge criteria contain a mix of the following: time after surgery, subjective reports of function, assessments of the strength of the lower extremities, functional tests (such as the hop test), and/or the quality of the lower limb motions¹⁴. Following ACL Reconstruction, participants exhibit a "stiffened knee" gait pattern that is defined by smaller peak knee flexion (PKF) moments and smaller peak knee flexion (PKF) angles during the stance phase of walking¹⁵. Vibration training can be safely added into the postoperative rehabilitation regimen following ACLR, based on the data. Patients may benefit from accelerated rehabilitation in the near term. Open kinetic chain workouts may provide extra benefits in terms of strength and endurance¹⁶. Postoperative functional braces are believed to protect the graft and restore normal tibiofemoral joint mechanics after an ACL reconstruction by lowering, rotatory, valgus and translational loads across the knee¹⁷. Blood flow restriction training (BFRT) has been proposed as a viable treatment for the strengthening of quadriceps muscles¹⁸.

In order to completely recover from an ACLR, postoperative rehabilitation is essential because it improves function and lowers the risk of negative outcomes from subsequent or repeated ACL injuries. The Significance of this research was to determine how rehabilitation affected the range of motion in the knee after ACL surgery.

A smaller population was used for the experimentation. Further research might have been done on larger population. Furthermore, some other techniques or modalities might have been used on patients on larger scale.

The purpose of this study was to examine the impact of rehabilitation on knee ranges of motion following ACL repair surgery.

Anterior cruciate ligament (ACL) is one of the Primary knee stabilizing structure. ACL tears happen to 3% of amateur athletes each year, needing surgical repair. Postoperative rehabilitation is a crucial component of recovering from an ACLR because it

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enhances function and reduces the likelihood of adverse consequences from subsequent or repeated ACL injuries.

MATERIAL AND METHODS

Study Design: An Original Article- Case Series was conducted in Jinnah Hospital, Lahore. Data was collected from 20th May 2022 to 10th November 2022 with Non-Probability Convenient Sampling technique. Study was Approved from ORIC (Office of Research Innovation and Commercialization), UMT (University of Management and Technology) on May 19th, 2022 with Ref No. RE- 0182022.

Participants: A total of 40 participants after ACL reconstruction Surgery ACLR, Of both genders were enrolled in this study.

Inclusion Criteria: The population included patients with ACL injuries and who had undergone reconstruction surgery and completed a rehabilitation program at Jinnah hospital Lahore whose Age was from 15 to 45 years.

Exclusion Criteria: Patients with pure injuries of the menisci or other collateral ligaments and those who were younger than 15 years and older than 45 years were excluded.

Approach: Data was collected using goniometry for measuring Range of motion of knee and Manual Muscle Testing for measuring muscle power of knee muscles. The data was analyzed using SPSS version 23 using ANOVA for assessing knee flexion and extension ranges across time.

RESULT

The study revealed that out of 40 participants, 13(32.5%) were in the age range of 18-25 years, 22(55%) were in the age range of 26-33 years and 5(12.5%) were in the age range of 34-40 years with minimum age of 18 years and maximum age of 40 years. Out of 40 Participants, 37(92.5%) were males and 3(7.5%) females were included in the study. 10(25%) participants had below normal and 30 (75%) had normal flexion range of knee at 1st week post-

op, 10(25%) participants had below normal and 30(75%) had normal flexion range of knee at 3rd week post-op and 35(87.5%) participants had normal and 5(12.5%) had above normal knee flexion range at 6th week post-operatively. 30(75%) participants had normal and 10(25%) had above normal Extension range of knee at 1st week post-op, 35(87.5%) participants had normal and 5(12.5%) had above normal Extension range of knee at 3rd week post-op and 35(87.5%) participants had normal and 5 (12.5%) had above normal knee extension range at 6th week post-operatively. Out of 40 participants, 3(7.1%) got infection following ACLR and difficulty in returning to healthy lifestyle after ACL surgery. There was significant difference between flexion and extension of knee across time (p<0.001).

Fig. 1: Histogram of mean ranges of Knee Flexion on 1st week post-op, 3rd Week Post-op and 6th Week post-op

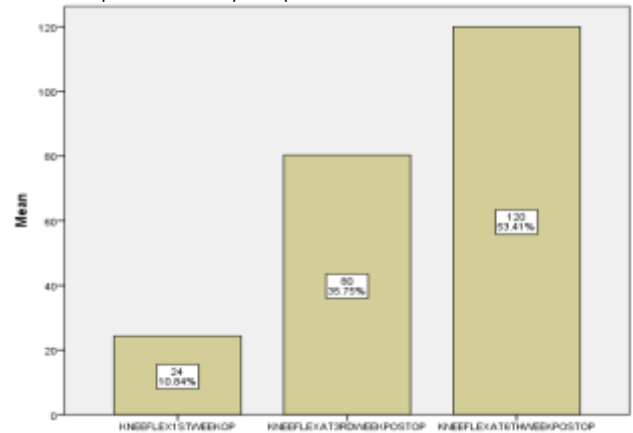


Table 1 Demographics of participants.

	N	Minimum	Maximum	Mean±SD
Knee Flexion at 1st week Post Op	40	17	30	24.35 ± 4.216
Knee Extension at 1st week Post Op	40	0	5	.93 ± 1.716
Knee Flexion at 3rd week Post Op	40	50	90	80.30± 9.646
Knee Extension at 3rd week Post Op	40	0	3	.30± .823
Knee Flexion at 6th week Post Op	40	112	130	119.98±5.081
knee extension at 6th week post op	40	.00	.00	.0000±.000
Knee Flexor Muscles power at 6th week post op	40	3	3	3.00±0.00
Knee Extensor Muscles power at 6th week post op	40	4	4	4.00±.000
Age	40	18	40	27.78±5.64
Valid N (list wise)	40			

Table 2 Knee Ranges at 1st,3rd and 6th week post-operatively

	Mean + SD	Below normal	Normal	Above normal	P value
Flexion 1 st week post op	24.35 ± 4.216	10 (25%)	30 (75%)	0	<0.001
Flexion 3 rd week post op	80.30± 9.646	10 (25%)	30 (75%)	0	
Flexion 6 th week post op	119.98±5.081	0	35 (87.5%)	5(12.5%)	
Extension 1 st week post op	.93 ± 1.716	0	30 (75%)	10 (25%)	<0.001
Extension 3rd week post op	.30± .823	0	35 (87.5%)	5(12.5%)	
Extension 6 th week post op	.0000±.000	0	35 (87.5%)	5(12.5%)	

DISCUSSION

In 2019, Mohsen Mardani et al conducted a study on 28 patients who underwent ACL reconstruction Surgery. Out of them, 21 Patients were males and 7 patients were female. All the patients had Normal Flexion and Extension ranges after 6 weeks post-operatively. There was significant difference between flexion and extension of knee across time. This is in accordance with our study which stated that out of 40 participants, 35 (87.5%) participants had normal and 5 (12.5%) had above normal knee flexion range at 6th week post-operatively and 35 (87.5%) participants had normal and 5 (12.5%) had above normal knee extension range at 6th week post-operatively (Table 2). Out of 40 Participants, 37 (92.5%) were

males and 3(7.5%) females were included in the study (Table 1). 3(7.1%) of the 40 individuals had problems and had trouble resuming a healthy lifestyle following ACL surgery. There was significant difference between flexion and extension of knee across time. (p<0.001)¹⁹.

In 2022, Abbas Khan et al conducted a study on 60 patients who underwent ACL reconstruction surgery. He studied them for a period of 6 months with 51(85%) males and 9(15%) females with the mean age of 33.7±5.21 Years. Out of 60 Patients, 20 patients (33.33%) were between the ages of 18 and 30 years; 30 patients (50%) were between the ages of 31 and 45 years; and 10 patients (16.67%) were between the ages of 46 and 60 years. The prevalence of infection was 2(3.33%), according to data from 60

patients who had arthroscopic ACLR utilizing hamstring autograft. Deep joint infection was noted in both patients 2(100%) with postoperative infection, according to the kind of infection. This is in accordance with our study which stated that out of 40 participants, 13(32.5%) were in the age range of 18-25 years, 22(55%) were in the age range of 26-33 years and 5(12.5%) were in the age range of 34-40 years with minimum age of 18 years and maximum age of 40 years. Out of 40 Participants, 37 (92.5%) were males and 3(7.5%) females were included in the study. Out of 40 participants, 3(7.1%) had infection and difficulty in returning to healthy lifestyle after ACL surgery²⁰ (Table 1).

In 2021, Yong Hao et al conducted a study on 595 participants with 450(76%) males. The several assessments showed a nonlinear improvement with time, with significant benefits seen in the first 2-4 months following surgery. Greater knee flexion range-of-motion, quadriceps strength, and self-efficacy over time were all substantially (P values <0.01). This is in accordance with our study which stated that 10(25%) participants had below normal and 30(75%) had normal flexion range of knee at 1st week post-op, 10(25%) participants had below normal and 30(75%) had normal flexion range of knee at 3rd week post-op and 35(87.5%) participants had normal and 5(12.5%) had above normal knee flexion range at 6th week post-operatively. 30(75%) participants had normal and 10(25%) had above normal Extension range of knee at 1st week post-op, 35(87.5%) participants had normal and 5(12.5%) had above normal Extension range of knee at 3rd week post-op and 35(87.5%) participants had normal and 5(12.5%) had above normal knee extension range at 6th week post-operatively. Unlike Previous study, there was significant difference between Knee flexion and extension ranges across time²¹ (Table 2).

In 2019, Baren J.E et al conducted a study on patients with ACLR. ACL reconstruction was performed on a total of 1,640 patients, 952 of whom were men (58%), with a mean age (and standard deviation) of 27.7 11.4 years (1,379 main surgeries, or 84.1%). These patients were included in the study. In 798 instances (48.7%), intraoperative vancomycin was utilized. Out of 798 patients, 1(0.1%) patient was diagnosed with infection. The use of intraoperative vancomycin resulted in a reduction in relative risk of 89.4%. This is in accordance with our study which stated that out of 40 participants, 13(32.5%) were in the age range of 18 to 25 years, 22(55%) were in the 26-to-33-year range, and 5(12.5%) were in the 34-to-40-year range. The participants' ages ranged from 18 to 40 years. Out of 40 Participants, the research comprised 37(92.5%) males and 3 (7.5%) females. 3 (7.1%) of the 40 individuals had infections following ACL surgery and found it challenging to resume a healthy lifestyle. Between knee flexion and extension with time, there was a substantial difference. (p<0.001) (Table 1)²².

COCNLUSION

The study reported that physical therapy rehabilitation post ACL reconstruction surgery greatly improved Knee flexion and extension range of motion. Post-operative complications were not reported in the majority of participants. Therefore, it is suggested that physical therapy rehabilitation is important for the return of knee function post ACL surgery.

Ethical consideration: Ethical approval of all procedures performed in studies involving human participants was per the ethical standards. Written Informed consent was obtained from all individual participants included in the study.

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Authorship and contribution Declaration: Each author of this article fulfilled following Criteria of Authorship:

1. Conception and design of or acquisition of data or analysis and interpretation of data.
2. Drafting the manuscript or revising it critically for important intellectual content.
3. Final approval of the version for publication.
4. All authors agree to be responsible for all aspects of their research work

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