The Effect of Preoperative Physiotherapy Interventions on Postoperative Outcomes in ACL Reconstruction Patients in Palestine.

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ABSTRACT
Anterior cruciate ligament injuries are common among athletes, resulting in serious injuries and prolonged rehabilitation. They affect the stability and knee activities, necessitating surgical intervention and rehabilitation. The study aims to provide empirical evidence on the effectiveness of pre-operative physiotherapy interventions in enhancing post-operative outcomes in ACL reconstruction patients. Methods: A cohort of 42 patients from orthopedic clinics were divided into two groups: group A, who received Preoperative physiotherapy, and group B, who didn't receive Preoperative physiotherapy. Participants were evaluated using Visual Analogue Scale (VAS) to evaluate pain, goniometry for assessing range of motion, and Lysholm knee scoring scale for functional disability. Participants in group A received physiotherapy for four weeks pre-operative, three sessions per week, both groups received physiotherapy for six weeks post-operative, three sessions per week, and after six weeks post-operative evaluation was conducted for both groups to compare the results. The study compared the effect of preoperative physiotherapy in ACL reconstruction patients with no preoperative physiotherapy. Findings revealed significant improvements in post-operative outcomes in both groups. Pre-operative physiotherapy group had more reduced pain levels, improved range of motion, and better functional capacity, compared to the None re-operative intervention group. Without pre-operative intervention group, also had reduced pain levels, improved range of motion, and functional capacity. A study found that both groups improved significantly in pain levels and range of motion, and functional capacity, with superiority for pre-operative physiotherapy group
Keywords: ACL, pre-operative physiotherapy, pain, Lysholm score

1.0 INTRODUCTION

The anterior cruciate ligament (ACL) is a crucial ligament in the knee, with around 200,000 individual injuries per year, which are common and debilitating for athletes. It can arise through contact or non-contact methods and is more common in sports that involve deliberate contact. The association between the amount of contact in a sport and the likelihood of ACL injury is uncertain, especially when gender is

a factor. Female soccer players had the highest rate of ACL injury, followed by minimal contact and noncontact sports such as alpine skiing and gymnastics (Li et al., 2020; Montalvo et al., 2019).

Annual ACL injury rates in girls and women have remained stable, while they have declined in boys and men. This suggests that biological causes alone may not be enough to improve outcomes for these groups. Girls and women were 3-6 times more likely than boys and men to sustain life-altering injuries (Parsons et al., 2021) .

The ACL deficit causes anterior and rotatory instability in the knee joint. The most frequent mechanism of injury occurs when pivoting, cutting, and jumping while the knee is slightly flexed and in valgus position. To explain non-contact ACL injuries, several risk factors have been found. These risk factors can be divided into two groups: extrinsic or environmental (weather, playing surface, sport level, etc.), and intrinsic, or those that are specific to an individual (anatomic, neuromuscular, biomechanical, physiological, psychological, and genetic) (Dauty et al., 2022; Diermeier et al., 2020).

Physicians may prescribe medications like anti-inflammatory drugs, muscle relaxants, pain relievers, and physical therapy for specific treatment, exercises, strengthening exercises, hot, and ice packs (Hunt et al., 2021; Saivineesha et al., 2022).

The significance of optimal post-operative outcomes after ACL reconstruction patients cannot be overstated. Successful outcomes encompass pain reduction, restoration of joint range of motion, enhanced muscle strength, and the ability to regain functional activities. These outcomes contribute to improve patient satisfaction, reduced healthcare costs, and minimize risks of complications (Brinlee et al., 2022; Shen et al., 2022; Taylor et al., 2020).

The concept of pre-operative physiotherapy intervention has gained attention as a potential strategy to enhance post-operative outcomes. Pre-operative physiotherapy programs aim to improve muscle strength, joint stability, proprioception, and overall physical conditioning before surgery (Carter et al., 2020; Cunha & Solomon, 2022; Kochman et al., 2022).

In a recent systematic review (2020), about the effectiveness of pre-operative rehabilitation programs on post-operative outcomes following ACL reconstruction, they reported the use of muscular strengthening exercise, balance and perturbation training pre-operatively. They reported that studies included in the review found that those programs offered a small benefit to quadriceps strength and single leg hop scores three months after ACL reconstruction compared with no pre-operative physiotherapy (Carter et al., 2020).

Most of the research focuses on pain reduction, improvement of range of motion (ROM), muscle strength, and functional results post-operative without paying attention to the role of pre-operative physiotherapy in patients with ACL injuries. To fill this gap, studies are required to focus on pre-operative physiotherapy which contain strengthening, stretching, proprioception, balance, and endurance exercises in knee flexors and extensors muscles using properly designed randomized controlled trials with larger sample sizes, standardized intervention protocols, and validated outcome measures. This would provide physical therapists with more reliable information to work with when deciding which treatment option is best for patients experiencing ACL injuries.

2.0 RESEARCH DESIGN

Randomized control trial study design from November 2023 to March 2024. The population consisted of patients with ACL injuries who sought treatment at Top Life physiotherapy centre and Al-Ahli Hospital. A total of 42 patients meeting the inclusion criteria were selected using a convenient sampling method. Eligibility criteria included: Age group between 18- 60 years, both male and female participants, knee joint instability and muscle weakness due to ACL injury, unilateral ACL injuries. The study included age group between 18- 60 years, both male and female participants, knee joint instability and muscle weakness due to ACL injury, unilateral ACL injuries. The excluded trials pertaining to the following ailments were disqualified: menisci injuries, multiple knee ligaments injuries, previous ACL injury for the same affected knee, bilateral ACL injuries, prior knee surgery, chronic musculoskeletal diseases (such as polyarthritis, muscle disease), vertebral fractures, cerebrovascular insufficiency.

3.0 Systematic Searching Strategies

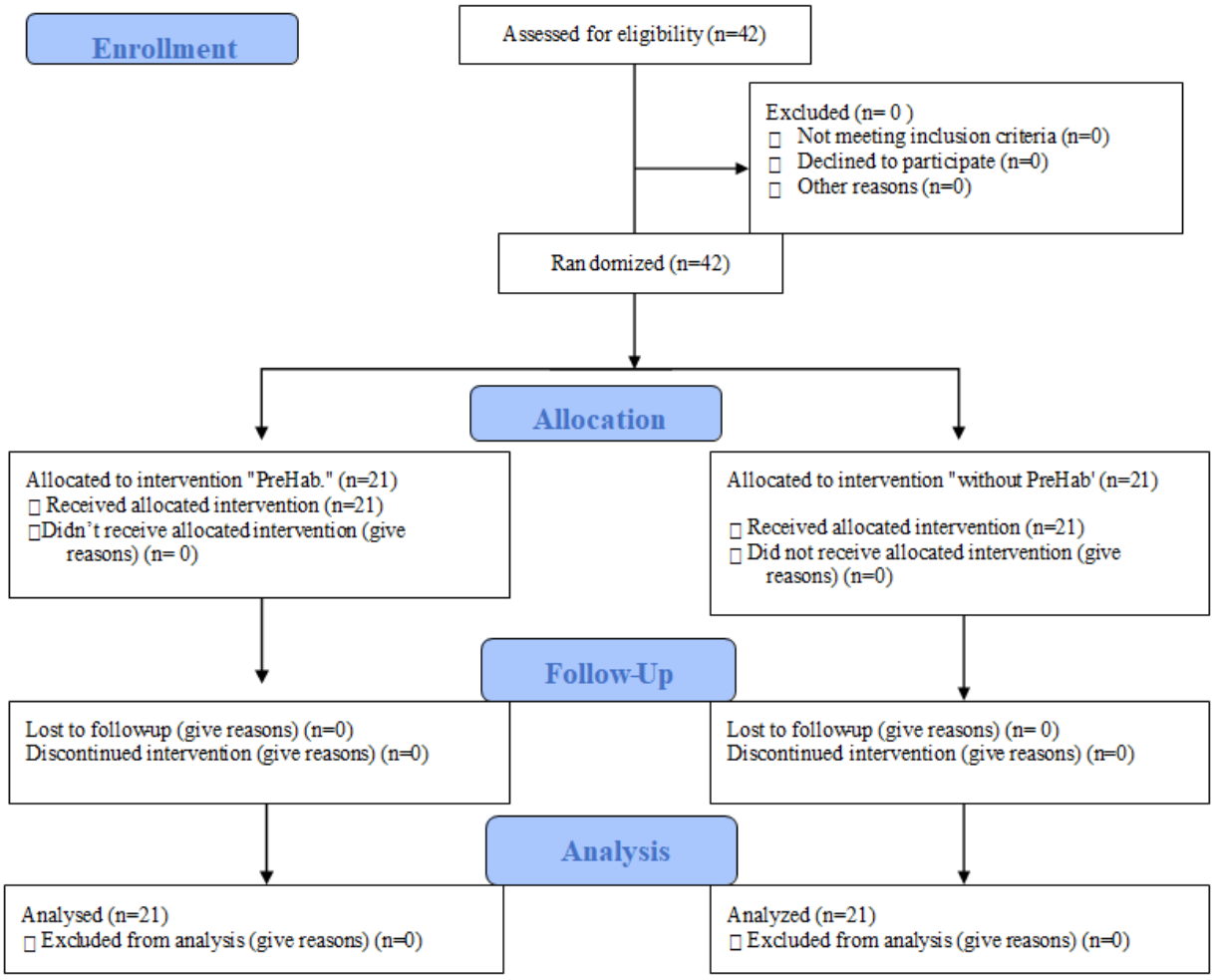

Fig 1: Flow diagram of the study.

3.1 Analysis process

The data analysis process involved a variety of software tools and statistical methods to gain insights into the research questions. SPSS 27.0 software provided a robust platform for examining differences within and between groups, while G*Power version 3.1.9.4 facilitated the calculation of test powers and effect sizes, offering valuable information on the significance and strength of the findings. Microsoft Excel was also utilized for efficient data processing tasks. Descriptive and frequency statistics were employed to delve into the main characteristics of the sample, presenting key metrics such as means, standard deviations, and percentages. Continuous variables were expressed as mean ± standard deviation, and categorical variables were represented as counts and percentages. The researcher utilized the independent samples t-test to assess the similarity of demographic data between groups. This parametric procedure allowed for robust statistical comparisons of means between two independent groups. Changes between pre- and post-treatment conditions were examined using the paired t-test for normally distributed samples.

The effect size of all tests was calculated using G*Power software, aiding in sample size determination under effect size (0.80), alpha (0.05), and power (0.80). Effect sizes typically fall within a range of small, medium, and large, with specific values indicating the strength of the effect. Interpreting results based on effect size involves considering the magnitude of the effect relative to the research context. A small effect size may be meaningful in certain contexts, especially if it aligns with theoretical expectations or has practical significance. Conversely, a large effect size suggests a robust and impactful difference that is likely to be of considerable importance. To compare the effectiveness of the two treatment groups, group A and group B, the researcher employed the independent t-test, suitable for scenarios where normality assumptions are met. Lastly, relationships between continuous variables were explored through Spearman or Pearson correlations, providing additional insights into the strength and direction of relationships within the data.

4.0 RESULTS AND ANALYSIS

The purpose of this study was to investigate the effectiveness of pre-operative physiotherapy interventions on pain, range of motion and function disability after Anterior cruciate ligament reconstruction (ACLR) in patients with Anterior Cruciate Ligament (ACL) injuries in Palestine.

General Characteristics of the Subjects:

In this study, 42 patients with Anterior Cruciate Ligament (ACL) injuries were assigned randomly into two groups, 21 patients in each group.

Group A (With Preoperative Physiotherapy):

Twenty-one patients were included in this group. The data in table (1) and fig (1) represented their mean age (39.38) years, mean height (173.28) centimeters (cm), mean weight (81.57) kilograms (Kg), and mean BMI (27.13) Kg/m2.

Group B (Without Preoperative Physiotherapy):

Twenty-one patients were included in this group. The data in table (1) and Chart (1) represented their mean age (38.86) years, mean height (175.71) centimeters (cm), mean weight (79.38) kilograms (Kg), and mean BMI (27.21) Kg/m2. There was no significant difference between both groups in their ages, weights, heights, and BMI.

Table 1: Comparison of demographic characteristics between groups

	Mean± SD		Independent Samples Test
	With Preoperative physiotherapy	Without Preoperative physiotherapy	P-value
Age in years	39.38 ± 10.609	38.86 ± 11.368	0.878
Height	173.2857 ± 4.11270	175.7143 ± 4.50714	0.076
Weight	81.5714 ± 9.61546	79.3810 ± 6.38339	0.390
Body mass index	27.1348 ± 2.52022	27.2167 ± 2.52830	0.917

***SD: standard deviation, P: probability**

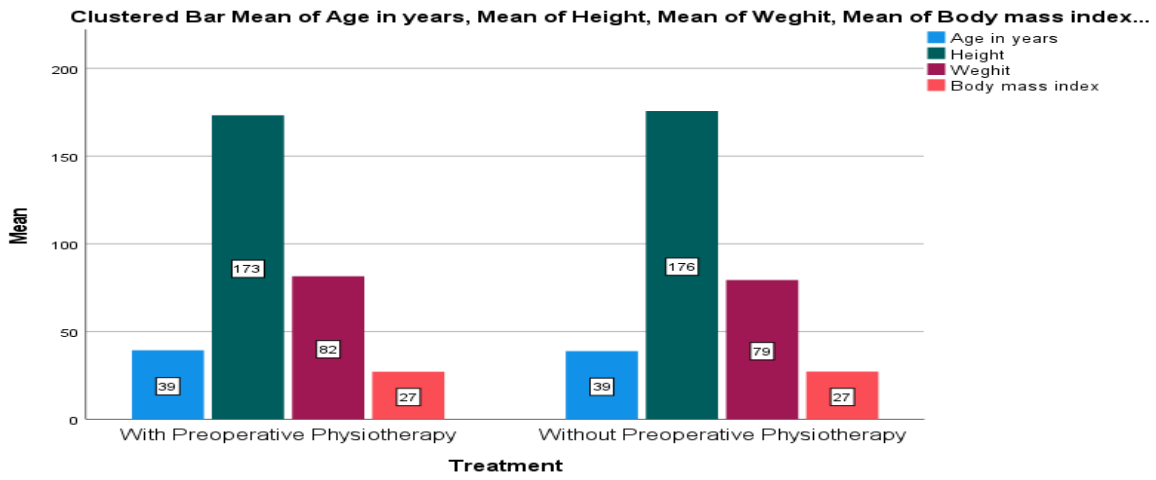

Chart 1: Mean of the age, weigh, ,height, and BMI for both groups

1) Within Subjects:

For the analysis of each dependent variable the Paired Samples Test was conducted as shown in table (2) for group A and in table (3) for group B.

For group A (With Preoperative Physiotherapy) there was a significant difference between pre and post anterior cruciate ligament reconstruction (ACLR) pain level as the pain level pre- ACLR was (6.33) and for post- ACLR was (1.62) where the p-value was (< 0.001), and there was a significant difference between pre and post ACLR for ROM as ROM pre- ACLR was flexion (84.85), limited extension by (5.09), and for post- ACLR was flexion (126.33), limited extension by (2.29) where the P-value was (<0.001), and there was a significant difference between pre and post lysholm score as pre- ACLR was (44.66%) and for post- ACLR was (82.76 %) where the P-value was (< 0.001), as shown in table (2) and Charts (2,3,4,5,6,7,8,9).

Table 2: Comparison of group A sample before and after ACLR .

Paired Samples Test (With Preoperative Physiotherapy)			
		Mean ± SD	P-value
Pair 1	VAS_PRE	6.3333 ± 1.11056	< 0.001
	VAS_POST	1.62 ± 1.071	
Pair 2	ROM_FLEXION_PRE	84.8571 ± 1.65184	< 0.001
	ROM_FLEXION_POST	126.33 ± 3.006	
Pair 3	ROM_EXTENSION_PRE	5.0952 ± .94365	< 0.001
	ROM_EXTENSION_POST	2.29 ± 1.007	

Pair 4	LYSHOLM_PRE	44.6667 ±10.57513	< 0.001
	LYSHOLM_POST	82.76 ± 7.063	

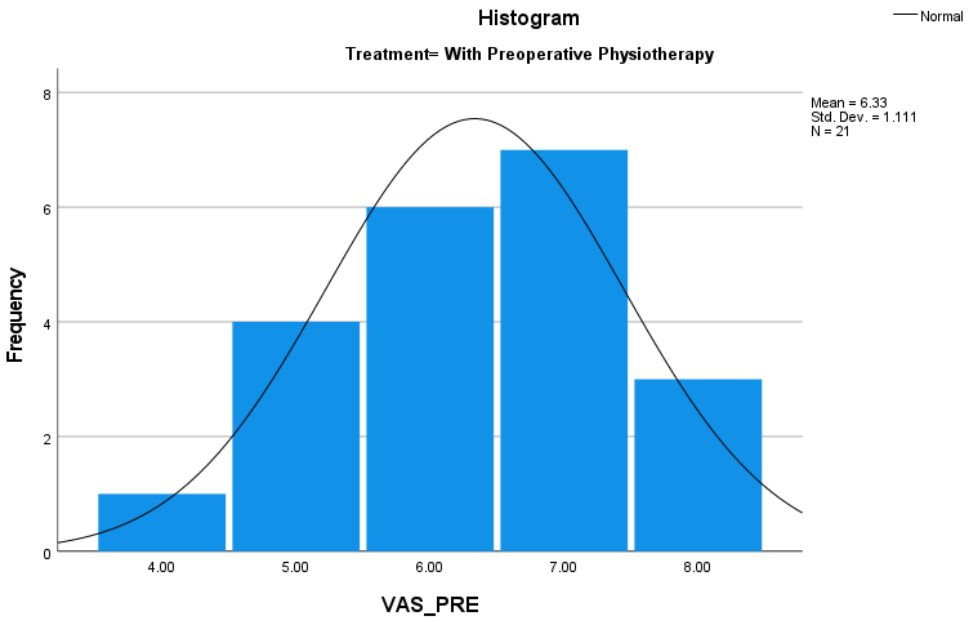

Chart 2: VAS of group A before ACLR

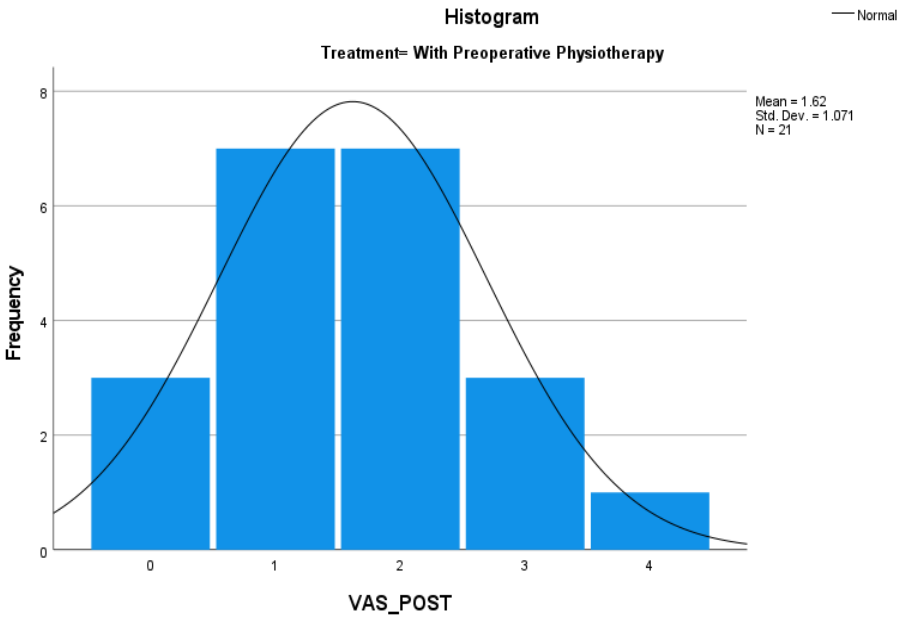

Chart 3: VAS of group A after ACLR

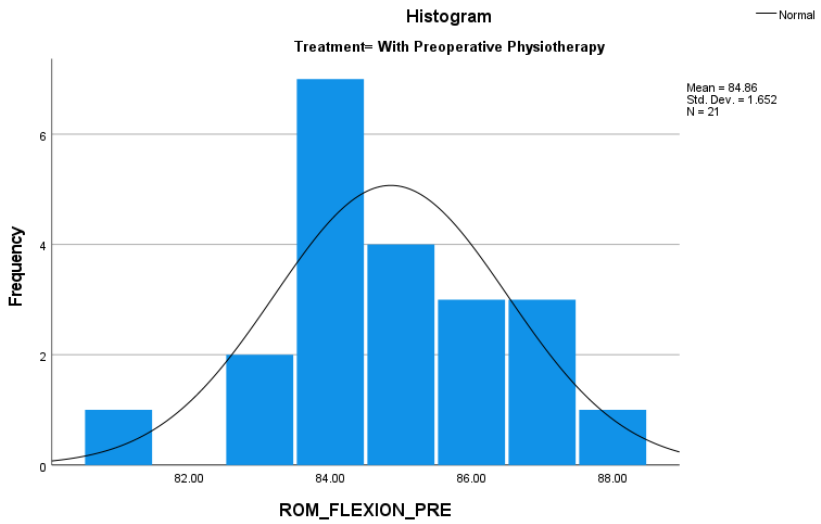

Chart 4: ROM for flexion in group A before ACLR

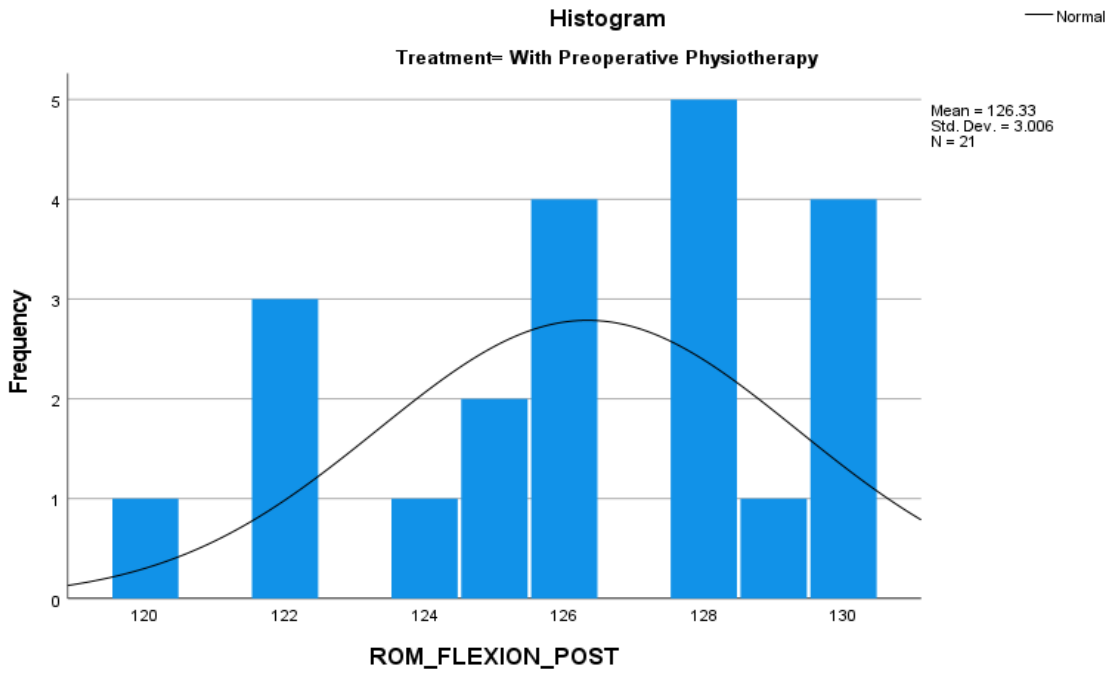

Chart 5: ROM for flexion in group A after ACLR

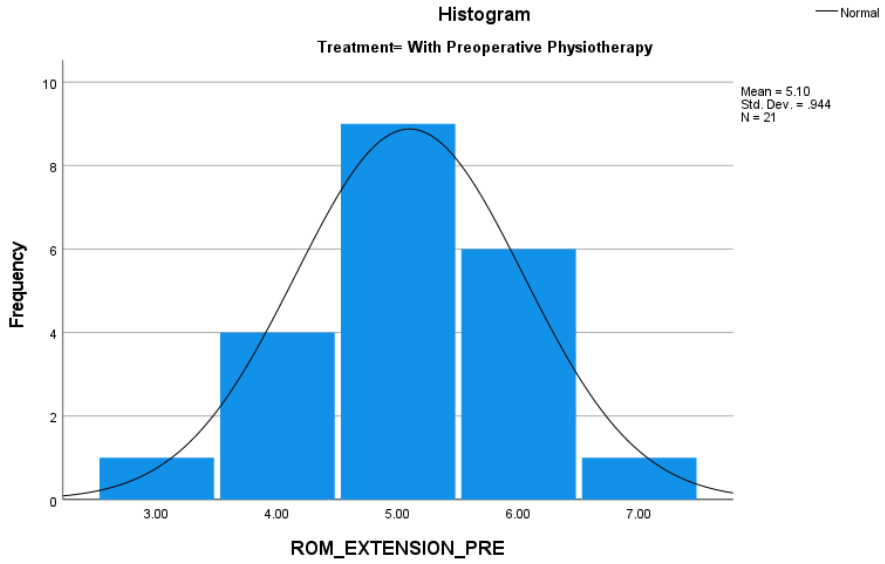

Chart 6: ROM for extension in group A before ACLR

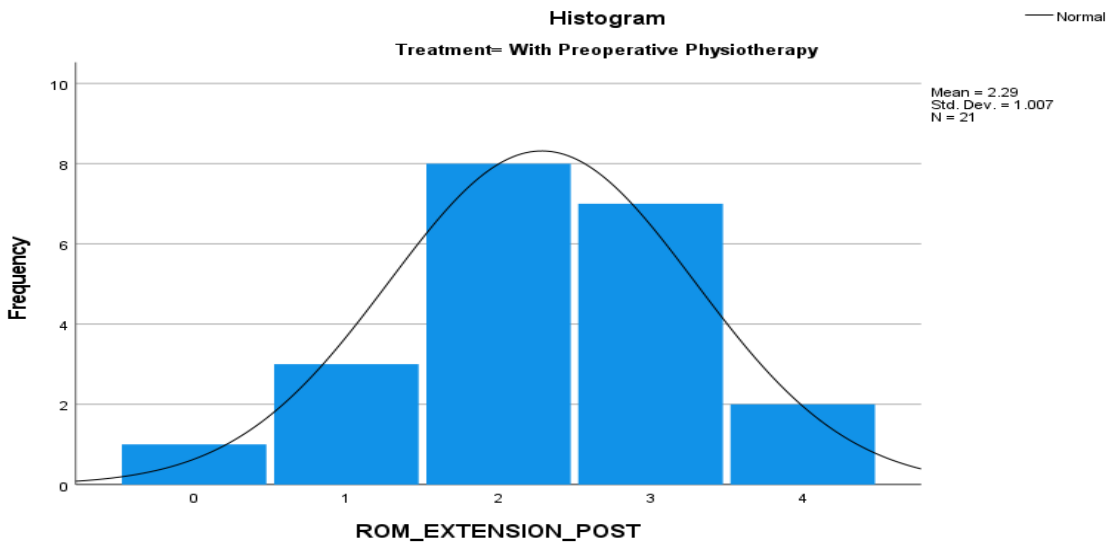

Chart 7: ROM for extension in group A after ACLR

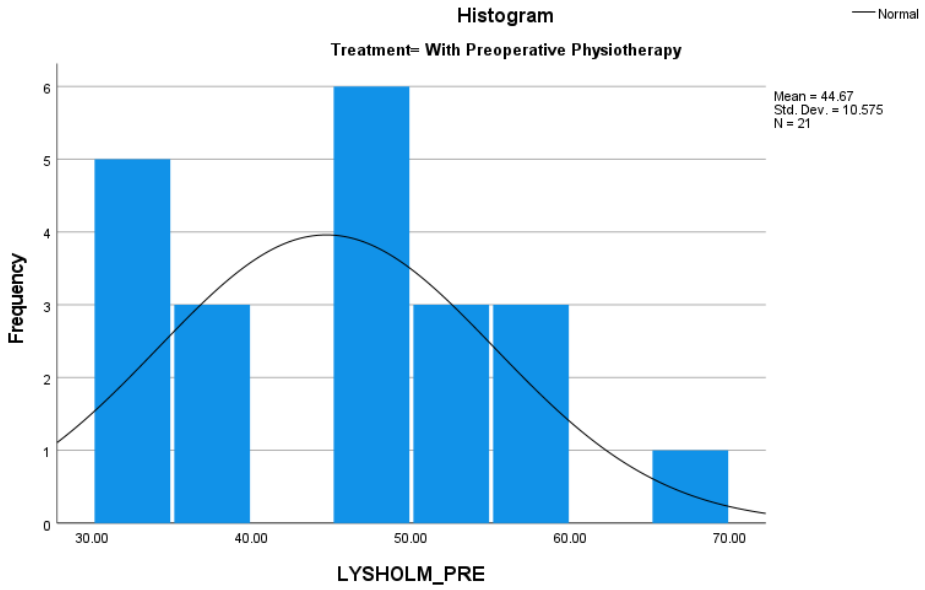

Chart 8: Lysholm score in group A before ACLR

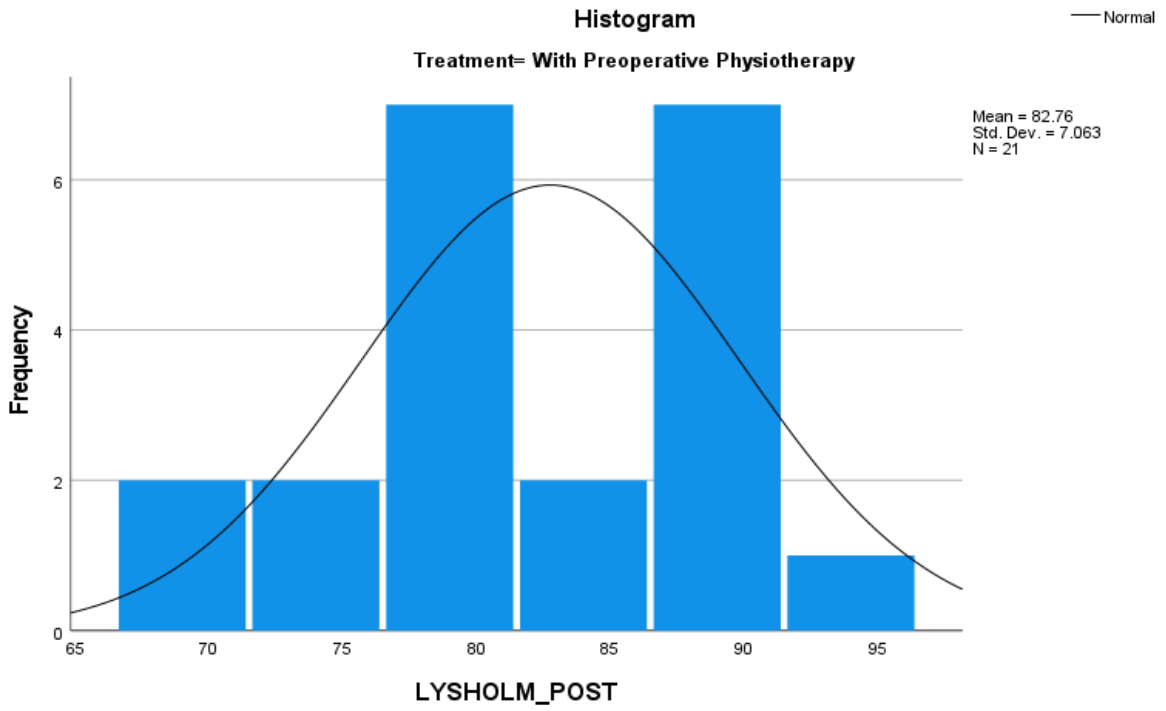

Chart 9: Lysholm score in group A after ACLR

For group B (Without Preoperative Physiotherapy) there was a significant difference between pre and post ACLR pain level as the pain level pre- ACLR was (6.28) and for post- ACLR was (4.81) where the P-value was (< 0.001), and there was a significant difference between pre and post ACLR for ROM as ROM pre- ACLR was flexion (84.42), limited extension by (5.00) and for post- ACLR was flexion (115.48), limited extension by (4.19) where the P-value was (< 0.001), and there was a significant difference between pre and post ACLR for Lysholm as pre- ACLR was (48.33%) and for post- ACLR was (60.81 %) where the P-value was (< 0.001), as shown in table (3) and Charts (10,11,12,13,14,15,16,17)

Table 3: Comparison of group B sample before and after ACLR .

Paired Samples Test (Without Preoperative physiotherapy)		
	Mean ± SD	P-value

Pair 1	VAS_PRE	6.2857 ± 1.10195	< 0.001
	VAS_POST	4.81 ± 1.030	
Pair 2	ROM_FLEXION_ PRE	84.4286 ± 1.16496	< 0.001
	ROM_FLEXION_POST	115.48 ± 2.822	
Pair 3	ROM_EXTENSION_ PRE	5.0000 ± .94868	< 0.001
	ROM_EXTENSION_POST	4.19 ± 1.030	
Pair 4	LYSHOLM_ PRE	48.3333 ± 7.57188	< 0.001
	LYSHOLM_POST	60.81 ± 8.880	

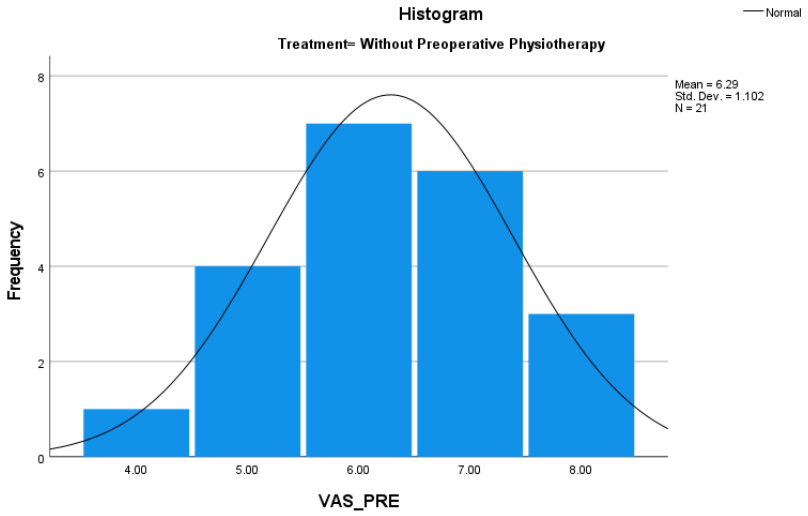

Chart 10: VAS of group B before ACLR

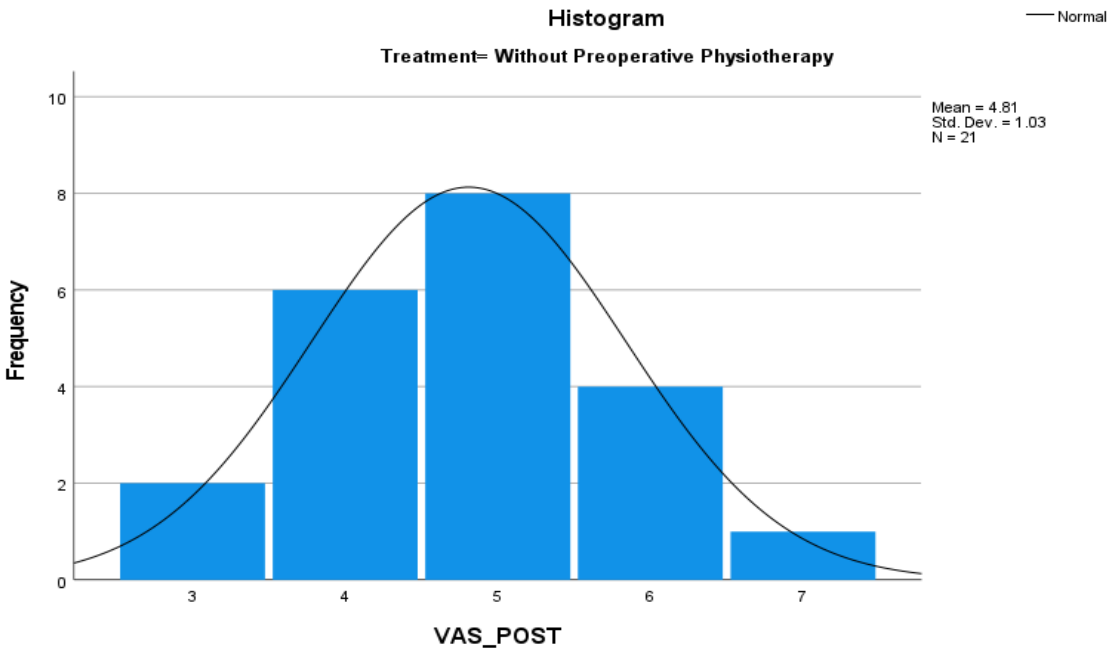

Chart 11: VAS of group B after ACLR

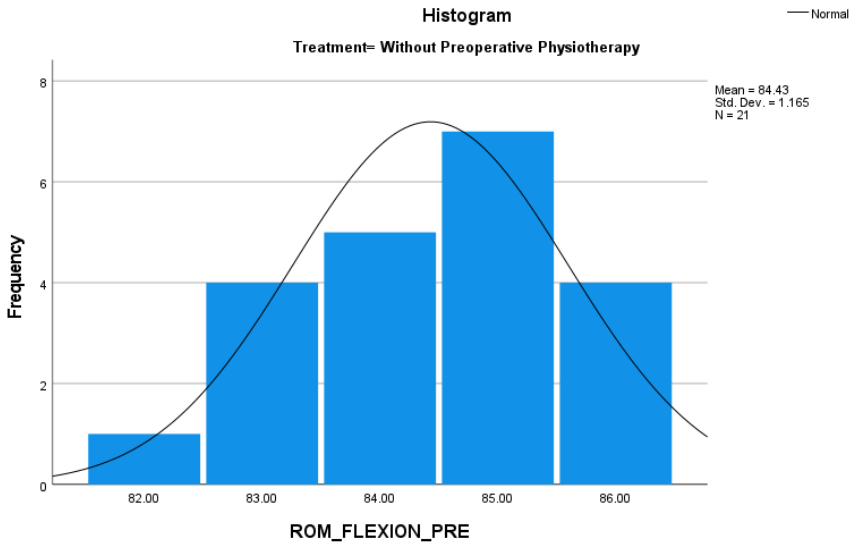

Chart 12: ROM for flexion in group B before ACLR

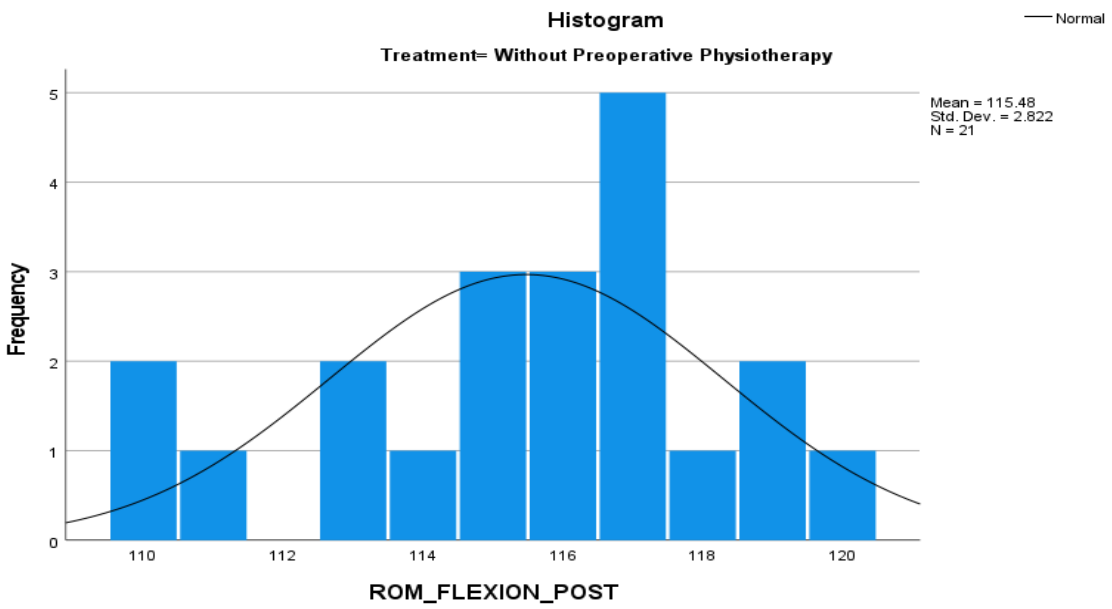

Chart 13: ROM for flexion in group B after ACLR

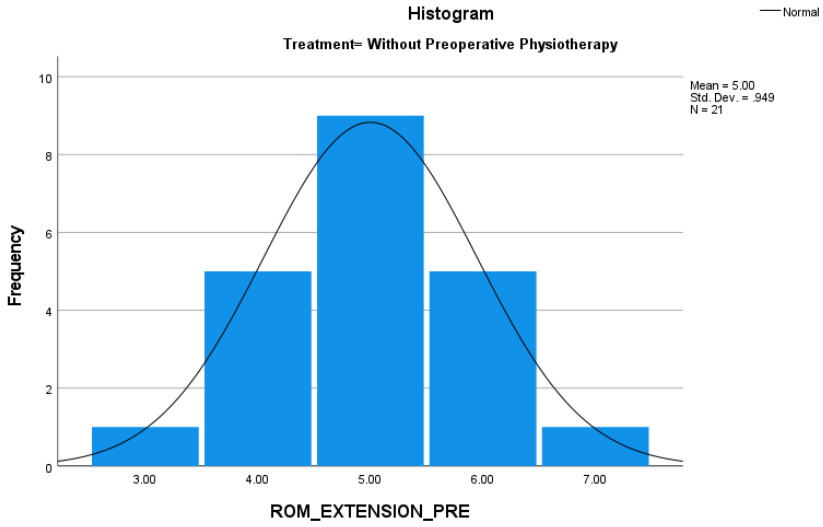

Chart 14: ROM for extension in group B before ACLR

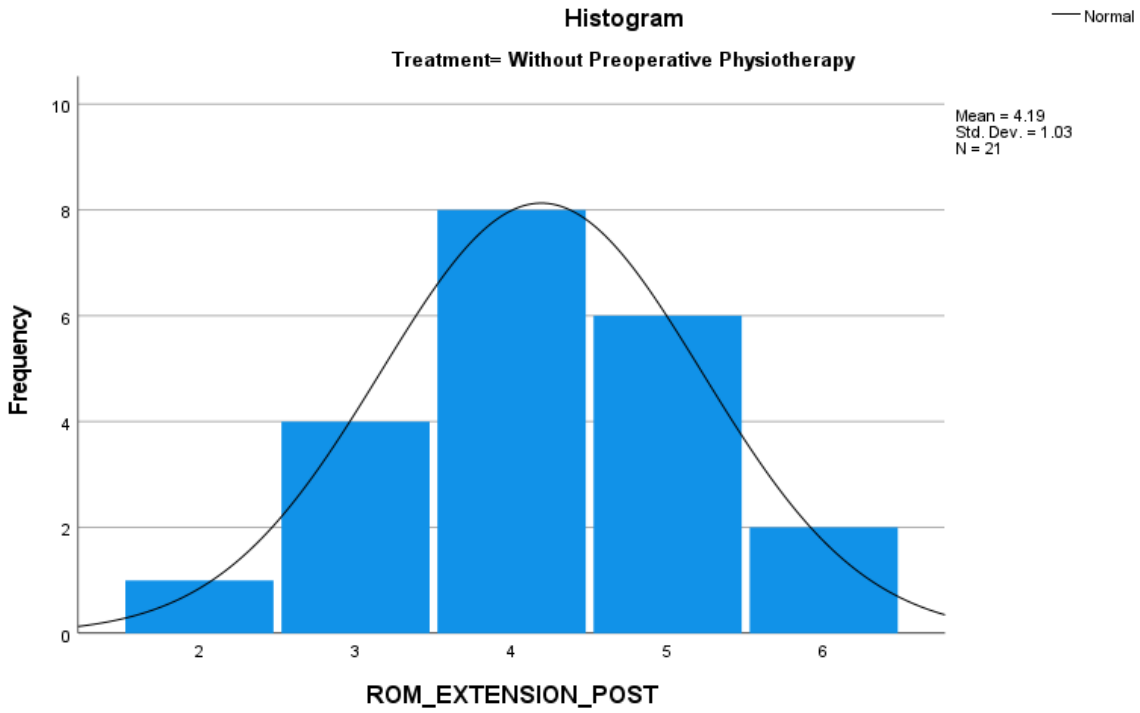

Chart 15: ROM for extension in group B after ACLR

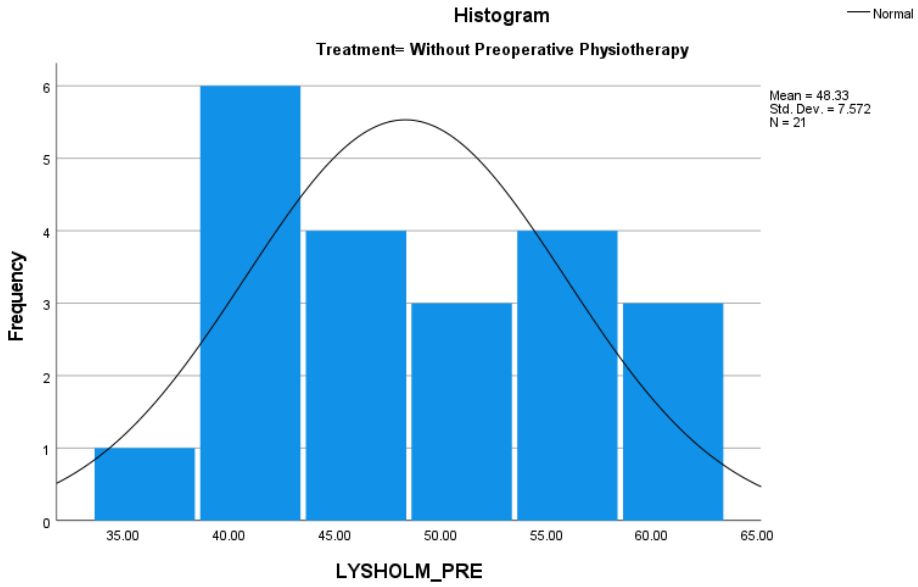

Chart 16: Lysholm score in group B before ACLR

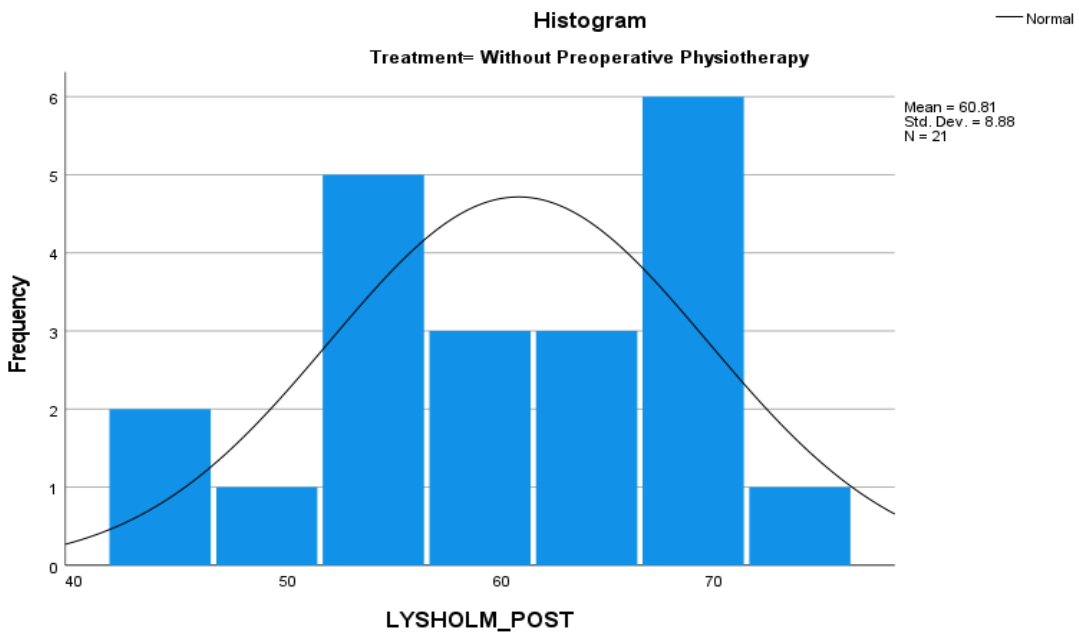

Chart 17: Lysholm score in group B after ACLR

II) Between Groups:

For the analysis of each dependent variable the Independent Samples Test was conducted.

Pre ACLR there was no significant difference between group A (With Preoperative physiotherapy) and B (Without Preoperative physiotherapy) in pain level where P-value was (0.890), and there was no significant difference between group (A) and (B) in ROM where P-value was (0.337) for flexion and P-value was (0.746) for extension and there was no significant difference between group (A) and (B) in lysholm score where P-value was (0.204) as shown in table (4).

Post ACLR there was a significant difference between group (A) and (B) in pain level where P-value was (<0.001), and there was significant difference between group (A) and (B) in ROM where the P- value was (<0.001) for flexion and P-value was (<0.001) for extension and there was significant difference between group (A) and (B) in lysholm score where the P-value was (<0.001) as shown in table (4).

Table 4: Comparison between group A and group B before and after ACLR.

	Mean ± SD		Independent Samples Test
	With Preoperative physiotherapy	Without Preoperative physiotherapy	P-value
VAS_PRE	6.3333 ± 1.11056	6.2857 ± 1.10195	0.890
VAS_POST	1.62 ± 1.071	4.81 ± 1.030	< 0.001
ROM_FLEXION_ PRE	84.8571 ± 1.65184	84.4286 ± 1.16496	0.337
ROM_FLEXION_POST	126.33 ± 3.006	115.48 ± 2.822	< 0.001
ROM_EXTENSION_ PRE	5.0952 ± .94365	5.0000 ± .94868	0.746
ROM_EXTENSION_POST	2.29 ± 1.007	4.19 ± 1.030	< 0.001
LYSHOLM_ PRE	44.6667 ±10.57513	48.3333 ± 7.57188	0.204
LYSHOLM_POST	82.76 ± 7.063	60.81 ± 8.880	< 0.001

***SD: standard deviation, P: probability**

5.0 DISCUSSION

The anterior cruciate ligament (ACL) is an important stabilizer of the knee joint. It joins the thighbone (femur) to the shinbone (tibia), preventing the shinbone from sliding forward too far. ACL injuries are among the most prevalent knee ligament injuries, frequently happening during sports that require rapid stops and alterations in direction. A ruptured ACL can cause severe pain, instability, and edema in the

knee. Treatment options for ACL injuries vary based on the severity of the rupture and the individual's needs and can range from rehabilitation activities to surgery.

The purpose of this study was to investigate the effectiveness of pre-operative physiotherapy interventions on pain, range of motion and function disability after Anterior cruciate ligament reconstruction (ACLR) in patients with Anterior Cruciate Ligament (ACL) injuries in Palestine.

In this study, the benefits of preoperative physiotherapy treatment on patients were compared with no preoperative physiotherapy treatment. The results indicated a considerable improvement in the postoperative outcomes. Pain levels decreased because of preoperative physiotherapy treatment, demonstrating the therapeutic advantages and efficacy of the therapy in treating pain. preoperative physiotherapy treatment dramatically reduced knee pain and impairment, increased ROM, and increased functional capacity with an astonishing effect size of -0.95 and p-value < 0.001. Additionally, pain level, ROM, and functional capacity were greatly enhanced with no preoperative physiotherapy. The study demonstrated an improvement in pain level, ROM, and functional capacity, underscoring the significance of preoperative physiotherapy in reducing pain level, increase ROM, and increase functional capacity. preoperative physiotherapy and no preoperative physiotherapy were both helpful in achieving the research goals, despite notable differences in the results.

Cunha & Solomon 's experimental study evaluated the effects of the ACL prehabilitation on postoperative strength and motion and return to sport in athletes. Successful ACL reconstruction surgery is based on improving a patient's knee stability, strength, and return to sport participation while limiting the chance of re-injury. These objectives are addressed by prehabilitation, which is a physical therapy program that begins before surgery. Research indicates that prehabilitation can dramatically enhance outcomes. It usually lasts at least 4-6 weeks and includes workouts that improve range of motion, quadriceps strength, and proprioception. According to some studies, delaying surgery for prehabilitation can improve outcomes even further. Overall, prehabilitation is an effective strategy for improving patient outcomes following ACL surgery (Cunha & Solomon, 2022).

Recent research evaluated the effectiveness of pre-operative rehabilitation for patients undergoing ACL reconstruction surgery. Researchers examined data from several research published between 2018 and 2023. The study found that patients who engaged in pre-operative rehabilitation programs had significantly superior long-term outcomes two years following surgery, as judged by the KOOS patient-reported outcome score. This improvement was seen in all KOOS sub-scores, including pain, symptoms, activities of daily living, sports and recreation, and quality of life. Interestingly, the short-term advantages

(3 months after surgery) were less noticeable. The study implies that pre-operative rehabilitation should be considered a standard component of ACL injury therapy to improve long-term patient outcomes after surgery (Aryana et al., 2024). Based on the study's findings, the pre-operative rehabilitation was successful in improving pain, symptoms, activities of daily living, sports and recreation, and quality of life, and it is supporting our research.

Harsh Kotecha et al. conducted prospective randomized clinical research to determine the effect of twelve weeks of preoperative physiotherapy rehabilitation on the results of arthroscopic anterior cruciate ligament (ACL) replacement surgery. The study was conducted at the MGM Medical College and Hospital in Navi Mumbai, India, with the goal of comparing functional results between patients who had pre-surgery physiotherapy and those who did not. Results from 30 participants revealed that the group receiving pre-rehabilitation had higher functional scores in terms of Tegner Lysholm and International Knee Documentation Committee Subjective Knee Form (IKDC) scores post-ACL reconstruction surgery than the non-pre-rehabilitation group. The results indicate a statistically significant link between prehabilitation and improved functional outcomes, highlighting the value of rigorous muscle strength training, plyometric exercises, and advanced neuromuscular exercises in improving postoperative outcomes. Prehabilitation should be included in the standard ACL therapy plan for patients following ACL restoration (Kotecha et al., 2022).

Yalfani et al. conducted a systematic review to investigate the efficacy of preoperative exercises on postoperative outcomes following anterior cruciate ligament (ACL) surgery. The review, which used the PubMed database, identified ten relevant studies from 1990 to 2019 that evaluated the effect of preoperative workouts on knee extensor strength and function. The study found that various preoperative activities, including conventional, strength, and neuromuscular workouts, significantly increased knee extensor strength and function in both males and females after surgery, both short and long term. The review found middling methodological quality in randomized controlled trials, with an average PEDro score of 6, and good quality in cohort studies, with CASP values ranging from 10 to 11 out of 12. The findings indicate that preoperative rehabilitation, followed by a criterion-based postoperative program, leads to better functional outcomes and faster recovery of knee extensor strength after ACL reconstruction, emphasizing the significance of preoperative rehabilitation as a standard treatment to optimize outcomes in ACL reconstruction patients (Yalfani et al., 2020).

According to Antoine Frouin et al., preoperative rehabilitation is critical in improving mental and physical well-being in people with anterior cruciate ligament (ACL) injuries. This mixed methods cross-sectional

study was conducted at multiple clinics in France with the goal of understanding the mindset and recovery expectations of persons having prehabilitation prior to ACL repair surgery. Surveys and semi-structured interviews with 25 participants revealed favorable experiences and attitudes of prehabilitation. Participants expressed hopes of avoiding re-injury and feeling confident in daily activities following surgery. They saw prehabilitation as a period of challenges, support, and self-motivation, with good effects on treatment outcomes such as faster recovery of muscle volume and strength. These findings highlight the relevance of preoperative rehabilitation in maximizing patient outcomes and are consistent with previous research on the functional benefits of prehabilitation. Integrating prehabilitation into ACL injury management procedures may improve patient experiences and treatment outcomes (Frouin et al., 2024).

For patients with ACL injury, preoperative physiotherapy is better for reducing pain, increasing ROM, and increasing functional capacity. This is because the outcome metrics are greatly impacted by their use. and the lack of set protocols or standards for these interventions is one such area of vulnerability to consider. In the lack of clear and consistent processes for their application and evaluation, evaluating the relative advantages of different processes may be challenging. The way that each person responds to different therapies may also have an impact on the outcome. When evaluating the effectiveness of preoperative physiotherapy and no preoperative physiotherapy for ACL injury, several factors should be considered.

6.0 CONCLUSION

This study was designed to detect the effect of Preoperative physiotherapy on treating patients with ACL injury, and to compare group A (With Preoperative physiotherapy) with group B (Without Preoperative physiotherapy) through detecting differences in pain intensity, range of motion and functional disability.

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