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Effects of Continuous Passive Movement versus Intermittent Compression in Patients after Anterior Cruciate Ligament Reconstruction Surgery

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KEYWORDS

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DECLARATIONS

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ABSTRACT

Background: Anterior cruciate ligament reconstruction surgery remains a prevalent and debilitating condition, despite invasive and non-invasive approaches aimed at reducing pain and improving function. **Objective:** To investigate the effects of continuous passive motion and intermittent compression therapy after anterior cruciate ligament reconstruction surgery. **Methodology:** This single-blinded study was a randomised controlled trial that recruited a sample of 50, and data were collected from Shalimar Hospital, Lahore, for 10 months. Inclusion criteria designated as patients were diagnosed by an orthopaedic surgeon and patients who have undergone reconstruction surgery, both male and female, patients who are within the 4th week post-operatively, aged between 20-50 years. Exclusion criteria include concomitant injuries, previous knee surgery, including ACL reconstruction, neurological or cardiovascular disease, or patients with allergies to the materials used in these devices. Group A was treated with continuous passive motion, and Group B was treated with intermittent compression for 30-45 minutes for 8 weeks. Paired sample t-test for within-group analysis and independent t-test for between-group analysis. **Results:** The mean score of the visual analogue scale pre-value was 7.58±1.7, post-value 2.52±1.3, continuous passive motion group. The mean visual analogue scale of the intermittent compression group pre-value was 6.50±1.33, post-value 4.85±1.3. KOOS of continuous passive motion pre-value 27.32±12.3, post-value 76.68±9.12. KOOS of intermittent compression pre-value 37.20 ±9.4, post-value 63.92±11.5. Range of motion pre value 35.64± 7.98 flexion, -8.04±1.59 extension, post-value 116.7±10, -2.28±1.4, flexion, extension respectively. The range of motion of intermittent compression pre-value 29.4±6.8 flexion, 6.16±1.02 extension, post value 91.68±8.10 flexion, -4.88±1.33 extension. **Conclusion:** The continuous passive movement group and intermittent compression group both are effective, but the former shows greater improvement in pain reduction, knee functional ability, and joint range of motion.

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INTRODUCTION

The knee joint is formed by the articulation of the anterior cruciate ligament (ACL) to the femur and tibia. This ligament is present at the central part of the knee, and it plays an essential part in the stability of the knee joint. In cases of traumatic injuries to the ACL, reconstruction surgeries are performed to restore the function and stability of the joint. The overall prevalence of ACL injuries is 0.15% to 3.67% in the general population.[1] Athletes are at more risk of these injuries, and the prevalence of these injuries in athletes is 0.3 to 1.67%.[2] These injuries are also present in adults and the incidence of injuries is highest in ACL injuries are more common in young adults, with a peak incidence between the ages of 19 and 25 years.[3] The rate of ACL injuries is inversely related to ageing (advancing age decreases the rate of ACL injuries). Traumas to the ACL account for the most common knee injury among sports persons. They happen most commonly in those who are athletes and involve pivoting, for example, in football, basketball, netball, soccer, handball, gymnastics, and downhill skiing.

Injuries can range from mild, just like small tears or sprains, or severe, for example ligament is completely torn. Contact and non-contact sports injuries occur; even non-contact tears and ruptures are most common. The limb is in non-contact and simultaneously in valgus and internal rotation injury. The main goal of ACL reconstruction surgery is to recover the full range of motion (ROM), strength, and stability of the knee joint and to decrease pain and swelling to hasten the rehabilitation process. The chances of recurrence are also decreased by promoting the stability of the knee joint. Minimise pain and inflammation to promote a smooth recovery. Females are more prone to ACL injury (2-8 times) than male athletes.[4] The patient has returned to the normal activity level gradually.

The ACL performs several functions, including joint stability by preventing exaggerated joint movement, maintaining balance through proprioception, and providing support during weight-bearing. Repetitive stress and strain on the ACL, Intense pain in the knee, specifically during weight bearing, sudden swelling, and giving way are some common symptoms indicating ACL injury. Continuous passive movement (CPM) is a modality in physiotherapy in which the device performs the passive knee joint movement according to the desired range and plays a part in maintaining the normal joint mobility level. Knee joint stiffness can be minimised through the regular use of CPM, thereby making the joint flexible. It can reduce joint stiffness and promote flexibility. It also speeds up the recovery by increasing the blood flow and decreasing joint swelling. Long periods of immobility increase joint pain, which can be minimised through the use of CPM. This is used in post-operative cases of the knee joint. It can also be used in cases of knee osteoarthritis and other disorders. However, it is contraindicated in cases of fractures and joint infections.

Intermittent compression (IC) is used in physiotherapy as a measure for rehabilitating the knee joint. It is equipment that applies intermittent pressure on the knee joint. It decreases the swelling at the joint by increasing the blood flow. Hence minimises the local oedema and makes the recovery process faster after undergoing the surgical process.[5] It also results in pain reduction and is commonly used after musculoskeletal surgeries to manage pain and swelling. It can also be used in injuries to the muscles, ligaments, and even fractures. It is also effective in cases of vascular insufficiencies and lymphedema. Active infections, deep vein thrombosis, and severe peripheral artery disease are some contraindications for intermittent compression. This study investigates the effects of continuous passive motion and intermittent compression therapy in individuals with post-ACL reconstruction surgery.

METHODOLOGY

This single-blinded study was a randomised controlled trial that recruited a sample of 50 calculated from G power 3.1.9.7.[6]. A Convenient sampling technique was used, and data were collected from Shalimar Hospital, Lahore, for 10 months. Patients diagnosed by an orthopaedic surgeon who have undergone ACL reconstruction surgery, both male and female, aged between 20-50 years and who are within the 4th week post-operatively.[7,8,9,10,11] Exclusion criteria include concomitant injuries such as meniscal tears or ligament sprains, patients who have undergone previous knee surgery, including ACL reconstruction, neurological or cardiovascular disease, or patients with allergies or sensitivities to the materials used in the CPM or IC devices. Group A was treated with CPM for 30-45 minutes

for two sessions per day for 8 weeks. CPM can be initiated in the immediate post-operative period, typically within 24-48 hours after surgery. Range of motion will be 0-90 degrees of flexion, with a gradual increase in range over time. Speed is 1-2 cycles per minute. The therapist will monitor patients for pain and discomfort during CPM and adjust the protocol as needed. The therapist will monitor the patient's range of motion and adjust the CPM protocol to ensure optimal progress.

Group B was treated with Intermittent Compression Therapy for 30-45 minutes for 2 sessions (morning and evening) per day for 8 weeks. The therapist stands beside the patient. IC therapy is initiated in the immediate post-operative period, typically within 24-48 hours after surgery. The pressure of the device is between 30-40 mmHg, and the cycle time is 10-30 seconds inflation, 10-30 seconds deflation. The therapist will monitor patients for pain and discomfort during IC therapy and adjust the protocol as needed. The therapist will monitor patients' swelling and oedema, and adjust the IC therapy protocol to ensure optimal progress. The therapist will monitor patients' knee functions and adjust the IC therapy protocol to ensure optimal progress. Parametric statistical tests were supported by normal data distributions and a paired sample t-test for within-group analysis and an independent t-test for between-group analysis. The p-value less than or equal to 0.005 was considered significant.

RESULTS

Results show a mean comparison of the visual analogue scale (VAS), KOOS, and knee ROM before and after treatment. The pre-treatment value of the VAS test was 7.04±1.64, and post-treatment was 3.68±1.76.mean difference was 3.356, which shows a significant difference in VAS values shows significant difference and suggests a decrease in pain mean comparison of KOOS. The pre-treatment value was 32.26±11.94, and the post-treatment value was 70.30±12.14; the mean difference was -38.040, which shows a significant difference in KOOS values, and a greater increase in post-treatment values suggests less disability, the mean comparison of knee joint ROM. The pre-treatment value was knee flexion 32.54±7.9, and the post-treatment value was 104.20±15.8; the mean difference was 71.66. The pre-treatment value of knee extension was -7.10±1.6, and the post-treatment value was -3.58±1.8, and the mean difference was -3.52.

The mean score of VAS in the CPM group before and after the treatment was 7.58±1.7 and 2.52±1.3, respectively, and the mean difference of VAS was 1.076. The mean score of VAS of the IC group before and after the treatment was 6.50±1.33 and 4.85±1.3, respectively, while the mean difference was -2.328. The p-value is less than 0.05, which shows there is a significant difference between the CPM group and IC group, but the CPM group shows greater improvement in pain relief. This table shows that the mean score of KOOS of the CPM group before the treatment was 27.32±12.3, and after the treatment was before the treatment was 37.20±9.4 and after the treatment was 63.92±11.5; the mean difference in KOOS of the IC group was 12.760. The p-value is less than 0.05, which shows there is a significant

Table 1: Mean, SD, and p-values of variables pre- and post-treatment

		Mean	Mean Difference	Std. Deviation	p-value
Pair 1	Pre-VAS	7.04	3.35	1.64	.000
	Post-VAS	3.68		1.77	
Pair 2	Pre-KOOS	32.26	-38.04	11.94	.000
	Post-KOOS	70.30		12.14	
Pair 3	Pre-knee flexion	32.54	-71.66	7.98	.000
	Post-knee flexion	104.20		15.84	
Pair 4	Pre-knee extension	-7.10	-3.52	1.63	.000
	Post-knee extension	-3.58		1.89	

Table 2: Between-group differences pre- and post-treatment

	Groups	Mean Difference	Mean	Std. Deviation	p-value
Pre-VAS	A	1.076	7.58	1.76	.019
	B		6.50	1.33	
Post-VAS	A	-2.32	2.52	1.30	.000
	B		4.85	1.38	
Pre-KOOS	A	-9.88	27.32	12.30	.003
	B		37.20	9.44	
Post-KOOS	A	12.76	76.68	9.12	.000
	B		63.92	11.53	
Pre-knee flexion	A	6.20	35.64	7.98	.005
	B		29.44	6.80	
Post-knee flexion	A	25.04	116.72	10.97	.000
	B		91.68	8.10	
Pre-knee extension	A	-1.88	-8.04	1.59	.000
	B		-6.16	1.02	
Post-knee extension	A	2.60	-2.28	1.42	.000
	B		-4.88	1.33	

differences between the CPM group and the IC group, but the CPM Group shows greater improvement in knee joint functional ability. The mean score of knee joint range of motion of the CPM group before treatment was 35.64±7.98 for flexion, and 8.04±1.59 for extension. After the treatment, 116.7±10.9, -2.28±1.4, for flexion and extension, respectively. The mean score of knee joint ROM of the IC group before the treatment was 29.4±6.8 for flexion, 6.16±1.02 for extension, and after the treatment was 91.68±8.10 for flexion, 4.88±1.33 for extension. There is a greater increase in Knee range of motion in the CPM group than the IC group. The p-value is less than 0.05, which shows there is a significant difference between the CPM group and the IC group, but CPM shows greater improvement in knee ROM.

DISCUSSION

The purpose of our study was to compare the effect of continuous passive movements and intermittent compression in patients with post-ACL reconstruction surgery on pain, knee range of motion, and knee functional ability. For this purpose, the VAS knee injury and osteoarthritis outcome score (KOOS) and knee joint range of motion (ROM) scales were used. Were applied. In addition, subjects completed post post-intervention questionnaire to determine the difference between patients' levels of comfort between the groups. The results of this study have shown that the group had significant differences in CPM and IC post-treatment values of pain intensity, KOOS, and knee ROM. A paired t-test was applied for within-group analysis. The mean values indicate that there is an increase in knee ROM and KOOS, while a decrease in pain score after the treatment session. The result of this study reveals that there is a significant difference between post-treatment values of pain intensity, KOOS, and knee ROM, p-value<0.05 across the group analysis. An important goal of improve knee functional ability and prevent any ligament injury.

This study focused on two types of interventions used to improve pain intensity, KOOS and knee ROM. The results of the current study suggested that the CPM group showed improvement after the treatment more than the Intermittent compression group. The mean score of VAS in the CPM group on the first day before the treatment was 7.58±1.7, and after the treatment was 2.52±1.3; the mean difference of VAS was 1.076. The mean score of VAS in the IC group on the first day before treatment was 6.50±1.33, and after the treatment was 4.85±1.3.while the mean difference was -2.328. The mean score of KOOS of the CPM group on the first day before the treatment was 27.32±12.3, and after the treatment was 76.68±9.12; the mean difference CPM group was 9.880. KOOS of the IC group on the first day before the treatment was 37.20±9.4 and after the treatment was 63.92±11.5; the mean difference

KOOS of the Intermittent Compression group was 12.76. The mean score of knee joint range of motion of the CPM group on the first day before treatment was 35.64±7.98 for flexion, 8.04±1.59 for extension, after the treatment was 116.7±10.9, -2.28±1.4, for flexion, extension, respectively. The mean score of knee ROM of the Intermittent Compression group on the first day before the treatment was 29.4±6.8 for flexion, 6.16±1.02 for extension, and after the treatment was 91.68±8.10 for flexion, 4.88±1.33 for extension. The p-value is less than 0.05, which shows there is a significant difference between the CPM group and IC group, but CPM shows greater improvement in pain reduction, knee functional ability, and knee ROM.[12, 13]

Our study results matched with a study conducted by Theo Jaspers et al (2019) on the effects of CPM on pain reduction and ROM in ACL reconstruction that included 442 participants.[14] It was concluded that CPM has shown significant effects in pain reduction in the first 2 operative days and ROM improvement in 6 postoperative weeks. Angie Biggs et al in 2009 effects of rehabilitation and found that patients who achieve symmetrical ROM and strength have better subjective and objective outcomes after ACL reconstruction surgery. It is concluded that patients who follow a rehabilitation program after ACL reconstruction show symmetrical knee ROM and have better subjective and objective outcomes.[15-17]

CONCLUSION

The study comparing the effect of continuous passive movements versus intermittent compression in patients with post-ACL reconstruction surgery on pain and knee disability in patients and knee joint mobility shows significant improvements in pain level, range of motion, and functional ability over time for all participants. Pain scores significantly declined, but KOOS and ROM of the knee joint scores increased throughout the study. Both interventions were effective in improving patient outcomes, but CPM is more effective in improving pain intensity, knee functional ability, and mobility.

DECLARATIONS

Consent to participate: Written consent had been obtained from patients. All methods were performed following the relevant guidelines.

Availability of data and materials: Data will be available on request. The corresponding author will submit all dataset files.

Competing interests: None

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CONSORT Guidelines: All methods were performed following the relevant guidelines and regulations.

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