

Effect of Russian Current Along with Structured Exercises in Improving Knee Range of Motion, Isometric Muscle Strength and Functional Status Following ACL Reconstruction

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ABSTRACT

Background: The most common ACL injuries occur during sports and are caused by twisting or pivoting movements. Decreased ROM, along with reduced muscle strength and functional status is more common in individuals with ACL reconstruction. Russian current is an emerging treatment in musculoskeletal physiotherapy.

Objective: To assess the effect of Russian current along with structured exercise in improving knee function following ACL reconstruction.

Methodology: This study included 44 individuals with ACL reconstructions, through random allocation they were divided into Group A (n=22) who received structured exercise alone and Group B (n=22) who received Russian current along with structured exercise over 6 weeks. The knee range of motion, isometric muscle strength and function were assessed by universal goniometer, hand held dynamometer, lysholm knee scores respectively. The assessment was performed 6 weeks after treatment.

Result: Between group comparison was analyzed using unpaired t-test, showed statistically significant ($p < 0.00$) improvement in Knee flexion ($t=29.41$) & extension range($t=2.08$), isometric quadriceps ($t=10.04$) and hamstring muscle strength ($t=17.81$) and functional status ($t=13.74$) in group which received russian current and structured exercises compared to structured exercises alone.

Conclusion: The finding suggest that Russian current along with structured exercise significantly improved knee ROM, muscle strength and functional status in individual with ACL reconstruction than structured exercise alone.

KEYWORDS: ACL Reconstruction, Russian current, Handheld dynamometer, Lysholm knee score.

INTRODUCTION

The anterior cruciate ligament (ACL) is highly researched ligament because of its anatomical location and its function of blocking anterior tibial translation and rotational stresses at knee joint.¹ It is among the most commonly damaged structures during sports or high-impact activities.² When the ACL is injured, it does not recover and requires surgical repair. Reconstruction strives to restore the afflicted knee's kinematics and stability, preventing degenerative alterations.^{3,4} Reduced ROM, quadriceps weakness, anterior knee pain, and gait difficulties are the potential complications following anterior cruciate ligament (ACL) restoration.⁵ The instability that is frequently associated with an ACL rupture may lead to the development of articular cartilage abnormalities. Quadriceps muscle strength is reduced 15% in the affected limb, which impairs function and performance.⁶ Quadriceps weakness is one of the common risk associated with the occurrence of osteoarthritis in the knee joint.⁷

Russian current, also known as medium frequency alternating current, is a sort of electrical stimulation used to increase muscle strength. Developed to improve muscular strength in Russian Olympic competitors, it increased force gain by up to 40% in elite athletes.⁸ Russian current stimulation enhances quadriceps muscle strength and functional abilities in individuals with primary OA knee.⁹



In order to assist the quadriceps and hamstrings, isolated isometric activations are carried out either with or without a minimal external load. Increased proprioception and improved limb control during ADL are achieved by functional workouts in the closed kinetic chain that target the muscles of the lower limb.¹⁰ Immediate knee mobility and early training for passive and active ROM of the knee joints can aid in quick healing and pain reduction.¹¹

The need of the study is to find the impact of Russian current along with structured exercises in improving knee range of motion, isometric strength and functional status following ACL reconstruction.

METHODOLOGY

The study design was an experimental study with convenience sampling 44 samples were selected for this study. The patients aged between 20 to 45 years with sports injuries were recruited for this study. Participants with any knee deformities, any previous surgery of the currently affected knee, any other rheumatic/arthritis conditions were excluded. The participants were recruited after receiving the consent form and they were randomly allocated into group A and B through computerized randomisation method. Group A (control group) received structured exercise alone whereas Group B (experimental group) received Russian current along with structured exercises for 6 weeks. Universal goniometer, hand held dynamometer, lysholm knee scores were measured after 6 weeks of intervention.

PROCEDURE

Outcome measure: The knee ROM is assessed by universal goniometer. The isometric muscle strength for Quadriceps and hamstring is measured through hand held dynamometer.¹⁴ The functional assessment was performed with Lysholm knee scores.¹⁵

The primary goal in this early phase is to maintain the available range of motion (ROM) and facilitate the gradual restoration of full ROM, this extends immediately after surgery and typically lasts up to the 6th week post-operation. Managing effusion and inflammation, as well as achieving terminal knee extension, are key priorities and Full ROM is considered a critical factor for successful rehabilitation outcomes. Moreover, early ROM restoration significantly reduces the risk of arthrofibrosis.¹⁶

ROM exercises progressively advanced, starting with active-assisted knee flexion over the edge of the bed. Progression include wall slides and active-assisted knee flexion in a sitting position, Seated assisted knee flexion & extension, patellar mobilizations: superior/inferior and medial/lateral, and stationary cycling with half circle motion. Low intensity, long duration extension stretches, prone hang. Standing gastrocnemius stretch and soleus stretch. Supine active hamstring stretches and supine passive hamstring stretch. These were the structured exercises performed 3 days /week for 6 weeks. Russian current protocol was applied using a carrier frequency of 2500 Hz and a pulse frequency of 50 Hz. Symmetrical sinusoidal pulses were delivered with a pulse duration of 200-300 microseconds. For patient comfort, a ramp-up time of 2-3 seconds and a ramp-down time of 2 seconds were utilized. The stimulation was applied with a 50% duty cycle for a total duration of 10 minutes. This was given 3 times/week for 4 week.

Statistical analysis: The collected data were recorded and analyzed using SPSS software version 20. An unpaired t-test was conducted to compare outcomes between groups, with the level of significance set at $p < 0.05$.

RESULT ANALYSIS

The participants had a mean age of 31.04 years. Group B who received Russian current with structured exercise showed statistically significant improvement than Group A, who received structured exercises alone.

The analysis of knee flexion post-test for control group showed a mean and standard deviation of 60.5 ± 4.68 , whereas experimental group showed mean and standard deviation 111.7 ± 6.69 (Figure 1). The obtained t-value was 29.41 and p values were 0.001 (Table 1). As explained in Table 2, the analysis of knee extension post-test for control group showed mean and standard deviation of 13 ± 3.69 , whereas experimental group showed mean and standard deviation of 16 ± 5.68 . (Figure 2) The obtained t-value was 2.08 and p values were 0.04.

The post-test for control group in lysholm score showed mean and standard deviation 61.5 ± 2.48 , whereas experimental group showed mean and standard deviation 73.85 ± 3.41 . The obtained t-value was 13.74 and p values were 0.00 (Table 3).

The isometric quadriceps strength post-test for control group showed mean and standard deviation 14 ± 3.79 , whereas experimental group showed mean and standard deviation 24 ± 2.73 . The obtained t-value was 10.04 and p values were 0.00 (Table 4). The isometric hamstring strength post-test for control group showed mean and standard deviation 12 ± 1.31 , whereas experimental group was 20 ± 1.65 . The obtained t-value was 17.81 and p values were 0.00 (Table 5).

Table 1: Analysis of knee flexion in degrees (Post-test).

Sl no	Group	No of samples	Mean	Standard deviation	t value	p value
1	Control	22	60.5	4.68	29.41	0.00
2	Experimental	22	111.7	6.69		

Table 2: Analysis of knee extension in degrees (Post-test):

Sl no	Group	No of samples	Mean	Standard deviation	t value	p value
1	Control	22	13	3.69	2.08	0.04
2	Experimental	22	16	5.68		

Table 3. Analysis of Lysholm knee scores values (Post-test):

Sl no	Group	No of samples	Mean	Standard deviation	t value	p value
1	Control	22	61.5	2.48	13.74	0.00
2	Experimental	22	73.85	3.41		

Table 4. Analysis of Isometric Quadriceps strength in Kilograms (Post-test):

Sl no	Group	No of samples	Mean	Standard deviation	t value	p value
1	Control	22	14	3.79	10.04	0.00
2	Experimental	22	24	2.73		

Table 5. Analysis of Isometric Hamstring strength in Kilograms (Post-test):

Sl no	Group	No of samples	Mean	Standard deviation	t value	p value
1	Control	22	12	1.31	17.81	0.00
2	Experimental	22	20	1.65		

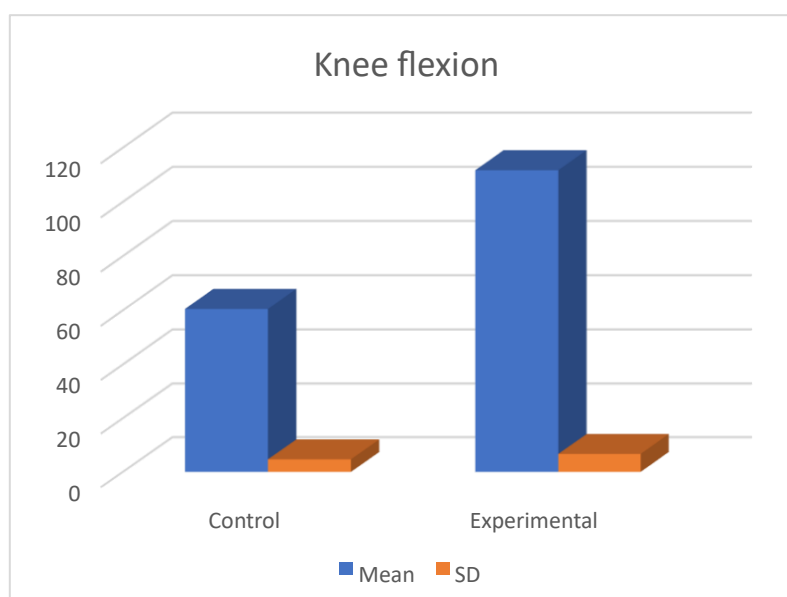


Fig 1: Knee flexion ROM post score

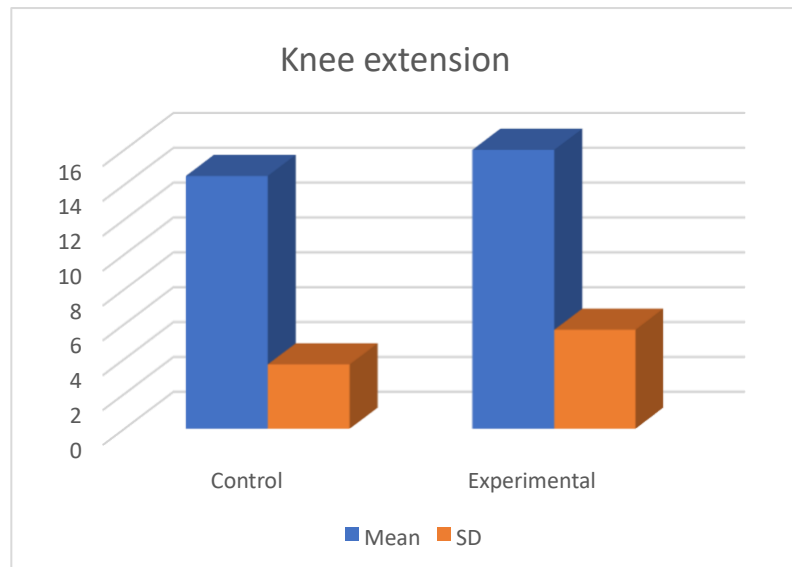


Fig 2: Knee extension ROM post score

DISCUSSION

The present study is an experimental study conducted to find out additional effect of Russian current in improving knee range of motion, isometric muscle strength and functional status following ACL reconstruction. The results of this study revealed the structured exercises along with Russian current increased knee ROM, isometric muscle strength and functional status in individuals who underwent ACL reconstruction.

It was established that ACL damage can result in a severe quadriceps strength deficiency, ranging from 15% to 40%. Preoperative quadriceps strength is a major predictor of knee function following ACL surgery. Following ACL surgery, the quadriceps muscles may have arthrogenic muscular inhibition, limiting volitional contraction and it also affect joint mobility and led to stiffness.¹¹ it was also found Russian current uses electrical stimulation to enhance voluntary muscle contraction, resulting in stronger contractions and improved muscle power, strength, and endurance over time¹² which was augmenting the current study results.

It is well known that Structured exercise releases endorphins, which assist to alleviate inflammation and pain. Also Progressive organized exercise improved knee ROM, joint proprioception, flexibility, and functional status after ACL reconstruction.¹³ similarly in the current study knee ROM and functional status improved after structured exercises.

CONCLUSION

This study concludes that the Russian current along with structured exercise showed significant effect in improving knee ROM, muscle isometric strength and functional status when compared with structured exercise alone in individual with ACL reconstruction following 6 weeks.

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