

## Effects Of Lumbar Core Stability Exercise Programme On Knee Pain, Range Of Motion And Function Post Anterior Cruciate Ligament Reconstruction

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## Abstract

**Background:** Anterior Cruciate Ligament (ACL) is the most commonly injured ligament of the knee joint. Injuries to the ACL are common in sports activities like football, basketball etc. which involves twisting or pivoting movements of the knee as well as in road traffic accidents and falls. The ACL injuries can be managed conservatively or operatively. The surgical management can be open or arthroscopic reconstruction. Core stability or strengthening is now an integral part of fitness and rehabilitation. A clear relationship exists between the trunk muscle activity and lower extremity movement. The trunk muscle activity maintains the integrity of the spinal column and forms a stable base for movement of the extremities resulting in proper force distribution and maximum force generation with minimal compressive, translational, or shearing forces at the joints of the kinetic chain. To accelerate recovery, core exercises should be made an integral part of ACL rehabilitation. Thus the study objective is to study the effectiveness of lumbar core stability exercises on knee pain, range of motion and function in ACL reconstruction (ACLR) population aged between 20-40 years by a prospective randomized control trial on 60 participants (30 per group) subjected to a control group (Group A) and an experimental group (Group B) for four weeks.

**Hypothesis:** ACL-R rehabilitation programme if clubbed with lumbar core stability exercises would give a better functional outcome as compared to the rehabilitation programme alone.

**Clinical Importance:** Adding lumbar core stability exercises to the ACLR rehabilitation programme would result in early recovery of this population in terms of returning back to routine or sports activities.

**Future direction:** To find out the beneficial effects on sports persons performance, lumbar core stability exercises could be given for a longer duration.

**Keywords:** Core stability, ACL Reconstruction, Function.

## THESIS SUMMARY

### Introduction

ACL is the most commonly injured ligament of the knee joint [1]. Injuries to the ACL are not uncommon in sports activities like football, basketball etc. which involves twisting or pivoting movements of the knee [1-3]. Athletic population in the age group of 20-40 years is prone to such injuries [4]. Damage to ACL and

related structures would lead to pain, instability, swelling, difficulty in climbing stairs, squatting, walking etc [1, 3, 4]. The ACL injuries can be managed conservatively or operatively. The surgical management can be open or arthroscopic reconstruction [3-5]. Rehabilitation post surgical intervention helps in reducing the pain, swelling, stiffness, instability and also to regain the strength and

normal functional activities [4]. Many studies on use of post operative bracing, accelerated strengthening of the muscles, home based rehabilitation program and neuromuscular training have been conducted [6]. According to Wilk K. et al rehabilitation process should begin immediately following ACL injury, with emphasis on reducing swelling and inflammation, regaining quadriceps control, allowing immediate weight bearing, restoring full passive knee extension, and gradually restoring flexion focusing on prevention of several postoperative complications, such as loss of motion, patello-femoral pain, graft failure, and muscular weakness [7]. Rehabilitation programs aimed to restore full, unrestricted function and to assist the patient to return to 100% of the pre-injury level while achieving excellent long-term outcomes [7].

Core stability or strengthening is now an integral part of almost all fitness and rehabilitation programmes, but literature lacks on its use in early post-operative rehabilitation plan. A clear relationship exists between the trunk muscle activity and lower extremity movement [8]. Core stability is defined as the ability to control the position and motion of the trunk over the pelvis to allow optimal production of force and motion, and their transfer to the terminal segment [9, 10]. It is necessary to maintain the integrity of the spinal column and forms a stable base for movement of the extremities [8]. As a result, there is proper force distribution and maximum force generation with minimal compressive, translational, or shearing forces at the joints of the kinetic chain. It provides proximal stability for distal mobility [11].

Core muscle strength provides the foundation for motor skills and activities of daily living allowing an individual to exert external force whilst maintaining dynamic balance [9, 12]. Therefore, core stability is related to the ability to control the trunk's responses to internal and external interference, including power generated by the distal body segments [9, 13].

There are however lack of studies stating effect of core stability on various functional impairments such as range of motion, pain etc, and activity limitation following ACLR. A lot of studies have been done on formulating rehabilitation protocol post ACLR with use of different interventions which does not include lumbar core stability and strengthening. To accelerate recovery, core exercises should be made an integral part of ACLR rehabilitation [9]. Hence, there is a need for incorporation of lumbar core stability exercise program to the ACLR rehabilitation protocol to know the additional effects it has in the rehabilitation process.

Many unanswered questions still exist regarding the optimal physiotherapy treatment for ACLR. Hence it is important to understand whether including lumbar core stability exercise programme will benefit existing ACLR rehabilitation protocol.

### Hypothesis

Core stability exercises are used in almost all the rehabilitation programmes. As a well-known fitness trend, it is being used extensively in the sports medicine world. [14] Proximal stability leads to distal mobility. It becomes necessary to introduce and study the effects of the lumbar core stability exercises to the ACLR rehabilitation programme to observe early functional improvement in the activities of daily living.

Hence, it is hypothesized that lumbar core stability exercises combined with ACLR rehabilitation programme offers improvement in knee joint function as well as reducing the pain and range of motion of the knee joint as compared to only ACLR

rehabilitation programme.

The current research aims at studying the effects of lumbar core stability exercises along with ACLR rehabilitation programme on knee joint pain, range of motion and function post ACLR in participants aged between 20-40 years. A Prospective Randomized Control Trial will be performed after ethical approval from the Institutes ethical committee. The sampling will be done by chit method after obtaining consent from the participants. Participants who would undergo isolated ACLR, or with associated meniscal tear excision or trephination would be included in the study. Participants who would undergo ACLR with meniscal repair shall not be included as the rehabilitation protocol differs with that of the one followed for ACLR with or without meniscal excision or trephination. Those having associated fracture and/or avulsion, history of previous knee surgery, fracture, dislocation, acute infection, neuropathic conditions, malignancy, and any other condition that might hamper the rehabilitation process at the time of data collection will be excluded from the study.

Before commencing the physiotherapy rehabilitation, the participants shall be evaluated and demographic data will be collected from each patient that includes age, sex, and occupation, time of injury, and mechanism of injury, pre-surgery rehabilitation status, and medications. For pain evaluation, Visual Analogue Scale will be used [14]. For range of motion evaluation, Goniometer Records application on android mobile device shall be used [15]; and Modified Lysholm Scoring Scale (MLSS) shall be used to assess functional ability and Tegner Activity Level (TAL) for the activity level [16].

Participants shall be assessed for knee pain, before treatment and at the time of discharge, at the end of second and fourth week. On the day of discharge, at the end of second week and fourth week range of motion shall be assessed. And at the end of fourth week of treatment, assessment of functional ability and activity level shall be done by using MLSS and TAL.

Participants shall be assigned into Group A (control group) and Group B (experimental group). Females will be equally allotted to each group and equality shall be maintained in terms of the associated meniscal surgeries. Each group shall undergo ACLR rehabilitation. Additionally, Group B shall undergo lumbar core stability exercise programme.

Before commencing the treatment, the participants will be assessed for lumbo-pelvic stability using Stabilizer Pressure Biofeedback Unit [17] by using the progressive leg loading test emphasizing on abdominals as a measure of control and hold time as a measure of endurance of the lumbo-pelvic complex [18]. Prior to testing for lumbo-pelvic stability all patients would receive training in the drawing-in manoeuvre to activate the abdominal core muscles in a supine modified crook lying position (operated leg straight and non-operated leg bent at 90° of knee flexion) with neutral pelvis.

Participants in both the groups shall be tested for core stability and endurance pre-treatment. And, participants in the experimental group shall be given progressive leg loading exercises emphasizing on the abdominals, starting at the level at which they will be for a week and progressing it level wise every week, for four weeks as part of their home exercise regime.

Both the groups will receive treatment until discharge (within first week) after which patients will continue with home exercise programme consisting of rehabilitation exercises with (for experimental group) or without (for control group) lumbar core stability exercises for the next four weeks which will be taught and explained thoroughly. To keep a record of the home exercise programme, patients will be given an exercise sheet for ease of following the exercises.

Thus, all the participants shall undergo a home exercise programme for four weeks. Paired t-test shall be used for analysing intra-group assessment of range of motion. Un-paired t- test shall be used for inter-group assessment of range of motion. Wilcoxon test shall be used intra-group assessment of pain. Mann Whitney U Test shall be used for inter-group assessment of pain, function and activity level using the Lysholm Knee score and Tegner activity level.

### Discussion

Many ACLR rehabilitation programmes talk of early weight bearing, prevention of re-injuries, open versus closed kinetic chain exercises, return to play, balance and proprioceptive training and also neuromuscular facilitation [6, 19-21]. But none has focused on incorporating core stability exercises as a part of rehabilitation training from the very beginning of the rehabilitation process post ACLR.

Stability means any foundation or base which is firm and allows no change. In context of the human body, the spinal column which consists of the vertebrae and the various joints and ligaments aligning the adjacent vertebrae, provides stability to the bony skeleton along with the various musculature surrounding the spinal column which consists of the deep and superficial core muscles. The stability of any system depends on its ability to limit displacement along with maintenance of integrity [8]. Stronger core muscles would provide a strong and stable proximal component which would result in efficient distal component mobility.

Relationship of core stability exercises in preventing lower extremity injuries has been proved. There is a negative correlation that exists between core stability and ACL injuries [9]. Several studies have evaluated various treatment techniques to reduce the risk of knee injuries, specifically the ACL injuries in males as well as females. The basic component of any rehabilitation programme involves training for task specific activities; for example, a sports person would be trained for cutting, pivoting, jumping etc which focuses on the rotational control of the extremity underneath the pelvis. As a clear relationship exists between core stability and lower extremity movement, one can be clear that decreased core stability predisposes a person to lower extremity injuries and that improved core stability reduces the chances of injuries [8]. It is observed that the deep abdominal muscles, i.e. the transverses abdominis get activated in anticipation to limb movement. Strength training of these trunk muscles would provide a better rotational control of the limb. This interrelationship between the lower extremity function and core stability should be used to an advantage while treating the patients who have undergone ACLR.

Thus, lumbar core stability exercises should be combined with the current ACLR rehabilitation programme in order to achieve its benefits in terms of achieving functional independence at the earliest. Functional independence could be achieved not only by the ability to perform tasks but by the availability of the range of motion required to accomplish the same along with low levels of pain.

Thus, this hypothesis states that a combination of lumbar core stability exercises with an emphasis on the abdominal limb loading exercises with ACLR rehabilitation programme, if progressively given to the subjects would help benefit them with achieving functional tasks earlier in the rehabilitation process along with an increased improvement in the range of motion and reduced pain levels as compared to the ACLR rehabilitation programme alone.

### Clinical Importance

Adding lumbar core stability exercises to the ACLR rehabilitation programme would result in early recovery of this population in terms of returning back to routine or sports activities.

### Future Direction

To find out the beneficial effects on sports persons performance, lumbar core stability exercises could be given for a longer duration.

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