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PHYSIOTHERAPY MANAGEMENT IN POST ACL RECONTUTION USING CLOSE KINETIC CHAIN EXERCISE IN PHASE III: A CASE REPORT

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Abstract

Introduction: One of the ligaments in the knee is the anterior cruciate ligament where the function of the ligament itself is joint stabilization. 60% sports injuries occur in the knee, one of which is specifically a tear in the anterior cruciate ligament (ACL) ligament with the largest incidence rate of 16% during sports activities then the role of physiotherapy using close chain kinetic is expected to overcome pain, increase range of motion, reduce muscle atrophy and increase muscle strength.

Case Presentation: A 23-year-old man last year had an accident while playing soccer and the patient felt the instability of his right knee when he was running, then after an MRI was done at the hospital 6 months ago the patient had ruptured anterior cruciate ligament (ACL) so 3 months ago it was done post anterior cruciate ligament (ACL) reconstruction measures.

Management and Outcomes: Giving therapy Exercises such as close chain exercise are effective for reducing pain, increasing muscle strength around the knee joint, reducing atrophy in the muscles around the knee joint as measured by the medline.

Discussion: After doing physiotherapy rehabilitation for 6 times therapy, the pain reduction from the first therapy was worth 3 then the last therapy was 2 measured by NRS (*numeric rating scale*), then the range of motion increased by 5° from before exercise measured with a goniometer, for anthropometry it increased by 0.5 cm to 2 cm and muscle strength was stable at 5.

Conclusion: After 2 weeks of therapy for 6 x sessions with intervention of close chain kinetic exercise therapy, the results were decreased pain, increased range of motion, increased muscle strength, reduced repeated falls, and reduced atrophy in the muscles that work on the knee joint.

Keywords: Anterior cruciate ligament (ACL) rupture, post anterior cruciate ligament (ACL) reconstruction management post anterior cruciate ligament (ACL) surgery, physiotherapy, exercise, close chain kinetic exercise, risk factor for falls.



Introduction

The knee is a very complex part of the human body and where the largest weight bearing is on the knee, the knee is composed of various bones, muscles, ligaments, one of which is the anterior cruciate ligament where the function of the ligament itself is joint stabilization. The anterior cruciate ligament itself functions to resist the sliding of the tibia anteriorly against the femur⁽¹⁾.

Sports injuries are injuries to the muscular, integumen, and skeletal systems caused by sports activities and are grouped into acute and overuse injuries. 60% of sports-related injuries occur in the knee, one of which is specifically a tear in the ACL ligament with the largest incidence rate of 16% during sports activities that involve jumping, squatting, twisting, stopping movements⁽²⁾.

Rupture is the tearing of tissue caused by trauma. The ACL is one of the major ligaments in the knee that functions to prevent the tibia from sliding forward from the femur and to control the rotational motion of the knee. ACL rupture can be caused by direct or indirect contact with the knee. Direct contact can occur due to a force from the side or outside such as a direct impact on the knee. Indirect contact e.g. landing after jumping with knees in hyperextension with excessive rotation of the hips and legs. This can cause the knee joint to become unstable, allowing the tibia to move too freely.⁽³⁾

The worldwide prevalence is about 5% more likely than women in general, in 2016 approximately 200,000 ACL-related injuries occur annually in the United States, with approximately 95,000 of 1 case found 3500 ACL ruptures and approximately 100,000 ACL reconstructions are performed annually. The average person is a person who is active in sports, then cases of ACL rupture often occur in sports athletes⁽⁴⁾

In general conditions people with ACL rupture are usually found to have joint instability in the knee so that ACL reconstruction must be carried out when ACL ruptures to restore knee function perfectly⁽⁵⁾. Then the role of physiotherapy after surgery is rehabilitation to return knee function back to normal with physiotherapy interventions and exercises, one of which is close chain kinetic exercise. Close chain kinetic is an exercise that is basically an active movement that involves several groups of muscles and joints (multiple joints) that work simultaneously with movement in the proximal segment.⁽⁶⁾

Case Presentation

A 22-year-old man as a student 1 year ago in 2020 fell during soccer until he experienced swelling in the right knee when he had swelling for 1 week to heal, then 6 months ago he fell for the 2nd time during volleyball after falling the next day the patient felt instability in his right knee when while running on a number 8 track the patient fell because of the instability of the knee joint, then 2 days after falling from running at number 8 the patient went to the doctor for a specific test, the anterior drawer test was positive, there was a slide of the tibia anterior to the femur and an MRI was also done, then the

results showed the patient had ruptured the ACL / ruptured the ACL so it was decided by the doctor to do ACL reconstruction 3 months ago after 1 week after ACL reconstruction the patient underwent rehabilitation in physiotherapy post ACL reconstruction.

At the beginning, after 1 week after ACL reconstruction, the patient was still walking using crutches when he went to the hospital, then the patient experienced muscle weakness, pain and atrophy in the quadriceps muscle after walking for 3 months in hospital rehabilitation and was given education at home. , almost full ROM, pain decreases and atrophy begins to decrease after experiencing this development still complaining of pain in his right knee when after waking up and activities that are too heavy but only mild pain, minimal atrophy, ROM that is not full and muscle strength is still not yet strong but the patient has walked normally and is doing his usual activities as usual.


The purpose of the physiotherapy treatment given is to reduce pain, reduce atrophy in the quadriceps muscle, increase the range of motion of the joints in the right knee, increase the strength of the knee propulsion muscles, reduce the risk factors for falling back and increase functional activity.






Some of the important checks carried out by physiotherapy in dealing with post ACL reconstruction conditions like this include vital sign examinations / vital sign examinations, NRS (Numeric Rating Scale) examinations, MMT (Manual Muscle Testing) examinations, ROM (Range of Motion) examinations, Anthropometry examinations. Vital sign examination was carried out before the intervention was given, physiotherapy was given, from the vital sign examination in the form of pulse, breathing, body temperature, blood pressure and the results were found to be within normal limits so that physiotherapy intervention could be carried out.

Management and Outcome

Some of the physiotherapy interventions provided are interventions based on problems complained of by patients such as pain when waking up and strenuous activities, atrophy of the quadriceps muscle, increasing the range of motion of the knee joint, increasing knee muscle strength, reducing risk factors for falling back and increasing activity. functional. The intervention given is in the form of Close Chain Kinetic Exercise which aims to overcome patient problems in the form of increasing muscle strength, increasing ROM, reducing pain, reducing muscle atrophy and reducing the risk of falling back in the future.

Table 1. close chain exercise program

Intervention Close chain kinetic exercise	Dose	Picture	Information
Static cycle	15 minutes / warm up before exercise		Warming up relaxes stiff muscles before exercising and reduces the risk of injury during exercise

Lunges	20 x 5 sets 3 x for 1 week		Aims to strengthen the hip and surrounding muscles
Side lunges	20 x 5 sets 3 x for 1 week		Aims to strengthen the hamstring, gluteus, and quadricep muscles
Squad	20 x 5 sets 3 x for 1 week		Aims to strengthen the extensor hip and knee extensors.
Single leg squats	20 x 5 sets 3 x for 1 week		Single squat is an exercise to strengthen the hip abductors and hip external rotators
Dynamic squats	20 x 5 sets 3x for 1 week		Aims to strengthen the muscles covering the hip, knee and ankle.

After several physiotherapy interventions were carried out for 6 therapy sessions for 2 weeks and several measurements such as pain, atrophy, range of motion, the following results were found.

Table 2. Pain Evaluation Results Using NRS (*numeric rating scale*)

Painful	T1	T6
Tenderness	0/10	0/10
Motion pain	3/10	2/10
Silent pain	0/10	0/10

The results of pain measurement using NRS (*numeric rating scale*) found that in the first therapy there was no tenderness, silent pain but only conditional motion pain when the patient woke up or when after exercise using strenuous activities after 2 weeks of therapy for 6 x therapy patients experience a decrease in motion pain that is equal to 2/10 when measured using the NRS (*numeric rating scale*).

Table 3. Joint Scope Of Motion Examination / Range of Motion

motion	IT		T6	
	Dextra	Sinistra	Dextra	Sinistra
Active motion	S: 5°-0°-130°	S: 5°-0°-140°	S: 5°-0°-135°	S: 5°-0°-140°
Passive motion	S: 5°-0°-135°	S: 5°-0°-145°	S: 5°-0°-140°	S: 5°-0°-145°

The results of the range of motion examination using a goniometer showed that there was a change in the range of motion of the joints after physiotherapy intervention for 2 weeks 6 x sessions, it was stated that the initial change in active and passive motion was an increase of 5° after the intervention.

Table 4. Anthropometric measurements of atrophy using the mline

Inspection	T1			T6		
	Sinistra	Dextra	Difference	Sinistra	Dextra	difference
10 cm and above from the Tibial Tuberosity	35cm	34.5 cm	0.5 cm	35cm	34.5 cm	1 cm
15 cm and up from the Tibial Tuberosity	37 cm	35.5 cm	2 cm	37 cm	36.5 cm	1.5cm
20 cm and above from the Tibial Tuberosity	44 cm	43 cm	1 cm	44 cm	43.5 cm	0.5 cm
10 cm and below from the Tibial Tuberosity	29.5 cm	26.5 cm	3 cm	29.5cm	27.5 cm	2 cm
15 cm and up from the Tibial Tuberosity	27.5 cm	27 cm	0.5 cm	27.5cm	27.3cm	0.2 cm

On anthropometric examination, the results showed that there were hypertrophic changes in the muscles that support the knee joint at 10 cm and above from the tibial tuberosity, the difference from 0.5 cm to 1 cm, 15 cm and above from the tibia tuberosity, there was a difference of 2 cm to 1.5 cm. cm, 20 cm above from the tibial tuberosity there is a change of 0.5 cm, 10 cm below from the tibia tuberosity there is a change of 1 cm, 15 cm and above from the tibial tuberosity there is a change of 0.3 cm.

Table 5. MMT (Manual Muscle Testing) examination.

Movement	Active	MMT
Right knee flexion	full rom	5
Right knee extension	full rom	5
Left knee flexion	full rom	5
Left knee flexion	full rom	5

After examining muscle strength using MMT (*Manual Muscle Testing*), the results from the beginning of therapy to the end of the therapy dive 6 x sessions remained the same, which was 5 where muscle strength was good at post ACL reconstruction in phase 3.

Discussion

Phase 3 rehabilitation

Rehabilitation after reconstruction of the ACL is always evolving from year to year with new surgical techniques and is responsible for patient satisfaction is the end result of the rehabilitation post ACL reconstruction greatly affects the process of functional improvement. At the beginning of the 3rd month in phase 4 of ACL reconstruction the goal is to achieve progressive 0° to 120° ROM, the limitation of 5° to 10° flexion is very not uncommon in this phase the best exercise is close chain kinetic exercise which is an exercise consisting of various kinds of strengthening purposes quadriceps, hamstring muscles and around the knee joint ⁽⁷⁾.

Exercise

Exercise is one of the modalities of physiotherapy in the application of rehabilitation in post ACL reconstruction exercise therapy on the knee can reduce levels of cytokines where cytokines themselves are one of the chemical mediators of inflammation when exercise therapy is carried out so that cytokine levels decrease, the mechanism of nociceptor stimulation by noxious stimuli is inhibited and the process Transduction of pain mechanisms is also inhibited when pain is reduced and more space can be moved. Then when exercise is applied regularly it will increase blood circulation so that metabolism increases and there is an increase in nutrition in the surrounding tissue so that it will accelerate the inflammatory process then when there is strong contraction of the quadriceps and hamstring muscles it will result in a pumping action mechanism so that local circulation takes place well or vasodilation and relaxation. thus metabolic residues (substance p) and acetabolic produced through the inflammatory process can run smoothly so that pain can be reduced ⁽⁸⁾.

Close Kinetic Chain Exercise

Close kinetic chain is a physiotherapy intervention that leads to strengthening exercises, basically the muscles that move the knee are part of the hamstring, quadricep, gastrocnemius and soleus muscles. These four muscles are primary muscles that act as locomotion and stabilize the knee joint and also close chain kinetic exercises can increase muscle strength and thus reduce muscle atrophy because the more often you do the exercise, the more muscle mass you will build so that it can reverse the muscle that is experiencing pain. atrophy⁽⁹⁾. Previous research has shown that several exercises have been

shown to be effective for maintaining muscle mass in patients with muscle weakness. It was identified that several proteolytic systems with overlapping tissues can target effector signal proteins and miRs compounds are compounds that attract these substances into a single unit to build muscle mass so as to maintain muscle mass and increase muscle mass⁽¹⁰⁾. then some close chain kinetic exercises that involve multiple joints immediately and can increase stabilization because this exercise stimulates large proprioceptive and kinesthetic through approximation of the resulting joint and stimulates mechanoreceptors in muscles and receptors around joints to increase sensory input in the movement control process so that can improve the functional ability of the muscles⁽¹¹⁾.

Education

Patients are asked to always exercise based on strengthening the muscles around the knee such as squat, lunges, side lunges and exc for preparing next phase to running exercise.

Conclusion

After 2 weeks of therapy for 6 x sessions with intervention of close chain kinetic exercise therapy, the results were decreased pain, increased range of motion, increased muscle strength, reduced repeated falls, and reduced atrophy in the muscles that work on the knee joint.

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