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EXERCISE IN PATIENTS WITH POST OPERATIVE RECONSTRUCTION ACL: A CASE STUDY

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Abstract

Introduction: The ACL is a break or tear in the ligaments in the knee joint. ACL injuries usually cause functional impairment and instability of the knee. The main problems after ACL injury are deficits or weakness of knee muscle strength, joint instability, and proprioception deficits. The annual incidence of ACL injuries increased by 43% (from 54.0 to 77.4 per 100,000 population), and 74% among those under 25 years of age (from 52.6 to 91.4 per 100,000 population). Injuries are more common in men than women. One of the interventions that can be given is exercise. Exercise is able to reduce the value of pain, activate the muscles in the injured leg, increase knee flexion, and improve the patient's functional ability.

Case Presentation: A 20-year-old man came to the clinic complaining of pain, aches, and difficulty in bending his right knee in full ROM. sometimes felt in the morning. In addition, pain increases when walking long distances and going up and down stairs, complaints arise after suffering an injury while playing soccer. Then the patient underwent ACL reconstruction on February 3, 2021 and underwent physiotherapy on February 17, 2021.

Management and Outcome: Exercise is one of the physiotherapy management that can be done on post-operative reconstruction ACL patients to reduce pain, activate the muscles in the injured leg, increase knee flexion, and improve the patient's functional ability.

Discussion: Patients with postoperative reconstruction usually complain of pain, weakness of the injured leg muscles, difficulty in flexing the knee in full ROM, and others. This study states that exercises in the form of stretching, strengthening, and balance can reduce pain scores, activate the muscles in the injured leg, increase knee flexion, and improve the patient's functional ability.

Conclusion: Exercises for postoperative ACL reconstruction patients in the form of stretching, strengthening, and balance can be used as a physiotherapy management for ACL postoperative reconstruction.

Keyword: Post-Operative Reconstruction ACL, Anterior Cruciate Ligament (ACL), Physical Exercise, Stretching Exercise, Balance Exercise, Strengthening Exercise.



Introduction

The ACL is a break or tear in the ligaments in the knee joint. ACL injuries usually cause functional impairment and instability of the knee. The main problems after ACL injury are deficit or weakness of knee muscle strength, joint instability, and proprioception deficit (Vidmar et al., 2019). The annual incidence of ACL injuries increased by 43% (from 54.0 to 77.4 per 100,000 population), and 74% among those under 25 years of age (from 52.6 to 91.4 per 100,000 population). Injuries are more common in men than women (Zbrojkiewicz et al., 2018).

The ACL is the connection point between the femur and the tibia which is held together by several ligaments. The most important aspect of knee stability is the Anterior Cruciate Ligament (ACL). The purpose of this ligament is to keep the tibia from sliding forward towards the femur (Arundale, et al., 2018). ACL injuries are common in athletes, especially soccer players. The mechanism of ACL injury usually occurs because the player changes direction suddenly and the ACL cannot withstand the force. The ACL can also be torn if the knee is forced to hyperextend when landing from a jump. The disorders that often occur are difficult to walk, difficult to bend and straighten the knee, and the knee feels like it is unstable (Madison, 2018).

Several clinical tests that can be used to determine ACL rupture are the Lachman Test, Anterior Drawer Test, and the Pivot Shift Test. The Lachman Test is the most accurate test for testing the ACL with a sensitivity of 85% and specificity of 94%. The Anterior Drawer Test has high sensitivity and specificity for chronic ACL ruptures (92% sensitivity and 91% specificity), but lower accuracy for acute cases. When positive, the Pivot Shift Test is a very clear indication of ACL rupture (specificity 98%). A negative test, however, is not sufficient to rule out injury (24% sensitivity) (Filbay & Grindem, 2019).

Patients with ACL injuries usually have complaints such as pain, weakness in the injured leg muscles, difficulty in flexing the knee in full ROM, and others. The disorder certainly causes a decrease in the patient's functional ability. The functional ability of patients with ACL injuries can be measured using the Knee Injury and Osteoarthritis Outcome Score (KOOS) which has validity values: 0.79-0.96 and reliability: 0.83-0.86 (Multanen et al., 2018).

One of the interventions that can be given to ACL injuries is exercise. Exercise is defined as an intervention that requires participants to be active and moving. This can include physical activities

such as strengthening, stretching, proprioceptive agility, and others (Arundale, et al., 2018).



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Case Presentation

Subjective Examination

A 20-year-old man came to the clinic complaining of pain, aches, and difficulty in bending his right knee in full ROM. Sometimes the pain is felt in the morning. In addition, the pain increases when walking long distances and going up and down stairs. Complaints arise after the patient suffered an injury while playing soccer where the uneven field conditions caused the patient to fall. Then the patient was examined by a doctor and it was found that the right ACL ligament was torn. Finally, the patient underwent ACL reconstruction on February 3, 2021 and underwent physiotherapy on February 17, 2021.

Physical examination

The basic physical examination includes aspects of vital signs, inspection, palpation. In addition, motion examinations, pain examinations, ROM measurements, anthropometric measurements, and knee functional examinations were also performed. Vital sign examination can be seen in table 1.

Table 1. Vital Sign Examination

Examination	Result
Blood Pressure	110/80 mmHg
Heart Rate	78 bpm
Respiratory Rate	18 x /minute
Height	160 cm
Weight	59 kg

Based on the inspection findings, it was found that there was atrophy in the right quadriceps, there were still incision marks on the knee, and the walking pattern was not so normal. Based on the palpation study, it was found that there was hypotonia in the right quadriceps muscle and swelling in the right knee.

Next, the physiotherapist performs a motion examination. Movement examination is carried out actively and passively. Active or passive flexion of the right leg can be done but not full ROM. In active or passive extension movements on the right and left legs can be done in full ROM.

Examination of the value of pain in both legs, measured using the Numerical Rating Scale (NRS) which has an 11-point scale from 0-10, where 0 means no pain/numbness to 10 means unbearable



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pain/numbness. The NRS values were 0 when silent (no pain), 1 when pressed (moderate pain), and 5 when moved (moderate pain).

Examination of the joint range of motion in the knee joint, measured using a goniometer. The examination was carried out with the patient in the prone position and active or passive flexion was performed. The value of knee flexion is 115o actively and 120o passively on the right leg. While on the left leg, knee flexion is 135o actively and 140o passively.

Anthropometric examination was performed on both knees of the patient using a meter line. Anthropometric examination was carried out to determine the presence of swelling in the knee and muscle atrophy in the quadriceps muscle and gastrocnemius muscle. Anthropometric examination can be seen in table 2.

Table 2. Anthropometric Examination

Benchmark	Dextra	Sinistra	Difference
10 cm and above from the Tibial Tuberosity	41 cm	44 cm	3 cm
20 cm and above from the Tibial Tuberosity	50 cm	51 cm	1 cm
10 cm and below from the Tibial Tuberosity	36 cm	36 cm	0 cm

Examination of knee functional ability was measured using the Knee Injury and Osteoarthritis Outcome Score (KOOS). KOOS has a total of 42 questions. If the score is low, it indicates decreased or problematic functional ability and a high score indicates good functional ability. In this examination, the score was 46.32 (good enough).

Management and Outcome

The process of physiotherapy is carried out on patients in the physiotherapy poly of a hospital. The purpose of the intervention is to reduce pain, activate the muscles in the injured leg, increase knee flexion, reduce spasm and train the patient's balance. The physiotherapy interventions carried out are as shown in the following table:



Table 3. Management

Intervention	Doses
Stretching	
<ul style="list-style-type: none"> • <i>Calf Stretching</i> The patient stands facing the wall. The healthy leg is forward and bent, then the injured leg is behind and fully extended until the gastrocnemius muscle is extended. • <i>Hamstring Stretching</i> The patient stands with the healthy leg behind and bent while the injured leg in front and fully extended until the hamstring muscles are extended. 	<p>Stretching until the patient feels the target muscle is stretched, hold the movement for 10 seconds, do the movement for 3 repetitions, 2 times a week.</p>
Strengthening	
<ul style="list-style-type: none"> • <i>Calf Raises</i> The patient stands facing a wall. Legs spread shoulder width apart. Ask the patient to stand on tiptoe and then relax. • <i>Hamstring Strengthening</i> The patient stands facing the wall. Ask the patient to flex the knee of the injured leg. 	<p>The movement is performed for 10 repetitions with 3 sets, 2 times a week.</p>
<ul style="list-style-type: none"> • <i>Squat on Foam</i> The patient stands on the foam and asks the patient to do squats. 	<p>Hold each movement for 30 seconds, do 10 repetitions and, 2 times a week.</p>
<ul style="list-style-type: none"> • <i>Forward Lunges</i> The patient stands and asks the patient to perform lunges forward using foam. • <i>Lateral Lunges</i> The patient stands and asks the patient to do lunges to the side using foam. 	<p>Each movement is held for 15 seconds, do 10 repetitions, 2 times a week.</p>



Balance

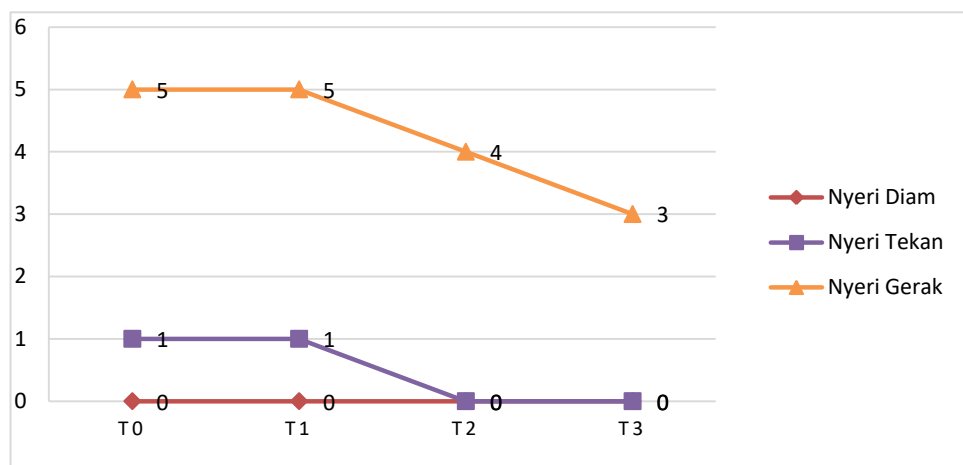
<ul style="list-style-type: none"> • <i>Single Leg Stance</i> The patient stands on the foam. Ask the patient to semi-flex the knee of the injured leg and elevate the healthy leg. • <i>Single Leg Stance with Cone</i> The patient stands on the foam. Ask the patient to semi-flex the knee of the injured leg and elevate the healthy leg. Then instruct the patient to touch the cone with the healthy foot. 	<p>Each movement is held for 15 seconds, do 10 repetitions, 2 times a week.</p>
<ul style="list-style-type: none"> • <i>Balance on Bosu</i> The patient stands on the bosu and asks the patient to do squats. The therapist throws the ball in all directions and asks the patient to catch the ball and keep it steady. 	<p>The movement is held for 15 seconds, do as much as 5 sets, 2 times a week.</p>

After the patient received physiotherapy sessions for 3 times, evaluation of pain value measurements using NRS, LGS measurements using a goniometer, anthropometric measurements using a meterline, and knee functional examination using Knee Injury and Osteoarthritis Outcome Score (KOOS).

The results of measuring the value of pain with NRS

Measurement of pain values using NRS was carried out before the intervention was given and evaluated after the intervention, the results of measuring the value of numbness with NRS were as follows:

Chart 1. NRS Measurement Results





The graph above shows a decrease in the value of pain in the right knee from T0-T3. Exercises in the form of stretching, strengthening, and balance can reduce the frequency of pain in the right knee of the patient at T0-T3 which is still in the moderate value range.

The results of measuring the range of motion of the knee joint using a goniometer

Measurement of joint range of motion was carried out before the intervention was given and evaluated at the third meeting, the results were as follows:

Table 4. Measurement of the Scope of Motion of the Joint

	Dextra		Sinistra	
	T0	T3	T0	T3
Knee Flexion Active Motion	115°	120°	135°	135°
Knee Flexion Passive Motion	120°	125°	140°	140°

The results of measuring the joint range of motion on the knee dextra using a goniometer showed an increase in the range of motion of the joint at T0-T3 from 115° to 120° when the knee flexed actively and from 120° to 125° when passive motion of the knee flexed, where there was a slight increase in the range of motion of the joint by 5°.

The results of anthropometric measurements using meter line

Anthropometric measurements were carried out before the intervention was given, and evaluated at the third meeting, the following results were obtained:

Table 5. Anthropometric Measurement

Benchmark	T0			T3		
	Dextra	Sinistra	Difference	Dextra	Sinistra	Difference
10 cm and above from the Tibial Tuberosity	41 cm	44 cm	3 cm	42 cm	44 cm	2 cm
20 cm and above from the Tibial Tuberosity	50 cm	51 cm	1 cm	51 cm	51 cm	0 cm
10 cm and below from the Tibial Tuberosity	36 cm	36 cm	0 cm	36 cm	36 cm	0 cm

The results of anthropometric measurements using a meter line showed a slight decrease in atrophy (an increase in muscle mass), namely at T0-T3 from a difference of 3 cm to 2 cm at the benchmark



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point '10 cm and above from the Tibia Tuberosity', and a difference of 1 cm to 0 cm at the point the '20 cm above the Tibial Tuberosity'.

Discussion

1. *Stretching*

Stretching is an important exercise for ACL post reconstruction patients with specific muscle imbalances (Madison, 2018). Giving stretching can maintain lower extremity flexibility. Giving stretching for 30 seconds can increase the Range of Motion (ROM). The duration of giving stretching or repetition of movements that are more likely to provide a more significant and necessary effect for patients with post reconstruction ACL (PHYSIOTHERAPY ACL PROTOCOL). Passive stretching will cause sustained tension in the muscles through the external force applied, resulting in an increase in muscle length thereby increasing muscle metabolic activity. This movement effectively has the benefit of exercising without physical stress (Gurudut & Rajan, 2017).

2. *Balance*

Individuals with unstable knees due to ACL rupture rely heavily on muscle function throughout the knee joint to maintain dynamic balance during functional activities (Gasibat & Jahan, 2017). Patients with post ACL reconstruction will experience muscle imbalance on the injured side with the healthy side as well as the knee extensor muscle groups and knee flexor groups (Vidmar et al., 2019). Balance exercises are very necessary for ACL reconstruction patients. The goal is to increase the dynamic stability of the knee joint, increase the stability of one leg, and activate muscle groups in the knee joint area (Wilk, 2017).

3. *Strengthening*

Post operation reconstruction ACL causes some disorders such as weakness in the lower extremities. Strengthening exercises are important to reduce lower extremity weakness. Strengthening exercises can help activate the muscles around the knee and help to increase the range of motion of the knee joint (Beardshaw et al., 2015). Strength training is a fundamental stage in the rehabilitation program after ACL reconstruction. Eccentric weight training appears to be more effective in restoring

quadriceps muscle mass, quadriceps muscle strength, and functional ability in individuals undergoing ACL reconstruction (Vidmar et al., 2019). Strengthening exercises are very important for post ACL reconstruction patients. The goal is to



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increase lower extremity strength, increase muscle strength, improve proprioception, balance and neuromuscular control, and improve knee joint stability (Wilk, 2017).

Conclusion

The physiotherapy program conducted three times with stretching, strengthening, and balance exercises was able to reduce pain scores, activate the muscles in the injured leg, increase knee flexion, and improve the patient's functional ability.

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