PHYSIOTHERAPY MANAGEMENT OF MEDIAL COLLATERAL LIGAMENT (MCL) REPAIR: A CASE STUDY

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Abstract

Introduction: The Medial Collateral Ligament (MCL) is a ligament located inside the knee joint that connects the femur to the tibia on the inner or medial side. The MCL's major role is to keep the knee joint stable and to avoid excessive sideways or valgus movements. Injury to the MCL might caused by valgus forces and sudden rotational extension of the knee, which frequently occurs during athletic activities causing the knee to be in a rotational position when the force is applied. As a result, the MCL is sprained or overstretched. If the force applied to the knee is greater, the ligament will rupture.
Case Report: The patient is a 30-year-old male who has a ruptured right MCL. He had intraoperative surgery 1 day after his injury for reconstruction. After two weeks, the patient returned to the physiotherapy clinic, where he had difficulties bending and straightening his knee, the quadriceps' muscle strength appeared to decrease, and he had difficulty in walking. Rehabilitation had been done twice a week and included activities to facilitate the improvement of joint range of motion and muscle strength.
Conclusion: The present case concluded that the training program provided can enhance knee joint range of motion following MCL surgery. The findings of this case pointed to the necessity for bigger patient groups to be studied with long-term examination of the safety and efficacy for the MCL's exercise program.

Keyword: medial collateral ligament, knee joint, surgery, muscle strength, exercise program.

Introduction

Sports injuries are pain caused by sports, and it can be characterized by pain, edema, cramps, bruising, stiffness, and limitations in joint mobility and strength in the affected area. Almost all athletes sustain injuries such as scratches, torn ligaments, or fractures as a result of falls during activity. Injuries can happen to anyone, not just athletes, and the most common are medial collateral ligament injuries (Tharziansyah, 2021).

Medial Collateral Ligament (MCL) injuries are frequently caused by direct trauma to the lateral side of the knee or by a quick action that forces the knee to bend inside. These injuries are commonly occurs in sports like football and basketball. MCL injuries are a sort of injury or trauma that happens in a variety of sport activities, including soccer players, runners, skiing, and a variety of other contact sports, particularly when this joint is moved beyond its capacity to produce ligament damage. The prevalence of Segond fractures ranges from 29% to 33% in patients with MCL injuries. A possible link between MCL injuries and Segond fractures is related to excessive valgus movement of the knee. There is a 23-35% incidence of concurrent MCL injuries, medial and lateral meniscus. While on the other hand reported an incidence of 10-60% of MCL (Ping Yen Yeo, 2022).

The MCL is a wide, flat, membranous ligament located on the medial side of the knee joint. This ligament is located more posteriorly on the medial surface of the tibiofemoral joint, where it is joined above the medial epicondyle of the femur below the adductor tubercle and downwards to the medial tibial condyle and the medial meniscus. The entire MCL is tightened during the full range of motion of the knee extension; the MCL is also linked to the medial meniscus. This ligament is frequently injured, and it frequently occurs in conjunction with medial meniscus injuries, the primary function of which is to maintain extension motions and prevent outward movement (Memarzadeh A, 2019).

Injury to the medial collateral ligament is caused by valgus forces and sudden rotational extension of the knee, which frequently occurs during athletic activities or as the body weight received by the knee when supporting body weight is imperfect or unstable, causing the knee to be in a rotational position when the force is applied. As a result, the MCL is sprained or overstretched. If the force applied to the knee is greater, the ligament will rupture (Martin et al., 2022).

Ligament rupture is the damaging or ripping of the ligament's fibers. Ligament injuries are divided into three grades. Grade 1 means that the ligament has been somewhat strained but is still able to preserve joint stability. A few broken fibers accompanied by mild pain and swelling but no further damage to the ligament. Grade 2 refers to the stage at which the ligament has widened and a partial tear has occurred. Ligaments normally heal without surgery. Can perform limited functions with little instabilities. Grade 3, where the ligament has completely torn. Because the ligaments have separated into two portions, the knee joint becomes unstable and often difficult to maintain. Despite the use of crutches, surgery is frequently required for repair (Ueshima, 2011).

Case Presentation

A 30-year-old man who works as a prison guard and enjoys playing soccer was the subject of this case study. He was injured in a football club amateur match in June 2023. He was hit from behind by one of the opposing player, which caused his knee to twist in a valgus orientation, followed by rotational extension of the knee, and then he fell in an attempt to retain stability. The pain in the medial part of the knee got worse while walking, and it experienced swelling. The next day, he went to the hospital for an evaluation. An MRI revealed a complete tear of the right MCL. The patient had the right knee MCL repaired surgery. After two weeks, the patient returned to the physiotherapy clinic because he found it difficult to bend and straighten his knee, his thigh muscles appeared to diminish, and he found it difficult to walk.

Interventions

1. Mobilization of the Patella
   a. Patient's position: supine lying on the bed with both legs straightened
   b. The therapist sits beside the patient
   c. The therapist holds the patella with the thumb and forefinger of both hands
   d. Mobilize the patella to proximal, distal, medial and lateral direction
   e. 15-30 repetitions
2. Quadriceps Sets

Figure 1. Quadriceps sets

   a. Patient's position: sitting upright and then leaning his body against the wall with both legs straightened
   b. Place an exercise pillow (each 3 pieces) under the hamstrings on the distal part of the femur
   c. Place the ball between the two ankles which serves as maintaining alignment when doing the movement tient to contract the quadriceps muscle by pressing the pillow down (towards the floor) with the knee in full extension and both ankles dorsally flexed. Hold for a few seconds according to the prescribed dose.

d. Make sure the alignment of that movement is correct
e. 20 repetitions, 2 sets

3. Straight leg raises

Figure 2. Straigth leg raises: Hip abduction **Figure 3**. Straigth leg raises: Hip extension

a. Hip Flexion
   1) Patient's position: supine lying
   2) Instruct the patient to do hip flexion (the exercise movement is based on the repetition count according to the given dose)
   3) When performing knee and ankle movements in a locked position
   4) If the movement is stable, it can be added progressively with the load
   5) Make sure the alignment of this exercise movement is done correctly
   6) 10 repetitions, 3 sets (at the end of the movement hold for 6 seconds)
b. Hip Abduction
   1) Patient's position: side lying (outer hip muscles)
   2) Instruct the patient to perform hip abduction movements (the exercise movement is based on the repetition count according to the given dose)
   3) When performing knee and ankle movements in a locked position
   4) If the movement is stable, it can be added progressively with the load
   5) Make sure the alignment of this exercise movement is done correctly
   6) 10 repetitions, 3 sets (at the end of the movement hold for 6 seconds)
c. Hip Extension
   1) Patient's position: prone lying
   2) Instruct the patient to do hip extension (the exercise movement is based on the repetition count according to the given dose)
   3) When the movement of the knee and ankle is in a locked position
   4) If the movement is stable, it can be added progressively with the load
   5) Make sure the alignment of this exercise movement is done correctly
   6) 10 repetitions, 3 sets (at the end of the movement hold for 6 seconds)

4. Heel Slides
   a. Patient's position: sitting upright leaning against the wall, both legs straightened
   b. Ask the patient to wear socks / wrapped in a slippery cloth
   c. Instruct the patient to bend the knee to the limit of its ability. Movement begins from the heel to the patient's ability limit. Targeted to full ROM progressively
   d. It should be noted that when bending the movement, the pain is within minimal limits (instruct the patient to not move the hip during this exercise)
   e. Make sure the alignment of this exercise is done correctly
   f. 15 repetitions, 2 sets

5. Ankle Theraband
   a. Patient's position: sitting straight, both legs straightened
   b. Place a pillow under the ankle
   c. Wrap the theraband on the metatarsal, the other end of the theraband becomes the anchor. The exercise is carried out with 4 movements; dorsal flexion, plantar flexion, eversion, inversion against the resistance of theraband according to the dose given
   d. It should be noted when doing these four movements, make sure that the knee locks, and there is no compensatory movement from the hip
   e. Make sure the alignment of this exercise movement is done correctly
   f. 30 repetitions, 1 set per movement

6. Weight shifting exercise
   a. Patient's position: standing with feet shoulder-width apart
   b. Make sure the patient is in an upright position, both hands on the hips
   c. Instruct the patient to lean on the injured leg slowly, the physiotherapist sits behind the patient to correct the movement
   d. When supporting the patient in a straight line, give resistance for a few seconds then slowly return to the normal standing position
   e. Make sure the knees are in a locked position, and there is no compensatory movement from the other limbs

8. TENS
   a. Patient's position: supine lying
   b. Place pillows under the patient's knees and feet
   c. Place the TENS electrode pads on the patient's knees and feet
   d. Slowly increase the intensity of TENS given to the patient with a duration of 10 minutes

9. Cold therapy
   a. Patient's position: sitting/supine lying
   b. Wrap ice cubes in an ice container and prepare a towel
   c. Place packed ice cubes around the knee and then wrap it with a towel
   d. Tape the towel so it does not wet the surrounding area and then do it for 10 to 15 minutes

10. Gait Training
   a. Patient is trained to walk Non-Weight Bearing (NWB)

Outcome Measurements

The range of motion (ROM) of the knee joint is measured with a goniometer, and the patient is asked to move his knee actively in the direction of flexion and extension with the axis of the lateral epycondyle femur. When compared to the healthy knee, the post-surgery knee had pain and limited ROM (Table 1). The patient has been unable to move adequately in the upper limbs, demonstrating muscle weakness in the right upper limb relative to the left.

The measurement of muscle circumference used a measuring tape to check each point segment circumference which resulted 3 cm higher difference on the 5 cm to proximal by the post-surgery knee compared to the healthy knee (Table 2). The measurement result indicated a swelling in the nearest area to the post surgical area, and resulting in limited movement, pain, and numbness.

A sphygmomanometer was used to test leg muscular strength by encouraging the patient to actively alternately contract the quadriceps and hamstrings muscles. On the post surgery knee, the value obtained was 20 mmHg for quadriceps muscles and 100 mmHg for hamstrings muscles. When compared to the healthy knee, the result indicated a decrease in quadriceps muscle strength on the postsurgical knee with 120 mmHg for quadriceps muscles and 100 mmHg for hamstring muscles (Table 3).

Table 1. Evaluation of ROM before and after intervention

Right Knee	**Pre Intervention**	**Post Intervention**
Flexion	55^{o}	76^{o}
Extension	5^{o}	0^{o}
Left Knee	**Pre Intervention**	**Post Intervention**
Flexion	148^{o}	148^{o}
Extension	0^{o}	0^{o}

Table 2. Knee circumference before and after intervention

Circumferences	**Pre Intervention**		**Post Intervention**	
	Right (cm)	**Left (cm)**	**Right (cm)**	**Left (cm)**
25 cm to Proximal	53	54	53	54
20 cm to Proximal	48,7	49,8	48,7	49,8

Circumferences	Pre Intervention		Post Intervention	
15 cm to Proximal	44,5	44,5	44,5	44,5
10 cm to Proximal	43,5	41	43,5	41
5 cm to Proximal	41,7	38	37,9	38
0 cm	**37**	**36**	**37**	**36**
5 cm to Distal	36,2	38	37,2	38
10 cm to Distal	38	39	38	39
15 cm to Distal	36,8	36,5	36,8	36,5

Table 3. Evaluation of muscle strength before and after the intervention

Right knee	Pre Intervention	Post Intervention
m. Quadriceps	20 mmHg	40 mmHg
m. Hamstring	100 mmHg	100 mmHg
Left knee		
m. Quadriceps	120 mmHg	120 mmHg
m. Hamstring	100 mmHg	100mmHg

Discussion

This case report identifies the recovery of MCL repair with an exercise program that aimed to minimize inflammation and increase the range of motion of the joint after 3 times of treatments where the mobilization of the patella aims to strengthen the muscles around the knee, increases flexibility, and improves the coordination of patella movement (Kisner, 2012). The patella mobilization is also beneficial in restoring knee joint range of motion; in addition to increasing joint mobility, this approach can also relieve pain. For best outcomes to the range of motion of the knee flexion, which should be performed soon after MCL reconstruction (Cavanaugh & Powers, 2017). Active ROM exercises was given in the form of a functioning heel slide movement which produced a good short-term effect on pain in knee function because this exercise encourages patients to actively participate in their rehabilitation process so that it is more effective in functional rehabilitation including neuromuscular activation and early return to daily activities.

Acute injuries are always followed by a bleeding process, which results in an accumulation of extra fluid in the tissue. Applying ice packs will slow or halt the bleeding. This is due to a variety of ice therapy effects. First, ice packs cause blood vessels to constrict due to the cold temperature action of the ice (vasoconstriction), lowering blood concentration in the damaged area. Second, the cold therapy will raise the amount of blood viscosity in that area. Third, the strong cold effect associated in being able to suppress the pain caused by the damage. It has been demonstrated that exceptionally low temperatures or continuous cooling cause a counterintuitive rise in local edema. Despite vasoconstriction and decreased blood flow, cold therapy can promote delayed vasodilation and subsequent hemostasis disruptions (Roadi, Farhatuzziyan, & Wardojo, 2023).

Cold therapy can cause cold stimulation to skin tissue as well as a decrease in tissue metabolism, resulting in a decrease in the formation of edema fluid and the production of lymph fluid, which can release inflammatory mediators through a decrease in the permeability of blood vessel walls, resulting in a decrease in edema. Cold therapy reduces pain by lowering intra-articular temperature and can reduce pain by accelerating nerve conduction with direct vasoconstriction, reducing vascular stiffness, and slowing blood flow, all of which can diminish tissue edema (Fatmarizka, 2022).

The patient's quadriceps muscle strength in this study showed an increase from a value of 20 mmHg before interventions to 40 mmHg after interventions. Muscle strengthening exercises using isometric exercises are in accordance with research of Anwer et al (2014), the isometric exercises showed a beneficial effect on quadriceps muscle strength, because these muscles’ functioning as knee extensors, thereby increasing knee stability and influencing a decrease in pain and an increase in activity functional. Meanwhile, when the muscle strength increases, there will be changes in muscle fiber contraction and neurological adaptation, namely increased coordination and recruitment of muscle units, which will increase muscle strength which also resulting in functional improvements (Delyuzir, 2009).

This isometric exercise causes a change in muscle morphology in which muscle mass rises, which is produced by the increased number of mitochondria as a result of this activity. Isometric quadriceps exercise resulted in constant muscle length during contraction, with no joint movement but an improvement in muscle tone, known as static contraction. The quadriceps muscles are frequently weak after MCL restoration (Hart, 2015). So, the impact of this strengthening exercise is to develop dynamic muscle strength and form power, which can strengthen the quadriceps muscles, minimizing excessive loads or stress, and thereby lowering knee discomfort (Huang, 2018).

According to the Suharsono et al’s study (2022), isometric exercise is a type of static exercise in which the length of the muscles being trained does not change and there is no joint movement, resulting in increased muscular tension and constant muscle length. This exercise is designed to improve muscle strength while also preventing quadriceps atrophy. According to the findings, isometric exercise stimulates the neuromuscular and muscles to operate, and this stimulation causes the lower motoric muscle nerves to work, producing acetylcholine and causing pain, resulting in an increase in the body's metabolism in polarity. Smooth muscle will produce adenosine triphosphate (ATP), which can be used as energy for contraction, resulting in increased limb smooth muscle tone (Suharsono, Novianti, & Suadnyana, 2022).

The disadvantage of this study was that physiotherapy only performed measurements and evaluations for two weeks, which were repeated for three times, so that the intervention given to the patients did not result any significant effects. The study's findings can be utilized as comparison and reference material for future research, and it is expected to conduct research over a longer period of time to determine the efficacy and hazards of in-depth analysis.

Conclusion

Based on the results of this case study that have been discussed, it can be concluded that the provision of exercise treatment and physiotherapy modalities has good evaluation outcomes. However, there was still a lack of decreasing the edema and the muscle strength on the right knee. Exercise therapy in the form of isometric exercises and modalities in TENS and cold therapy are also helpful in enhancing ROM in post-MCL repair conditions.

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