

Pre and postoperative rehabilitation of adult athletic player with ACL reconstruction.

Yousef Rafat¹, Lois Salem²

1. Department of Physical Therapy for Musculoskeletal Disorders and Their Surgeries, Faculty of physical Therapy, Beni-Suef University

2. Department of Physical Therapy for Musculoskeletal Disorders and Their Surgeries, Faculty of physical Therapy, Beni-Suef University

Abstract

Objective:

The purpose of this study was to determine the effects of preoperative and postoperative rehabilitation on knee proprioception, muscle strength, stability and functional level in athlete with anterior cruciate ligament reconstruction (ACL-R).

Study Design: Case report.

Level of Evidence: Level 5.

Methods: a 6 weeks preoperative RICE, four set exercise, cryo and electrotherapy was applied to a 23 years old professional level football player with right ACL tear was going into ACLR. Followed by 24 weeks of postoperative functional strength training, stability, balancing, proprioceptive, manual therapy exercise and gait training ending by perturbation, jumping, running and hop training.

Results: joint effusion was controlled after 6 weeks preoperative rehab with restoration of joint ROM, allowing patient to get into ACLR surgery. By the end of 24th week postoperatively patient regained full muscle power, full joint ROM, could realize joint sense, double and single leg stance on balance board up to 3 min. 80% to 90% of hop testing was achieved in addition to running continuously 15–20 min.

Conclusion: a well-designed pre and postoperative training program get a young athlete to a successful ACLR surgery, preventing postoperative complications and improving postoperative out-comes. Leading patient to get into his sports again.

Key words: ACL, ACL-R, postoperative, preoperative.

Introduction

An ACL injury is a tear or\and sprain of anterior cruciate ligament that connect the femur & tibia together and provides rotational stability to the knee in frontal &transverse planes ,it account for up to 64% of athletic knee injuries , &About 200000 people are injured per year , ACL tears newly occur in about 69 per 100000 per year with rates in males (6) of 82 per 100000, males between the ages of 19:24 had the highest rates of injury.

Injury of Anterior cruciate ligament is one of the most common traumatic injuries of the knee joint (1). Associated with many risk factors divided into anatomical factors (narrow femoral intercondylar notch at the patient knee joint), and external factors includes type of competition, footwear and environmental as high level of friction between shoes and the playing surface. The injury makes joint instability that associate with both acute dysfunction & long term degenerative osteoarthritic changes and meniscal damage. This casereport represent a case of football player with ACL sprain, and a posterior horn medial meniscus degeneration (PHMM) ,That became injured during playing when the knee joint had been positioned at dynamic valgus stress and his journey with a preoperative (which is necessary for preparing his knee structures for the ACL reconstructor surgery) &postoperative rehabilitation programs with its seven phases after the hamstring autograft ,for qualifying him to return into playing in the beni suif football team as if he wasn't injured before, With making sure that incidence of reinjuring him again duringplaying is almost seldom.

Case presentation

The patient was a male 23-year-old professional level football player, who at the time of injury was playing football in the Beni-Suef sports club. His medical history prior to injury reported that it was ACL sprain, degenerated PHMM and bucket handle tear of the lateral meniscus in the contralateral knee and it was managed conservatively (Figure 1).

December 25, 2021 was the date of the injury, it was non-contact, with the knee slightly flexed by about 30° with valgus knee force and external tibial torsion. He experienced immediate pain, joint effusion after 6hr, muscle inhibition, lateral aspect tenderness, ROM restriction and episodes of instability. An MRI scan the day after injury confirmed an interstitial tear of the right ACL, PHMM and PHLM degeneration grade I, mild joint effusion and bone marrow edema and contusion (Figure 2). Surgical opinions were sought by the orthopedic knee surgeon and the footballer's choice. Surgery would be inevitable due to the demands and level of football and taking into consideration the conservatively treated left knee injury. After 6 weeks of preoperative rehabilitation focusing on reducing joint effusion, regaining ROM, promoting neuromuscular control of the quadriceps, hamstrings, gastrocnemius, and hip musculature, and patient education in a home exercise program. The ACL reconstruction was performed on March 3, 2022 consisting of arthroscopically assisted ACL reconstruction using a hamstrings autograft with suspensory fixation at the femur and tibia. Then the patient underwent postoperative rehabilitation.

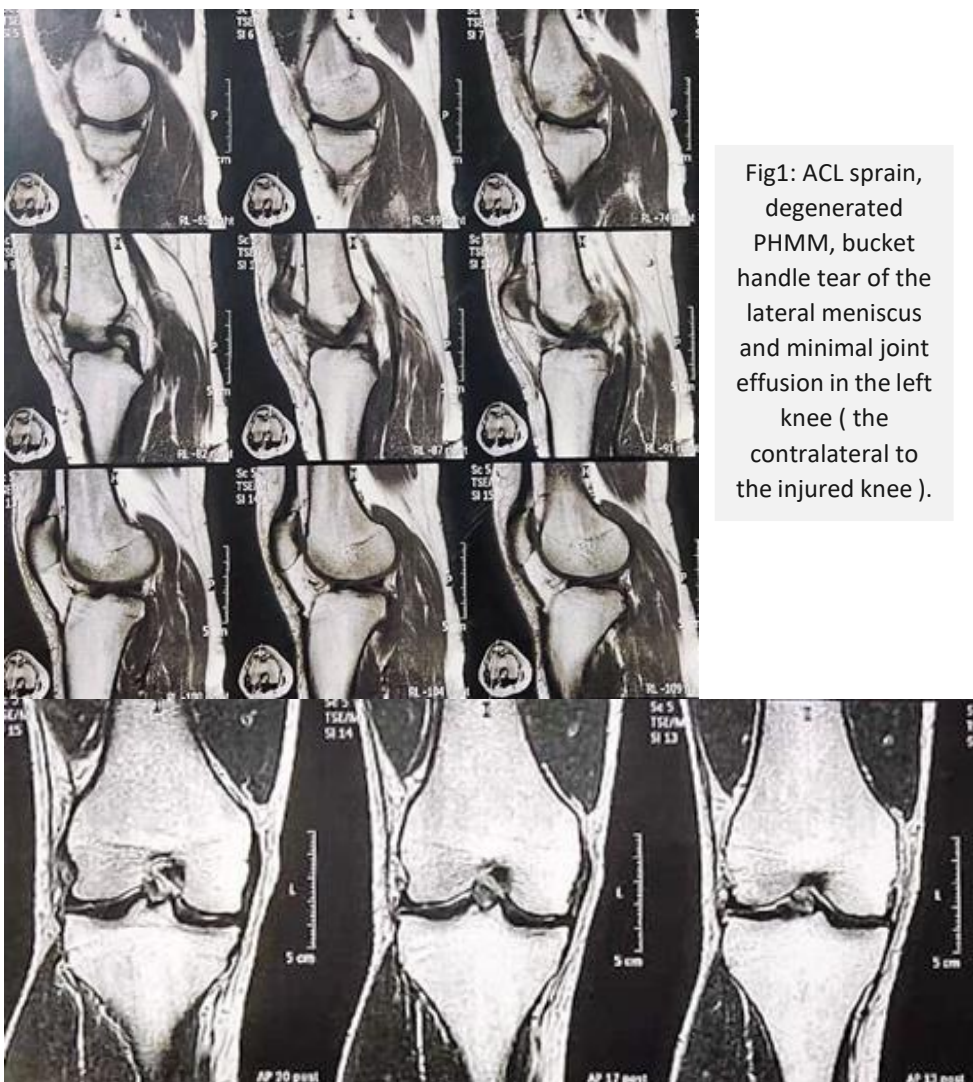


Fig1: ACL sprain, degenerated PHMM, bucket handle tear of the lateral meniscus and minimal joint effusion in the left knee (the contralateral to the injured knee).

Fig2 : RT ACL tear with PHMM and PHLM degeneration grade I and bone marrow edema\contusion.

Materials and methods

Clinical Assessment:

ACL injury diagnosis is typically made by mainly the physical examination & MRI.

The physical examination tests are usually not conducted, thus different index tests must be combined to assist in the diagnosis of ACL injury.

The physical examination of the knee might not be possible in acute situations because of swelling and pain. On examination we found a tenderness around the knee joint, reduced ROM, increased looseness of the joint so we started to make some tests to the case as: Anterior drawer test which has a reported sensitivity values ranged from 0.18 to 0.92 and specificity values ranged from 0.78 to 0.98 (2)

we asked the patient to lie supine, the knee being tested flexed to 90 degree and the hip flexed 45 degrees. While sitting on the patient's foot and grasp the tibia proximally from behind and palpate the tendons of the hamstring muscle to ensure relaxation then I applied a force directed anteriorly

*Our case response was an anterior displacement on the affected side compared with the unaffected side. (figure 3) Because of the positive result of the previous test with our case we had to confirm the findings with another test, so we decided to perform the pivot shifting test; which in it we asked the patient to lie supine, while I flex the case knee 90 degree; and I applied a medial rotation of the tibia the slowly extend the knee joint while still applying the medial rotation on the tibia; on reaching the full extension a relocation of the tibial plateau occurred with a click sound we heard coming up from his knee, the sensitivity of this test ranged from 0.18 to 0.48 and specificity from 0.90 to 0.99 (3)

After hearing the popping sound and seeing the relocation of the tibial plateau that surely declares loudly about the positive result of the second test we used,

Since then we had to put a corner stone in confirmation our diagnosis to this young man we knocked the door of our last test that has a sensitivity 0.63 to 0.93 and the specificity 0.99 to 0.55 (4), Lachman test: in it we asked the patient to lie supine the injured knee is flexed to 15 degree; while I stabilized distal femur with one hand and grasp the proximal tibia with the other hand with applying anterior force directed anteriorly to the proximal tibia, we found anterior tibial displacement occurred compared with the other knee, finally we became so sure of our case diagnosis to start our treatment stage journey.



Fig.3: ANT drawer test



TREATMENT

Preoperative ; The aim mainly in our treatment program is for functional training to restore knee function rather than timed based protocol and to prevent further knee injury and optimize quality of life ,that's why we started the rehabilitation program with our case immediately after the injury ,then we started to progress with him according to the case level that he pass throw during every single phase ,we started with him exercises that target full passive extension as leg hinged out of the plinth while he was prone lying and quadriceps muscle function at day one .

We used these specific types of electrotherapy with our case : as Tens for pain relief, laser to increase the circulation and promote healing, cryotherapy which is essential for decreasing the joint effusion ,-pneumatic pressure we used it to decrease effusion specially in the acute phase of our patient &for pain relief &increase joint mobility &speed up recovery which is our main goal , how could us forget using RICE : rest –ice –compression –elevation ,these techniques helped us a lot in pain control and decrease joint effusion we also put them into the case home program

P.S : we use the cryotherapy with our case before the exercise mainly to decrease pain &after the exercise to decrease the knee joint effusion The main muscle group focused on in our preoperative rehabilitation is the anterior muscle group (the quadriceps muscle) as isometric contraction of quadriceps muscle by asking the patient to press down on the plinth without putting A towel under his knee of course to prevent the anterior translation of the tibia on femur that could make the injure worse

as the patient progress and his muscle power started to increase up to grade 3 muscle power with complete extension of the injured knee (which occur in the third weak after the injury) we started a SLR excise with 20 repetition on 2 sets then up to 25 repetition on 3 sets on the 4th week after injury ,on the 5th weak we increased the sets with adding a circular movement of the SLR exercise

We also used a strengthening exercise to the rest lower limb muscles of the affected side as hamstring muscle we started with eccentric contraction in the first 2 weeks the on the 3rd weak the patient had the enough muscle power to start the concentric exercise by asking him to flex his injured knee actively , on talking about the adductor &abductor these muscles actually were very good on its muscle power since the first weak as the patient can actively move his lower limb toward &outward the other thigh and with resistance science the second weak. Because of our awareness of the importance of core muscle in prompting healing we couldn't forget core stability exercise like, bridging and blank up to 1 minute stability, we focused also on balance and proprioceptive exercise started from week 4 by using AP, ML and multi balance.

In addition to patellar mobilization that we used mainly to prevent the formation of arthrofibrosis & infra patellar contracture syndrome that let the patella move free.

Postoperative; (figure 4) Because Operative treatment was the right choice because our patient Is younger than 25 years old (23years old) ,he had a marked anterior tibial subluxation ,and he was a highly active person ,and unfortunately had an intra articular damage . here our post operative rehabilitation program started that consists of 7 phases, let's take a quick look on them!

Phase I (from day 1 to 7) :in it we asked from the patient to use his crutches and to use the knee immobilizer and we learned him how to walk while using them ,we started also with him a few genital exercise as heel sliding and wall sliding ,ankle pump and isometric quadriceps contraction ,prone hanged on the plinth for passive knee extension ,weight shifting in standing for weight bearing from standing position while wearing the brace ,cryotherapy also helped us a lot in this phase in reduction of effusion but most of our session time had been pended on passive movements & patellar mobilization

Phase II (from day 8 to 14):in it happily we removed using one of the crutches and start using a single one , in this phase we used with him our clinic stationary bike for 10 minutes ,with isometric quadriceps muscle exercise (of course he had increased his muscle power ,that's give us a confident to start single leg stance in his brace .and ROM exercise , we cheered up when he became able to do squat 30 degree knee flexion and here we realized that the outcome of our case would be awesome !.

Phase III (form week 2-4):at this phase our patient finally get rid of his crutches (both of them) &brace on the 3rd week and certainly as our case functional state improve we increase our training load on his muscles , so we added a resistance in the stationary bike to improve his endurance ,with squatting which is one of the closed kinetic chain exercise up to 90 degree knee flexion ,and how we could forget using the balance board ,with progressing into single leg balance started with open eyes then with closed ones ,then we moved on using our treadmill for him to walk on it under our observation .

Phase IV (from week 4-8): we started this phase witha genital scare mobilization that present on the hamstrings muscle just above the popliteal fossa

The operative site), and we continue using our stationary bike with of course increasment in resistance with few intervals time, lunges exercise up to 60 degree but our case wasn't good at performing this specific type of exercise unfortunately. but at calf raises exercise was good that's why gradually we increased the reputation with him ended up with him into 50 repetition on 2 set !which was a great result, we started in this phase the 4 direction treadmill training, and multi direction balanceboard, with core strengthening exercise as bridging exercise.

Phase V (from weak8-12): squat exercise with resistance (holding weight while performing squatting) And lunges exercise but he became good in performing this exercise so we increased the repetition with him

,calf raises exercise in it we reached to 80 repetition in 2 sets, resisted hamstring strengthening with increment at the exercises for core muscle by adding the plank & side plank in addition to bridging exercise, with adding very changeable exercises that combine between the balance and strengthening here we started squat on the balance board and single leg stance (the affected of course) while pulling band laterally on RT & LT sides.

Phase VI (from week12 -16): on reaching this phase we added a few more important exercise with continuity of the previous ones, the new ones were walking on uneven surfaces with weights on his L.L for 10 minutes, with usage of slide board exercise, we started also a jogging in balance exercise, standing on multidirectional balance board with eye closed while I gave him a disturbance in all direction, a shuttle jumping with perfect landing strategy with finally a perturbation training on the roll and balance board training in a very focused manner.

Phase VII (from 16-24): progressed with running with him & training him with hop test after making sure about the ability of our case to perform it, and jumping from double limb into a single limb in vertical and horizontal planes, jumping over barriers and obstacles with perfect landing, squat jumping and scissor jumping depth jumping which mean increasing in the knee flexion on landing, ending with plyometric exercises as stance jumping on the affected limb.



Fig.4 : different postoperative techniques including strengthening, proprioceptive, core stability, balancing and gait training exercises

RESULTS

By the end of 6 weeks preoperative joint effusion was controlled, the right knee almost fully extended with quadriceps power G=4 MMT and +90 degree knee flexion was regained with hamstring power G=3 MMT. During postoperative training, pain gradually subsides, full ROM restored by the end of 4th week (phase III). A G5 MMT for right quad and ham muscles.

By the 16th week (end of phase VI) patient can perform, single-leg squat, 20 repetitions to 60 degrees

of knee flexion, single-leg stance at least 60 seconds, single-leg calf raise 30 repetitions and good landing form with bilateral vertical and horizontal jumping Hop testing†: 80% of uninvolved limb performed prior to running.



Table 1: From 16th week till the end of 24th week.

Hop testing	Progressive running
Single-leg hop for distance = 90%	Week 1: Run: 10–15 minutes
Single-leg triple hop for distance = 90%	Week 2: Run: 10–20 minutes
Triple crossover hop for distance = 90%	Week 3: Run: 15–20 minutes
Timed 10-m single-leg hop 80% to 90%	Week 4: Run: 3–4 times/w 20–25 min
60 Sec timed vertical hop test	Week 5: Run continuously 15–20 min 3–5 times/week

On monitoring the previous results for hop testing and progressive running by the end of 24th week, our athlete was passed the his 1st ball and return to sport.

Discussion:

Finding indicated reasonable awareness about seriousness of ACL injury specially in athletes like our case, but there is a lack of information in the athletics' communities about the risk factors of this injury (9), there is a need for increasing health education and awareness for them in our community and it is our role as a PTs.

Preoperatively: the case took 22 sessions in our collage clinics, to get his knee structure and muscle ready for the surgery.

*here our rule appeared like a hero to prevent a serious & various problems that could happen secondary to the injury as: (Knee stiffness – Arthrofibrosis- Muscle atrophy – near normal gait -Full ROM (inflexion & extension) - The ability to hop on one leg as needed in the game he play -Mental preparing the case before the surgery to get the complete control on the (Hem arthrosis -Knee pain -Hotness (and all the acute symptoms) -Extension lag (incomplete extension)-Giving way phenomena - Joint instability of the knee -The gait abnormality (quadriceps avoidance gait)

and because of the complexity of the knee joint (formed by 3 bones) that makes the presence of the ligament (ACL) that connect them all together essential, it runs from the front of the tibia to the back of the femur, and because ACL injury used to be a career ending injury for the athletes, that's why the rehabilitation is the corner stone (7)(8)

Post operatively: the case took 24 week to participate into playing with his team again (p.s as we described in the treatment): so our main goal at this 7 phases was to Restore stability-&focusing on Maintenance of full ROM of the injured knee joint with Isometric ligament function which is essential to restore the full function Patient education we used to prevent his knee from any other injury also studies showed Wearing a padded footwear & wearing a knee brace doesn't appear to prevent ACL injury or reduce the risk of recurrent injury after surgery (5), while other studies found a greater risk of knee injury in those who didn't wear a functional brace than in those wore in brace (10), but at the end we were with the second study and we consult

the case to wear a knee brace during play football and its result was good for us, P.S (Prevention mainly occur via core strengthening exercise & neuromuscular training).

Conclusion:

In summary, this case study confirms the feasibility of preoperative intervention post injury to improve joint mechanics, stability, regain ROM, joint effusion control and patient education. Which lead to a successful surgery and improve postoperative outcomes. In addition to a professionally designed postoperative rehabilitation program for athlete representing VII phases, completed within 24 weeks of intensive rehabilitation from the day after ACLR to return to sport. A variety of functional strengthening and ROM exercise, weight bearing, balancing, proprioceptive, perturbation, jumping, jogging training and suitable manual therapy techniques. All of this training consequence was gradually performed according to each phase availability criteria, to lead our athlete to recovery and professionally return to sport.

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