



Rehabilitation of Anterior Cruciate Ligament Reconstruction for Return to Sports – A Case Study

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ABSTRACT

Most often in athletics, the ACL is a cruciate ligament that is particularly prone to injury. ACL injuries are more common in athletes who play high-demand sports like basketball, football, and soccer. Partial ACL tears are uncommon; entire or nearly full tears of the ACL constitute the majority of ACL injuries. This study's objective was to demonstrate RTS's extraordinary recovery 24 weeks following ACLR. A total of 10 publications were retrieved from Google Scholar, PubMed, and Scopus, and the findings of relevant articles were examined. Additionally, find the RTS for ACLR to provide exceptional achievement. The authors review current ACLR research to develop a successful treatment and rehabilitation strategy. Strategies for preventing recurrent ACL tears and return-to-play issues are also discussed. A sports physician should base their judgement about whether an athlete should resume their sport on self-reported variables, manual stability checks, and functional performance testing. Our case study revealed that RTS was finished in 24 weeks as well as the patient made a fantastic recovery.

Keywords -ACLR; Rehabilitation; Physiotherapy management; Return to sports; early recovery.

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INTRODUCTION

To retain consistency in athletics, be patient with your prognosis. The anterior cruciate ligament (ACL) injury is one of the most serious and frequent knee ligament injuries. ACL tears have a very complex exact aetiology. The aetiology of ACL tears is complex and multifactorial; various research groups have found a link between genetic risk factors, environmental risk factors, the intrinsic risk factors. (1)

The ACL is critical to the knee joint's kinematics because it stabilises the knee joint's rotation and restricts anterior tibia-to-femur translation. Mechanoreceptors are also present, and their function is to keep the joint under the direction of the neuromuscular system. It is a structure, but it is also one where damage is among the most frequent and significant locomotor injuries. An ACL tear results in an alteration in the biomechanics of the joint, which promotes the emergence of aberrant movement patterns as well as chronic instability, both of which impair dynamic performance. Reconstruction is typically required when the ACL is completely torn. (2)

ACL tear severity grading:

Grade 1 Sprains- It cause only minor ligament damage. Although it has somewhat extended, it can nevertheless support maintaining the stability of the knee joint.

Grade 2 Sprains- The ligament is stretched to the point of becoming loose. This is frequently referred as a partial ligament tear.

Grade 3 Sprains- It is most frequently described as a complete rupture of a ligament. The knee joint is unsafe because the ligament has now been split in half or yanked/ripped straight off the bone.

The majority of ACL injuries are total or nearly complete tears; partial ACL tears are uncommon.

Sports involving cutting, landing, and pivoting movements are particularly prone to ACL ruptures, which have an incidence rate of 68.6 every 100,000 person-years. (3,4)

Modern ACL repair methods have brought ACL repair back into the forefront. Despite initially positive short-term outcomes following open ACL repair was reported in the 1970s, long-term outcomes declined. (3,5) In 17 among 32 patients who underwent an open repair of the ACL and underwent a five-year follow-

up, Feagin et al. found a substantial re-injury rate. (5) Anterior Cruciate Ligament Reconstruction (ACLR) is a common treatment for ACL injury. (1)

Between 2000 and 2015, the prevalence of ACLR increased by 43% every year, from 54.0 to 77.4 (each 100,000 people), and by 74% among patients under the age of 25, from 52.6 to 91.4. (4) It should be underlined that the rehabilitation programme used to treat patients following surgery is solely responsible for their prognosis. Patients frequently experience pain, swelling, decreased muscle strength, or limited range of motion for just a long time after surgery despite the reconstruction of mechanical stability of joint following ACLR. These side effects can result in functional limitations and worsen a patient's quality of life. (2)

By establishing rotational & posterior/anterior knee stability, the ACL restoration reduces the risk of articular cartilage deterioration while enabling the patient to resume their previous levels of activity. (3) Following an injury or surgery, a consensus statement from 2016 describes a continuum of return to sports (RTS), which includes: 1) return to participation (return to training even though it has not yet been determined whether you are medically, physically, or psychologically ready to resume to RTS), 2) RTS (returned to a defined sport, including games), & 3) return to achievement (playing & performing at or above pre-injury level). Preoperative factors like age, preoperative rehabilitation, knee extension, and neuromuscular control, as well as intraoperative and postoperative factors like graft selection and rehabilitation and psychological factors, can have an impact on a patient's ability and readiness to RTS as well as their risk of re-injury. Pre-operative rehabilitation seeks to improve the patient's physical and emotional readiness for surgery by addressing musculoskeletal & range of motion impairments. (4) Depending on the graft option, such as hamstring tendon, bone-patella-tendon-bone (BPTB), or quadriceps tendon, several surgical techniques may be suggested. (6)

Semitendinosus and gracilis, two hamstring tendon types, are less consistent in size as well as weaken knee flexion. Although it has not been shown that BPTB and HT have different clinical outcomes, ACL reconstruction using HT fails more frequently than BPTB, particularly in young athletes. Although young active males having HT ACL reconstruction are said to have a failure rate as high as 28%, the rate of failure for primary ACL reconstruction as a whole is under 5%. Another source would be allografts, although they are more expensive and have more than 13 times the likelihood of re-tearing than BPTB auto grafts, particularly in young patients. Due to the drawbacks with other graft options, quadriceps tendon (QT) grafts has gained popularity recently. With the right method, it is possible to create a graft that is 50% larger than a BPTB tendon, longer, wider, and stronger in terms of tensile strength. The International Quadriceps Tendon Interest group (IQTIG) was recently established by a group of professionals with the goal of advancing quadriceps tendon research and enhancing patient outcomes following ACL surgery. (7)

After ACL reconstruction surgery, physiotherapy rehabilitation programmes are helpful, according to research. These programmes often aim to maximise the patient's functional independence by regaining their range of motion, strength, & neuromuscular coordination. Regardless of the kind of graft utilised during the surgery, physiotherapy is typically advised following ACL restoration. Depending on how long it has been since surgery and the unique indications and symptoms of the patient, physiotherapy aims change for each patient. Regaining quadriceps muscular strength during rehabilitation is one of the main physiotherapy objectives. In order to help patients recover to normal activity levels after a knee injury, rehabilitation programmes are created with the following objectives in mind: to enhance muscular strength, regain joint mobility, and neuromuscular control. (8) Patients in an accelerated programme were able to regain strength earlier; at 6 months, strength was noticeably different, but at 9 months, there was no change. Similar results were obtained when looking at quadriceps strength & quadriceps limb symmetry index, albeit the differences between the accelerated & conservative groups at 4, 6, 8, 12, & 24 months were not clinically significant. In 2021, a study examined the strength of the hamstring and the single-leg hop test after 4, 6, 8, 12, & 24 months to see how standard or expedited protocols affected various graft types. For all metrics and time points, they discovered no statistically significant differences between standard as well as accelerated rehabilitation. By comparing single-leg hop tests between accelerated and conventional procedures, knee laxity, IKDC scores, the Knee Injury and Osteoarthritis Outcome Score (KOOS), and other metrics. They discovered no changes between the 2 procedures in terms of knee laxity, level of activity, patient satisfaction, or functional performance, but they did find statistically significant variations in IKDC and KOOS after 3 and 6 months. Although there is a propensity for the expedited protocol to increase strength, the majority of studies have not discovered a statistically significant difference in the results. To compare these 2 methods, additional study should continue to examine at re-injury rate, functional metrics, as well as strength at 24 months and even beyond. Increased healing time, reduced stress on the graft early in the rehab timeline, and perhaps a lower chance of injury or re-injury due to a delayed return to sport are some benefits of a cautious approach. (9) Post-operative rehabilitation tries to address limb loading strategies and neuromuscular strength impairments. Additionally, they will be essential elements for

lowering the risk of secondary harm. The elements of rehabilitation have been compiled by a recent multidisciplinary consensus and systematic review. (4) There is no definite optimum practise for ACL reconstruction. Every surgeon has a different approach and a different preference. More contemporary techniques are still yielding conflicting results for long-term outcomes. There are many different approaches, including arthroscopic versus open surgery, intra versus extra-articular restoration, femoral tunnel insertion, the quantity of graft fibres, single versus double bundles, and fixation methods. Extra-articular reconstruction has been used to treat pivotal shift; it has been demonstrated to have wider implications than those provided by intra-articular reconstruction yet lacks residual stability. Although intra-articular therapy has gained popularity, the knee's natural kinematics are not restored.

Double bundles are believed to be more stable and anatomically sound, especially during rotary loads. Anteromedial & posteriolateral bundles are modelled using the semitendinosus and gracilis tendons. For the single bundle approach, there have been reports of long-term rotator instability (of the AM portion). To establish long-term stability, it is essential that all ligaments & capsular constraints are isometric over the whole range of motion. An isometric function of the ACL is made possible by the configuration of its two fibre bundles (anteromedial & posteriolateral) and their attachments. The individual fibre bundles that make up the ACL assume a spiral form and are dispersed over large attachment surfaces. Not one cord, but several. Due to their complex anatomy, ligament attachment points shouldn't be altered during reconstruction. Anterolateral meniscal root attachment is impacted by tibial tunnel reaming in anatomic single bundle ACL restoration, which ultimately weakens the failure resistance. In addition, retaining the natural ACL has the additional advantage of maintaining vascular & proprioceptive systems, which results in much more consistent anatomical tissue placements as compared to ACL reconstruction. considered essential for stability and function in the knee and lower extremities. Donor site morbidity is finally eradicated. However, latest research supports the idea that the ACL does have a few inherent capacity to heal. It appears that the majority of those who oppose ACL repair emphasise the ACL's diminished ability to heal. It has been demonstrated that the proximal third of the ACL possesses inherent healing abilities that are comparable to those of the medial collateral ligament (MCL), generating type III collagen fibres with a similar histological make-up. The fact that the ACL can self-heal suggests that proximal ACL tears, when treated with an ACL repair, may be able to regain joint stability. The healing response process realises many of the same healing qualities that the ACL repair procedure has suggested. By establishing a healing stimulus via micro fracturing close to the anatomical imprint, mesenchymal cells are given access, and a supportive environment for the ACL is created. (3)

This case report describes the recovery process after an ACLR and the timing of the NRTS.

Patient description-

A 24-year-old male patient from Greater Noida visited the physiotherapy unit at xxx Hospital complaining of right leg pain, stiffness, and difficulties bending and walking for the past 15 days. When the patient was involved in a road traffic accident in January 2023, he appeared to be in good health seven months prior. He was riding a bike when an auto rickshaw struck him from the front at a nearby market. After that, and just at the moment of the accident, he began to experience intense, shooting pain within his right knee. The pain began suddenly, was intense, of the acute shooting variety, and became worse with movement. The family member then drove him to a nearby clinic where first aid was administered. They then requested that he visit an orthopaedic physician due to the pain and edema in his right knee. He visited a local orthopaedic physician who advised him to get an X-ray for the situation. For the pain, he also prescribed some NSAIDS. The discomfort was then reduced by the medication & rest even though the X-ray revealed no fracture. Then, after 2 months he started having difficulty in walking and started having pain at same place but he ignored it. After some days, the pain aggravated and he faced the problem in bending his knee also. But he was working in that condition only for 1 month. Then, he started limping while walking, then he got the medication prescribed before but the pain didn't reduce.

Then, in June 2023, he visited a doctor for a check-up. During the examination, the doctor performed a manual test on him and informed him that he may have a ligament tear. He should therefore get an MRI for this, but the patient decided against it and sought a second opinion. He next visited the orthopaedic department of Sharda Hospital on June 29, 2023, when the doctor examined him and suggested an MRI for the same knee. The doctor informed him that he had an ACL tear of Grade 3 after reviewing the reports. The patient was educated about the surgery and was also offered a modern way of surgery that will be helpful in his RTS i.e. the hybrid surgery. The patient opted for the same in which the surgeon will take a graft from the hamstring and add fibre tape to it to maximize the strength of graft and decrease the load from nature graft in it's initial phases. Patient agreed with the he doctor, who also prescribed some NSAIDS. The patient took medication for around a month before returning to the orthopaedic department of Sharda Hospital on August 20, 2023, to undergo surgery. The doctors then obtained a medical history and

performed more tests. No previous history of additional symptoms, seizures, vomiting, or ENT haemorrhage was present. Fever, weight loss, or an appetite loss have never occurred. He was admitted to the hospital for the procedure after they agreed to it. His procedure took place on August 22, 2023, after all of his tests were completed in just two days.

After the surgery the doctor advised him Physiotherapy from the same day.

Past History – He had no history of diabetes, tuberculosis, or thyroid disease.

He had no known relatives.

On observation, the patient was a badminton player, making him mesomorphic. He was standing normally. His had an antalgic gait and was walking with Walker. The right knee had edoema, and the skin was slightly reddened.

On palpation, At the medial aspect of the right knee, the patient had Grade 1 tenderness. There was a small rise in temperature. There was also stiffness there.

There was no loss of any sensation.

Prior to beginning treatment, a treatment plan was created with the goals of reducing discomfort, enhancing strength, and decreasing stiffness and tightness –**Outcome Measure-**

SCALES	1 st DAY	12 th WEEK	24 th WEEK
KOOS	67.26%	24.40%	6.54%
IKDC	34.48%	58.62%	68.9%
TLKSS	59/100	77/100	100/100

- KOOS- Knee Injury and Osteoarthritis Outcome Score
- IKDC- International Knee Documentation Committee
- TLKSS- Tegner Lysholm Knee Scoring Scale

Treatment –

The protocol is both time-based and criteria-based (depending on tissue healing). Individual needs should guide the development of the specific intervention, which should also take exam results and clinical judgement into account. This guideline's timelines for anticipated results are approximate and subject to change dependent on the surgeon's preferences, further procedures carried out, and/or complications. A clinician should speak with the referring surgeon if they need help advancing a post-operative patient.

PHASE 1-

Immediate Post Operative-
(Day 0- 02 weeks)

Goals of Rehabilitation:

- Protect graft fixation
- Reduce swelling, lessen pain.
- Minimize arthogenic muscle inhibitors.
- Restore patellar mobility.
- Improving patellofemoral joint mobility.
- Achieve full extension, gradually improve flexion 90°
- Educate patient about rehabilitation program

Brace- For ambulation and sleeping, the brace is first fastened. Apply to unlock the brace when you can perform SLR without lag.

Weight bearing – It is possible with the aid of a brace & two crutches.

After seven days, the crutches were discontinued as tolerated.

Therapeutic Exercise:

For Swelling –

Icing, Compression, Elevation, Retrograde massage, Ankle pump.

For Range of Motion-

- Patellar mobilization.
- Seated assisted knee flexion and extension.
- Heel slides with towel.
- Low intensity, long duration extension stretch.
- Tibiofemoral mobilization.
- Quadriceps and patellar tendon mobilization.
- Standing gastro soleus stretch, soleus stretch.
- Prone leg hangs for extension.
- Stationary biking.

For Strengthening-

- Calf raises.
- Quadriceps set, Hamstring set.
- Single leg raise.
- Hip Abduction.
- Multiple angle isometric 90° & 60° knee extension.

PHASE 2-

Immediate Post Operative-
(03- 05 weeks)

Goals of Rehabilitation:

- Continuous to protect graft.
- Mobility for patella.
- Maintain full extension, restore full flexion.
- Normalise gait.
- Reduce bulging and discomfort.
- Improve strength, endurance.
- Proprioception is restored.

Weight bearing – Hamstring graft and allograft- Discontinue brace use when normal gait pattern and quadriceps control are achieved.

Therapeutic Exercise-

For Range of Motion-

- Stationary bicycle.
- Closed chain exercises.
- Continue prone leg hangs with progressively heavier ankle weights until full extension is achieved.

For Strengthening-

- Standing hamstring curls.
- Step up, step up with March.
- Partial squats exercise (Up to 40°).
- Toe raises.
- Ball squats, wall slide. (3 reps)

Lumbar Strengthening-

- Bridge and unilateral bridging.
- Side lying hip extension rotation.

For Balance-

- Single leg raise balance static to dynamic (5 reps).
- Lateral step over.
- Joint position retraining.

PHASE 3-

Later Post Operative-
(06- 12 weeks)

Goals of Rehabilitation:

- Continuous to protect graft.
- Maintain full ROM.
- Promote movement pattern.
- Progress strength & proprioception to initiate function activities.
- Avoid post exercise pain/swelling at receiver and donor site.
- Improve confidence in the knee.

Therapeutic Exercise-

For Cardiorespiratory-

- Continue bicycle.
- Elliptical stepper.
- Stair climber.
- Flutter kick.

For Strengthening-

- Squat to chair.
- Lateral lunges.
- Deadlift (15kg).
- Advance closed- kinetic chain strengthening.

Single leg progression-

- Partial weight bearing single leg press.
- Slide board lunges (retro & lateral).
- Step up, step down.
- Single leg squats.
- Wall slide.
- Begin sub max sport training in sagittal plane.

Bilateral partial weight bearing plyometric progressed to full weight bearing.

For Agility-

- Start at slow speed, advance slowly.
- Shuttle run.
- Lateral slides.
- Carioca cross-slide.

For Balance-

- Progressed single leg balance including perturbation training.
- No effusion.
- Range Of Motion equal to contralateral side.

PHASE 4-

Return to Sports- (12- 24 weeks)

Goals of Rehabilitation:

- Continue strengthening and proprioceptive exercise.
- Symmetrical performance with sport specific drills.
- Safely progress to full sports.
- Safe return to athletic.
- Patient education concerning any possible limitations.

For Agility-

- Same as above, cutting drills, Multiplane agility specific plyometric program.

Additional Interventions-

- Multiplane sport specific plyometric program.
- Non-contract practice- Full practice- Full Play.

DISCUSSION

This case report shows that recovery after ACL restoration is highly likely. The patient is able to advance quickly. Effusion has been the most important sign of taxation gone too far. Knee effusion or swelling are crucial factors in putting off recovery because they prevent muscle activation (De Carlo et al.,1999). In order to restore full knee extension, manage swelling, ensure appropriate gait, and strengthen the quadriceps, we implemented a thorough rehabilitation plan in our patient. Muscle strength was maintained throughout the healing process with isometric, isotonic, and isokinetic preparation carried out in accordance with the theory of progressive loading (8).

In order to support therapeutic recommendations that must be put into practise, numerous trials have been conducted. This has allowed for successful & revised care that really can address injuries, normalise static mobility as well as unstable knees, and restore them in the shortest amount of time possible while still being extremely safe. (1)

These surgeries have a number of drawbacks, including anterior knee pain (20%), kneeling pain (15%), hamstring muscle weakness after harvesting (10%), rotatory instability with such a positive pivot shift (24%), re-rupture (6%, up to 28% in high-risk populations), & clinical failure (10%). Only 50–65 percent of recreational athletes return to their preinjury level of sports. (5)

Due to the evolution of the surgical limb over time, the quadriceps strength is a reflection of individual quadriceps inhibition. Several studies have added a variety of functional parameters to aid in the decision to NRTS, including balance tests, hop tests, and measurements of knee laxity related to isokinetic tests. If some degree of symmetrical mobility is allowed after the third month following surgery, running might be feasible.

Indeed, when running, knee kinematics and kinetics are related to quadriceps and hamstring strength. The isokinetic quadriceps strength as well as the knee extension moment while running were found to be significantly correlated. With the ultimate goal of returning to sport without restriction, being able to run constitutes a significant step in advancing the rehabilitation process. Returning to running, however, before your quadriceps have fully recovered could result in knee problems (pain, swelling, or graft failure).

Monitoring the rehabilitation of your knee and muscular strength may therefore be a must before you can resume jogging. (6)

It was noteworthy that during the first 6 post-operative weeks, when roughly 80% of therapists declared that rehabilitation was "vital" (and another 20% said it was important), almost 40% of therapists preferred once or twice weekly visiting, with a further 12% choosing once every two weeks. Although there is no agreement on the ideal number of supervised sessions each week or over all over the initial six-week period, this is another multi-factorial issue, and traditions of the rehabilitation practise and individual patient growth may change these opinions. From three months after surgery, nearly 26% of therapists continued to favour supervised visitation once or twice a week, with more than 40% of therapists at that point advising less frequent review with a patient transition toward home-based independent rehabilitation (or gym-based independent rehabilitation). As an alternative, while physiotherapists and AEPs frequently work with patients during these end-stage & sport-specific conditioning phases of rehabilitation, a referral by an individual therapist to a personal trainer or strength and fitness coach for late-stage rehabilitation could change the recommended frequency of visits. (4)

Re-tear rates over 2 years following surgery range from 6% to 31% in both the ipsilateral & contralateral limbs, which suggests that returning athletes to sport too soon may not be the best course of action. Some restrictions include slower strength improvements in the early stages of rehabilitation, a potential lack of adherence to the rehabilitation plan and schedule, a later RTS (which may have an adverse financial and psychological impact), and higher healthcare costs. (9)

In this case report, the patient's RTS at the shortest possible post-operative interval was the main focus. Our primary goals were to reduce the swelling, lessen pain, minimise arthrogenic muscle inhibitors, allow access the initial 90° range, and improve the strength of the quadriceps and hamstrings by using a static bicycle and wall squats during the patient's initial phase, which was an inflammatory phase. The patient was eager and able to perform a variety of exercises during this phase. Our primary objectives in the second phase were to protect the graft, promote patella mobility, maintain full extension, recover complete flexion, normalise gait, lessen discomfort and bulging, and increase strength and endurance. In the third phase, our key objectives were to keep the knee's full range of motion, encourage good movement patterns, advance strength and proprioception to begin function activities, prevent post-exercise pain and edoema at the recipient and donor sites, and boost knee confidence. Our objectives in the fourth phase included symmetrical performance with sport-specific drills, a safe transition to full sports, a safe return to athletics, and most importantly, patient education regarding any potential limitations. With this trial, we discovered that NRTS was completed in 24 weeks and the patient's recovery was remarkable.

CONCLUSION

We talked about how post operative ACL rehabilitation can lessen pain, edoema, swelling, range of motion, strength in the knee muscles, or knee function. And as a result, in just 24 weeks, we have had a wonderful response for ACLR. The patient also demonstrated good cooperation throughout the length of the treatment. According to the outcome measures, the physical therapy intervention helped him become a better athlete with NRTS. Although there is presently no established timetable for NRTS, evidence shows that using accelerated procedures when the patient's specific needs and the NRTS call for it can be advantageous. More research is required to determine the best return to play criteria and sequencing.

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