



Role of Physiotherapy in Anterior Cruciate Ligament Injury: A literature review

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Abstract

Physiotherapy has a very significant role after a knee injury that involves the ACL ligament. It is very important to begin rehabilitation as soon as the inflammation has subsided. This qualitative study explored physiotherapist's experiences of ACL injury management, from time of injury to return to occupational or recreational activities. While both conservative and surgical management of ACL injuries was discussed, the main findings of this study focused on referral and rehabilitation following surgery.

Key words: Ligament injury, Rehabilitation, Post operative management, Physiotherapy.

Introduction

The anterior cruciate ligament (ACL) rupture has become a very common injury and it is usually sports-related. The incidence of this injury has an increasing tendency, as people tend to engage more with sporting activities. There are three timing stages where physiotherapy has a very important role in this injury. The first stage is before the injury and the strategies we are adopting to avoid a potential ACL injury^{1,2}. The second stage is after the injury and how we end up deciding on operative or conservative management for the patient. The third stage is the rehabilitation protocol after the ACL reconstruction surgery. In all of these stages, the physiotherapist has the primary role in the patient's treatment^{3,4,5}.

Anatomy and Biomechanics

The knee is a hinge joint connecting the femur and tibia bones. It is held together by several important ligaments. The most important ligament to the knee's stability is the Anterior Cruciate Ligament (ACL). The ACL attaches from the front part of the tibia to the back part of the femur^{6,7}. The purpose of this ligament is to keep the tibia from sliding forward and rotating on the femur. For this reason, the ACL is most susceptible to injury when twisting or rotational forces are placed on the knee. Although this can happen with contact, approximately 70% of ACL tears occur during non-contact events when athletes are cutting, decelerating, or landing from a jump. After the ACL is torn, the knee is less stable and it becomes difficult to maintain a high level of activity without the knee buckling or giving way. It is particularly difficult to perform the repetitive cutting and pivoting that is required in many sports^{8,9,10}.

Pre-operative Rehabilitation

Prior rehabilitation is essential for improved outcomes following Anterior Cruciate Ligament (ACL) Reconstruction surgery. Your knee incurs deficits in terms of strength, proprioception (the ability to maintain balance), muscle timing, and gait (walking patterns) after suffering an ACL injury. Physiotherapy before undergoing ACL reconstructive surgery is effective in improving strength and balance which may reduce the episodes of 'giving way' and decrease the chances of re-injury in an ACL deficient knee. The goals of pre-operative rehabilitation include restoring full range of motion, achieve adequate neuromuscular control, strengthening muscles that are important in post-operative rehabilitation, and achieving an understanding of exercises to be performed after surgery. These factors greatly influence the chances of surgery^{11,12,23,14}.

Post-operative Rehabilitation

The surgeon and physiotherapists will guide you through a comprehensive rehabilitation program to optimize recovery following surgery and facilitate return to sport/activities.

Treatment Options: Regardless of how the ACL is torn, your physician will work with you to determine a personalized course of treatment. People participating in sports or work-related activities that require a lot of pivoting, cutting, or jumping may decide to have surgery. Depending on your lifestyle, however; conservative treatment may be the best option. In the case of an isolated ACL tear with no other ligamentous or cartilage involvement, the associated pain and dysfunction can be successfully treated with physical therapy^{15,16,17}.

Physiotherapy for ACL deficient patients: Physiotherapy has a very significant role after a knee injury that involves the ACL ligament. It is very important to begin as soon as the inflammation has subsided passive range of motion exercises of the knee and weight-bearing as tolerated limitation of complete extension, delay in strength recovery, anterior knee pain]. Prevention of muscle atrophy is important as well. A balanced quadriceps-hamstrings co-activation ratio exercises, such as single-limb leg-lift, lateral and transverse hop-to-balance exercises can be proven beneficial for the ACL deficient patients. Lunge exercises can help with quadriceps strengthening^{18,19,20}. Good hamstrings control is linked with a high incidence of successful avoidance of surgery after an ACL rupture. The use of a knee brace has been proposed to reduce patients' instability feeling, but some reports could interfere with the day-to-day activities from the open-chain exercises, as they are. Patients who have high demands such as professional players engaging with sports which include pivoting movements and patients with other major knee injuries (pathology in the other ligaments, menisci tears, or cartilage injuries) will be treated operatively with an ACL reconstruction^{21,22}. For the rest of them, conservative management is the initial option, which includes an intense physiotherapy protocol to return to the pre-injury activities without instability symptoms. This program lasts at least 6 weeks and consists of muscle strengthening exercises, cardiovascular endurance training, and sport-specific and agility exercises such as quick start and stops, cutting, and pivoting. At the end of the program, the patients who achieve to return to their pre-injury activity level without symptoms are identified as 'copers', the rest of them are candidates for operative treatment and identified as 'non-copers' thereby ultimately resulting in knee instability and dysfunction. However, ACL rupture does not automatically infer functional impairment and instability as confirmed by the ACL deficiency (ACLD). Although 'copers' have normal activity levels and they manage to overcome their deficiency without functional problems, their walking economy remains impaired compared to the healthy baseline. This fact could lead us to treat them operatively as well when the energy cost is important for the patient^{22,23,24}.

Phase 1: Immediate Post-op (0-2 weeks post surgery)

Rehabilitation Goals:	<ul style="list-style-type: none"> • Protect graft • Reduce swelling, minimize pain • Restore patellar mobility • Restore full extension, gradually improve flexion • Minimize arthrogenic muscle inhibition, re-establish quad control, regain full active extension • Patient education <ul style="list-style-type: none"> o Keep your knee straight and elevated when sitting or laying down. Do not rest with a towel placed under the knee o Do not actively kick your knee out straight; support your surgical side when performing transfers (i.e. sitting to laying down) o Do not pivot on your surgical side.
Weight Bearing	<p>Walking</p> <ul style="list-style-type: none"> • Initially brace locked, crutches • May start walking without crutches as long as there is no increased pain <ul style="list-style-type: none"> o Allograft and hamstring autograft continue partial weight bearing with crutches for 6 weeks unless otherwise instructed by MD • May unlock brace once able to perform straight leg raise without lag • May discontinue use of brace after 6 wks per MD and once adequate quad control is achieved • When climbing stairs, make sure you are leading with the non-surgical side when going up the stairs, make sure you are leading with the
Intervention	<p>Swelling Management</p> <ul style="list-style-type: none"> • Ice, compression, elevation (check with MD re: cold therapy) • Retrograde massage • Ankle pumps Range of motion/Mobility • Patellar mobilizations: superior/inferior and medial/lateral o **Patellar mobilizations are heavily emphasized in the early post-operative phase following patella tendon autograft** • Seated assisted knee flexion extension and heel slides with towel • Low intensity, long duration extension stretches: prone hang, heel prop • Standing gastronemius stretch and soleus stretch • Supine active hamstring stretch and supine passive hamstring stretch <p>Strengthening</p> <ul style="list-style-type: none"> • Calf raises • Quad sets • NMES high intensity (2500 Hz, 75 bursts) supine knee extended 10 sec/50 sec, 10 contractions, 2x/wk during sessions—use of clinical stimulator during session, consider home units distributed immediate post op • Straight leg raise o **Do not perform straight leg raise if you have a knee extension lag • Hip abduction • Multi-angle isometrics 90 and 60 deg knee extension
Criteria to progress	<ul style="list-style-type: none"> • Knee extension ROM 0 deg • Quad contraction with superior patella glide and full active

	extension • Able to perform straight leg raise without lag
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Phase 2- Intermediate Post-Op (3-5 weeks after surgery):

Rehabilitation goals.	<ul style="list-style-type: none"> • Continue to protect graft • Maintain full extension, restore full flexion (contra lateral side) • Normalize gait
Additional intervention Continue with Phase 1 interventions.	Range of motion/Mobility <ul style="list-style-type: none"> • Stationary bicycle • Gentle stretching all muscle groups: prone quad stretch, standing quad stretch, kneeling hip flexor stretch Strengthening <ul style="list-style-type: none"> • Prone hamstring curls • Step ups and step ups with march • Partial squat exercise • Ball squats, wall slides, mini squats from 0-60 deg • Lumbopelvic strengthening: bridge & unilateral bridge, side lying hip external rotation clamshell, bridges on physio ball, bridge on physio ball with roll-in, bridge on physio ball alternating, hip hike Balance/proprioception <ul style="list-style-type: none"> • Single leg standing balance (knee slightly flexed) static progressed to dynamic and level progressed to unsteady surface • Lateral step-overs • Joint position re-training
Criteria to progress	<ul style="list-style-type: none"> • No swelling (Modified Stroke Test) • Flexion ROM within 10 deg contra lateral side • Extension ROM equal to contra lateral side

Phase 3- Late Post-Op (6-8 weeks after surgery):

Rehabilitation goals	<ul style="list-style-type: none"> • Continue to protect graft site • Maintain full ROM • Safely progress strengthening • Promote proper movement patterns • Avoid post exercise pain/swelling • Avoid activities that produce pain at graft donor site
Additional Intervention (Continue with Phase I-II Interventions)	Range of motion/Mobility <ul style="list-style-type: none"> • Rotational tibial mobilizations if limited ROM Cardio <ul style="list-style-type: none"> • Elliptical, stair climber, flutter kick swimming, pool jogging Strengthening <ul style="list-style-type: none"> • Gym equipment: leg press machine, seated hamstring curl machine and hamstring curl machine, hip abductor and adductor machine, hip extension machine, roman chair, seated calf machine <ul style="list-style-type: none"> o Hamstring autograft can begin resisted hamstring strengthening at 12 weeks • Progress intensity (strength) and duration (endurance) of exercises * <p>*The following exercises to focus on proper control with</p>

	<p>emphasis on good proximal stability • Squat to chair</p> <ul style="list-style-type: none"> • Lateral lunges • Romanian deadlift • Single leg progression: partial weight bearing single leg press, slide board lunges: retro and lateral, step ups and step ups with march, lateral step-ups, step downs, single leg squats, single leg wall slides • Knee Exercises for additional exercises and descriptions <p>Balance/proprioception</p> <ul style="list-style-type: none"> • Progress single limb balance including perturbation training.
Criteria to progress	<ul style="list-style-type: none"> • No swelling/pain after exercise • Normal gait • ROM equal to contra lateral side • Joint position sense symmetrical (<5 degree margin of error) • Quadriceps index $\geq 80\%$; HHD mean preferred (isokinetic testing if available)

Phase 4 - Transitional (9-12 weeks after surgery)

Rehabilitation goals	<ul style="list-style-type: none"> • Maintain full ROM • Safely progress strengthening • Promote proper movement patterns • Avoid post exercise pain/swelling • Avoid activities that produce pain at graft donor site
Additional Intervention (Continue with Phase I-III interventions)	<ul style="list-style-type: none"> • Begin sub-max sport specific training in the sagittal plane • Bilateral PWB plyometrics progressed to FWB plyometrics
Criteria to progress	<ul style="list-style-type: none"> • No episodes of instability • Maintain quad strength • 10 repetitions single leg squat proper form through at least 60 deg knee flexion • Drop vertical jump with good control • KOOS-sports questionnaire >70% • Functional Assessment <ul style="list-style-type: none"> o Quadriceps index >80%; HHD mean preferred (isokinetic testing if available) o Hamstring, glut med, glut max index $\geq 80\%$; HHD mean preferred (isokinetic testing for HS if available) o Single leg hop test $\geq 75\%$ compared to contra lateral side (earliest 12 wks) • Return-to-sport testing

Phase 5 - Early return to sport (3-5 months after surgery)

Rehabilitation goals	<ul style="list-style-type: none"> • Safely progress strengthening • Safely initiate sport specific training program • Promote proper movement patterns • Avoid post exercise pain/swelling • Avoid activities that produce pain at graft donor site
Additional Intervention (Continue with Phase II-IV interventions)	<ul style="list-style-type: none"> • Interval running program <ul style="list-style-type: none"> ◦ Return to Running Program • Progress to plyometric and agility program (with functional brace if prescribed) <ul style="list-style-type: none"> ◦ Agility and Plyometric Program
Criteria to Progress	<ul style="list-style-type: none"> • Clearance from MD and ALL milestone criteria below have been met • Completion jog/run program without pain/swelling • Functional Assessment <ul style="list-style-type: none"> ◦ Quad/HS/glut index $\geq 90\%$; HHD mean preferred (isokinetic testing if available) ◦ Hamstring/Quad ratio $\geq 70\%$; HHD mean preferred (isokinetic testing if available) ◦ Hop Testing $\geq 90\%$ compared to contra lateral side • KOOS-sports questionnaire $>90\%$ • International Knee Committee Subjective Knee Evaluation >93 • Psych Readiness to Return to Sport (PRRS)

Phase 6 - unrestricted return to sport (6+ months after surgery)

Rehabilitation goals	<ul style="list-style-type: none"> • Continue strengthening and proprioceptive exercises • Symmetrical performance with sport specific drills • Safely progress to full sport
Additional Intervention (Continue with Phase II-V interventions)	<ul style="list-style-type: none"> • Multi-plane sport specific plyometrics program • Multi-plane sport specific agility program • Include hard cutting and pivoting depending on the individuals' goals (~7 mo) • Non-contact practice → Full practice → Full play
Criteria to progress	<ul style="list-style-type: none"> • Last stage, no additional criteria ^{25,26,27,28}.

Discussion

A biopsychosocial approach to health care is considered an important part of providing the best possible management for sports injuries. The participants believed in this holistic view of the management of ACL injuries to provide individualized management considering biomechanical, psychological, and social factors. Some participants were also cognizant of patients' fears of returning to heavy manual occupations (such as farming) or the ability to perform at previous sporting levels. They appeared comfortable dealing with psychological concerns through clinical experience, using a variety of methods such as education, reassurance, and relevant goal-based exercise prescription^{29,30,31,32}

While participants were aware of published guidelines for ACL management, they discussed a milestone (as opposed to time frame) approach for rehabilitation. They believed this was particularly important to increase patient motivation and allowed individualized rehabilitation. A milestone approach enables treatment flexibility based on the patients' individual needs, contributing towards motivation^{33,34}.

Physiotherapists' ideas for future research: It was clear from the participants' responses that they did access, critique, and apply evidence. There is debate in the literature regarding the optimal combination of open and closed kinetic chain exercises. Return to sport is complex and entails consideration of psychological, social, and physical factors^{35,36}. Thus, making sense of research findings in these areas, often with contradicting findings, and translating these into clinical practice appeared to be challenging for the clinicians. The facilitation of evidence-based practice in this area might require the use of expert clinical commentary which synthesizes, critiques the relevant literature, summarises, and then applies the evidence via a case study^{337,38,39}.

Implications for clinical practice and future research: Physiotherapists may want to maintain, improve or consider adopting a biopsychosocial and evidence-informed approach to managing ACL injuries to achieve the best outcomes. A milestone approach to rehabilitation progression appears to be more readily adopted rather than timeframe-based goals. Enhancing inter-professional communication to adopt a more team-based approach, and problem-solving to simplify the current referral process, could potentially further improve ACL injury management. In particular, psychological needs should be acknowledged and addressed to achieve best possible outcomes for return to sport. Physiotherapists may need further education and research to support them in understanding and applying these approaches. Research in psychological management for sports injuries and the inclusion of rurally based participants should be considered.

Conclusion

In conclusion, we can state that physiotherapy is the most important part of the patient's management and treatment. Physiotherapy has a significant impact on the prevention of ACL injury and a leading part of pre-and post- ACL reconstruction management. The main aims are to restore the full ROM of the knee and to restore muscle strength and proprioception. These aims have to be achieved by performing easy and safe exercises and by avoiding shear forces of the knee, to prevent re-injury.

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Conflict of interest

None declared