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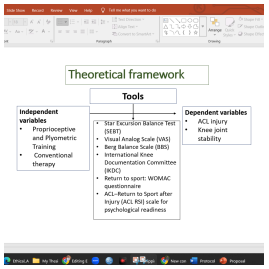
Effectiveness of Proprioceptive and Plyometric Training on Joint Stability in Athletes Following ACL Injury



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We use this protocol and it's working

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Keywords: ACL injury, proprioceptive training, plyometric training, joint stability, rehabilitation, SEBT, IKDC, WOMAC, ACL-RSI., athletes with unilateral acl reconstruction, plyometric training on joint stability, sport readiness in athlete, improving joint stability, combined effectiveness on joint stability, physiotherapy program, effectiveness of proprioceptive, conventional physiotherapy, sport readiness, receiving conventional physiotherapy, integral components of physiotherapy program, unilateral acl reconstruction, return to sport, anterior cruciate ligament, athletic performance, functional return to sport, knee function, athletes in the intervention group, enhancing neuromuscular control, acl injury, term athletic performance, sport in athlete, following acl injury, greater improvements in joint stability, acl injury background, plyometric training in addition, international knee documentation committee, following acl injury background, postural control, neuromuscular control, earlier return to sport, reduced

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Abstract

Background: Anterior cruciate ligament (ACL) injury is among the most common sports-related injuries and is associated with reduced joint stability, impaired functional performance, and psychological barriers to returning to sport. Although conventional physiotherapy focusing on strengthening and mobility is widely used, recent evidence suggests that proprioceptive and plyometric training may provide additional benefits by enhancing neuromuscular control, balance, and confidence. However, limited randomized controlled trials have comprehensively examined their combined effectiveness on joint stability and return-to-sport readiness in athletes following ACL injury.

Objective: The purpose of this randomized controlled trial is to evaluate the effectiveness of proprioceptive and plyometric training, when combined with conventional physiotherapy, in improving joint stability, reducing pain, enhancing functional outcomes, and promoting psychological readiness for return to sport in athletes following ACL injury.

Methods: A total of 62 athletes with unilateral ACL reconstruction will be recruited and randomly assigned into two groups: (i) intervention group (n = 31), receiving proprioceptive and plyometric training in addition to conventional physiotherapy, and (ii) control group (n = 31), receiving conventional physiotherapy alone. The intervention will be carried out over 8 weeks, with supervised sessions two days per week. The primary outcome will be joint stability assessed by the Star Excursion Balance Test (SEBT). Secondary outcomes will include pain measured by the Visual Analog Scale (VAS), postural control assessed by the Berg Balance Scale (BBS), knee function evaluated using the International Knee Documentation Committee (IKDC) subjective score, functional return to sport measured by the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and psychological readiness assessed using the ACL–Return to Sport after Injury (ACL-RSI) scale. Outcomes will be measured at baseline and after the intervention.

Expected Results: It is anticipated that athletes in the intervention group will demonstrate greater improvements in joint stability, pain reduction, balance, knee function, and psychological readiness compared to the control group. Proprioceptive and plyometric training are expected to enhance neuromuscular control and confidence, thereby facilitating safer and earlier return to sport.

Conclusion: This study will provide valuable evidence on the role of proprioceptive and plyometric training in post-ACL rehabilitation. If effective, these approaches may be recommended as integral components of physiotherapy programs to optimize recovery, reduce re-injury risk, and improve long-term athletic performance.

Keywords: ACL injury, proprioceptive training, plyometric training, joint stability, rehabilitation, SEBT, IKDC, WOMAC, ACL-RSI.

Attachments

Annexure.docx
31KB

Institutional Review...
134KB

Guidelines

Plyometric Training:
1. Standing vertical hops 2sets, 8reps
2. Counter movement jump (CMJ) 2sets, 8reps
3. Depth jumps 2sets, 8reps
4. Multiple two-foot hurdle jumps (hurdle height 0.55m) 2sets, 8reps
5. Two-foot jumps forward and backward 2sets, 8reps
6. Single foot jumps 3sets, 10reps
7. Lateral two-foot jumps 3sets, 10reps

Intervention: Control Group
Conventional therapy:
1. Passive ROM, Patellar mobilization for 5 minutes.
2. Hamstring, quadriceps, calf, hip flexor stretches exercise for 10 minutes and 3 reps, 30 sec, 15 sec rest.
3. Isometric quads 5 minutes and 10 reps, 3sets, 10 sec hold, 15 sec rest.
4. Hamstring curls for 5 minutes and 10 reps, 3sets,15 sec rest.
5. Heel slides for 5 minutes and 10 reps x 3 sets, 2 hold
6. Bridging with double or single leg for 15 minutes and 10 reps x 3 sets, 5 sec hold, 5 sec rest.
7. Closed-chain exercises (mini squats) for 5 minutes and 10 reps x 2 sets, 5 sec rest.
8. Sit-to-stand for 5 minutes and 10 reps x 3 sets, 5 sec rest.
9. Step-ups for 5 minutes and 10 reps x 3 sets, 5 sec rest.

Materials

Musculoskeletal Lab Room - 301, Department of Physiotherapy and Rehabilitation, Jashore University of Science and Technology, Bangladesh.
Tools:
- Star Excursion Balance Test (SEBT)
- Visual Analog Scale (VAS)
- Berg Balance Scale (BBS)
- International Knee Documentation Committee (IKDC)
- WOMAC questionnaire
- ACL–Return to Sport after Injury (ACL-RSI) scale

Troubleshooting

Safety warnings

- Begin only after medical clearance from your surgeon or physician.
- Always perform exercises under the guidance of a qualified physiotherapist.
- Stop immediately if you feel sharp pain, swelling, dizziness, or instability.
- Do not skip steps — progress must be gradual and patient-specific.
- Exercises should not cause locking, catching, or giving-way of the knee.
- Recovery timelines vary; adapt intensity and volume individually.
- The author and institution are not responsible for misuse or unsupervised application of this protocol.

Ethics statement

This study involving human participants will be conducted in accordance with the Declaration of Helsinki and its later amendments. Ethical approval has been (or will be) obtained from the *Institutional Ethics Committee of* Jashore University of Science and Technology, Bangladesh.
All participants will provide written informed consent before enrollment. They will be informed about the study objectives, procedures, potential risks, and benefits, and assured of the right to withdraw at any time without any consequence to their medical care. Confidentiality of personal data will be strictly maintained, and all information will be used solely for academic and scientific purposes.

Before start

This rehabilitation protocol is designed for athletes following ACL injury and reconstruction. While the protocol has been applied in practice and shown beneficial outcomes, it must be implemented under the supervision of a qualified physiotherapist or healthcare professional. Individual responses to rehabilitation may vary depending on injury severity, surgical outcomes, and patient-specific factors.
Do **not** attempt this program without proper medical clearance. The author and affiliated institution do not accept responsibility for any injury, complications, or adverse outcomes resulting from unsupervised or inappropriate application of this protocol.

Intervention details

1 **Intervention: Experimental Group**
Proprioception Training: for 30 minutes
1. **Single-stance balance exercise performed on:** a stable surface, an unstable surface (foam), and an unstable surface (wobble board) with open eyes and closed eyes.

2 2. Single-stance balance exercise throws the ball in different directions on a stable and unstable surface.

3 3. Single-stance balance exercise proprioceptive neuromuscular facilitation (PNF) with TheraBand.

4 4. Single-leg cone pick-up

5 5. Single-leg balance with ball toss

6 **Plyometric Training: for 30 minutes**

7 1. Standing vertical hops 2sets, 8reps

8 2. Counter movement jump (CMJ) 2sets, 8reps

9

	3. Depth jumps 2sets, 8reps 4. Multiple two-foot hurdle jumps (hurdle height 0.55m) 2sets, 8reps 5. Two-foot jumps forward and backward 2sets, 8reps 6. Single foot jumps 3sets, 10reps 7. Lateral two-foot jumps 3sets, 10reps **Intervention: Control Group** **Conventional therapy: -** 1. Passive ROM, Patellar mobilization for 5 minutes. 2. Hamstring, quadriceps, calf, hip flexor stretches exercise for 10 minutes and 3 reps, 30 sec, 15 sec rest. 3. Isometric quads 5 minutes and 10 reps, 3sets, 10 sec hold, 15 sec rest. 4. Hamstring curls for 5 minutes and 10 reps, 3sets,15 sec rest. 5. Heel slides for 5 minutes and 10 reps x 3 sets, 2 hold 6. Bridging with double or single leg for 15 minutes and 10 reps x 3 sets, 5 sec hold, 5 sec rest. 7. Closed-chain exercises (mini squats) for 5 minutes and 10 reps x 2 sets, 5 sec rest. 8. Sit-to-stand for 5 minutes and 10 reps x 3 sets, 5 sec rest. 9. Step-ups for 5 minutes and 10 reps x 3 sets, 5 sec rest
Intervention provider qualification (s)	Physiotherapist with a completed Bachelor's and Master's in a Specific Discipline.
Tools	**Primary Outcomes:** • **Joint Stability: Star Excursion Balance Test (SEBT)** **Secondary Outcomes:** • **Pain:** Visual Analog Scale (VAS) • **Berg Balance Scale (BBS)** • **International Knee Documentation Committee (IKDC)** • **Return to sport:** WOMAC questionnaire • **ACL–Return to Sport after Injury (ACL-RSI) scale for psychological readiness**
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