American Impact Review

Review Article

Comprehensive Physical Rehabilitation of Athletes After Injuries: A Combination of Strength, Coordination, and Functional Exercises

Ekaterina Opekunova*

Independent Researcher, Miami, USA

* Corresponding author

OPEN ACCESS

Citation:
Ekaterina Opekunova (2026). Comprehensive Physical Rehabilitation of Athletes After Injuries: A Combination of Strength, Coordination, and Functional Exercises. *Am. Impact Rev.*
10.66308/air.e2026075

Received: July 1, 2026
Accepted: July 8, 2026
Published: July 14, 2026

DOI:
10.66308/air.e2026075

ISSN: 3071-124X

Abstract

The article discusses modern approaches to the comprehensive physical rehabilitation of athletes after injuries. It analyzes the features of using strength, coordination, and functional exercises during different stages of recovery. The role of strength training in restoring muscle function, the importance of coordination exercises for improving balance and motor control, as well as the significance of functional loads in preparing athletes for specific sports activities, are highlighted. Functional tests and criteria for transitioning to more complex loads are also considered. The need for personalized rehabilitation programs and the importance of objective monitoring of an athlete's functional state are emphasized. The purpose of the study is to examine the features of the integrated use of strength, coordination, and functional exercises during the process of athletes' physical rehabilitation after injuries and to determine their significance for restoring functional fitness for training and competition. Modern scientific publications, clinical recommendations, international expert documents, as well as systematic reviews and meta-analyses devoted to the physical rehabilitation of athletes after injuries were used as materials for the study; methods of analysis, generalization, and systematization of scientific data were applied, and a comparative method was used to evaluate different approaches. The analysis shows that effective physical rehabilitation for athletes should be based on a complex and phased approach, with transitions between stages guided by the results of functional testing, tolerance to load, and the condition of the injured area.

Keywords: physical rehabilitation, athletes, sports injuries, strength exercises, coordination exercises, functional exercises, motor control, functional testing, return to sports

Relevance of the study

The relevance of this study is due to the importance of athletes' full recovery from injuries, as well as ensuring their safe return to training and competition. Modern physical rehabilitation is aimed not only at restoring damaged tissues but also at eliminating functional disorders caused by a decrease in muscle strength, coordination, movement control, and the ability to perform specialized athletic movements.

The complex application of strength training, coordination exercises, and functional training is of particular significance. Strength training aids in restoring muscle function, while coordination exercises enhance balance and neuromuscular control. Functional training ensures a gradual transition to specific movements required for a particular sport. The consistent combination of these methods improves the quality of rehabilitation and reduces the risk of reinjury [10].

The study of an integrated approach to the physical rehabilitation of athletes holds considerable scientific and practical importance.

The purpose of the study

The purpose of the study is to study the features of the integrated use of strength, coordination, and functional exercises during the process of athletes' physical rehabilitation after injuries and to determine their significance for restoring functional fitness for training and competition.

Materials and research methods

Modern scientific publications, clinical recommendations, international expert documents, as well as systematic reviews and meta-analyses devoted to the physical rehabilitation of athletes after injuries, were used as materials for the study.

In the course of the work, methods of analysis, generalization, and systematization of scientific data were applied. In addition, a comparative method was used to evaluate different approaches to the use of strength, coordination, and functional exercises in rehabilitation.

The results of the study

The process of physical rehabilitation of an athlete depends on the nature and severity of the injury, the condition of the tissues, as well as on the existing functional disorders and the specifics of a particular sport. The transition to the next stage of recovery should be carried out only after achieving certain clinical and functional indicators. According to international expert documents, when assessing an athlete's condition, pain, swelling, range of motion, muscle strength, quality of exercise, reaction to previous stress, and the results of functional testing should be taken into account. However, none of these indicators can serve as a sufficient basis for making a decision to further increase the workload [1].

In case of muscle damage, after the initial period of rest, a gradual increase in exercise load is applied, taking into account the tolerance of the individual and the recovery of tissue function. According to the international consensus on injuries to the posterior thigh muscles, 89.8% of experts support the individualization of rehabilitation based on the characteristics of the athlete, sport, damaged muscle, and type and severity of injury. Experts agree on the need to use specific criteria to increase exercise difficulty, with agreement ranging from 73% to 92.7%. During the later stages, it is important to achieve strength with elongated muscle positions, and for athletes engaged in running sports, it is crucial to gradually return to running and sprints [6].

The complex nature of rehabilitation requires the collaboration of various professionals, including a sports medicine doctor, a physiotherapist, a physical fitness specialist, and a coach. In some cases, a sports psychologist or nutrition specialist may also be involved. This collaboration is essential to ensure that the therapeutic goals are aligned with the gradual recovery of physical abilities and the demands of training [3].

The strength load during the rehabilitation period is chosen based on the injured structure and the stage of recovery. This aspect has been studied most thoroughly in lower limb injuries. Aspetar's clinical guidelines for recovering from anterior cruciate ligament reconstruction analyzed 140 randomized clinical trials involving 5.231 individuals (Table 1). The average age of participants in these studies was 27.9 years. The authors of these guidelines note that exercise is the primary means of rehabilitation after this surgery, but for many types of strength training, the exact balance between volume, intensity, and outcome has not been well established.

Table 1. The main variants of strength exercises and the parameters of their application in rehabilitation after reconstruction of the anterior cruciate ligament

A variant of strength work after the reconstruction of the anterior cruciate ligament (ACL)	The parameters specified in the Aspetar recommendations	Set position	The average level of expert agreement
Isometric work of the quadriceps muscle	The first 2 weeks	It may slightly speed up knee flexion recovery, but it has not been proven to significantly increase strength	84.7%
Leg press	From the 3rd week; movement within 0-45° during grafting from the tendons of the posterior femoral group	It is recommended to restore function if the pain in the front of the knee is controlled	88.3%
Eccentric work of the quadriceps muscle	From the 3rd week; 20-60° knee flexion	Studies have shown improvements in strength and hypertrophy without increasing joint instability	82.7%
Knee extension in an open kinematic chain	From the 4th week; initially 90-45°	It can be used without reducing knee stability, but it is necessary to control the pain	88.8%
Combination of open and closed kinematic circuits	As part of the recovery program	It helps to restore the strength of the quadriceps more effectively than exercises using only a closed chain	91.3%
A combination of eccentric and concentric work	As part of strength training	It is recommended to improve strength and functional performance	91.8%

A source: author's development based on [2].

The percentages in the last column represent the level of agreement among experts on the recommendation, rather than the magnitude of the therapeutic effect. These data specifically relate to rehabilitation after anterior cruciate ligament reconstruction.

Therefore, it is recommended to approach strength training in sports rehabilitation as a system of gradually increasing complexity, rather than a single type of exercise. The selection of exercises, range of motion, and level of resistance should be based on the condition of the injured structure and the athlete's response to training. Specifically, studies following anterior cruciate ligament reconstruction have shown that it is possible to combine exercises in open and closed kinetic chains, as well as concentric and eccentric training, while closely monitoring the condition of the knee joint.

Coordination training after an injury is primarily focused on restoring dynamic balance, posture control, and the ability to maintain stability while performing movements with one limb. These goals are particularly relevant in cases of ankle injuries and have been well studied in clinical settings. The Academy of Orthopedic Physical Therapy, affiliated with the American Physical Therapy Association, recommends the use of proprioceptive and neuromuscular exercises to enhance dynamic postural stability and subjective joint stability perception. Following an acute lateral ankle sprain, a program may also incorporate balance training, neuromuscular training, and posture retraining [4].

One way to objectively assess dynamic postural control is through the Star Excursion Balance Test (SEBT). In this test, the athlete stands on one leg while using the other leg to perform the maximum possible controlled movement in a specific direction. The distance reached allows us to quantify dynamic control and compare the results between damaged and undamaged limbs, or before and after rehabilitation.

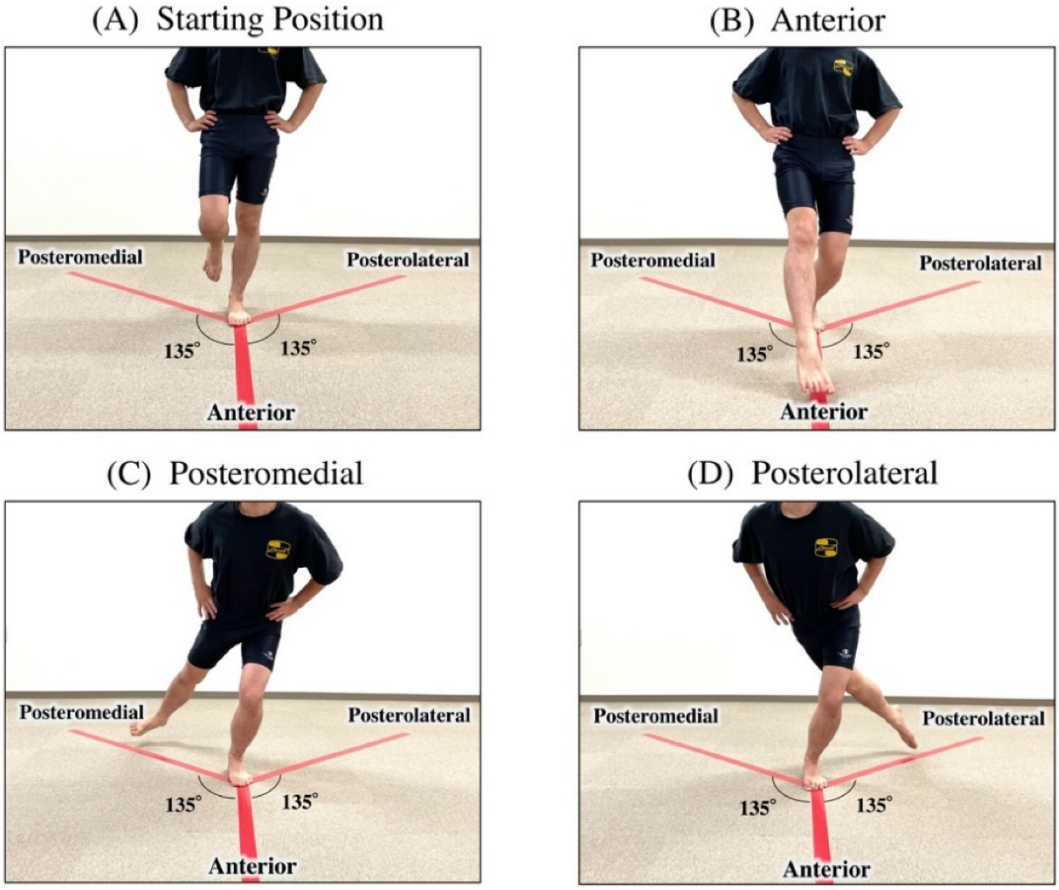

Figure 1. Performing the modified Star Excursion Balance Test in three directions [8]

Data from the 2024 meta-analysis confirm the measurable impact of balance training on chronic ankle instability. The analysis included 20 studies with 682 participants. Significant improvements were observed both in ankle joint function and in three aspects of the SEBT (Table 2).

Table 2. Results of a meta-analysis of the effectiveness of balance training in chronic ankle instability

Estimated indicator	Result	95% confidence interval	Statistical significance
Self-assessment of the function	SMD = 1.02	0.61 - 1.43	$p < 0.00001$
SEBT, forward direction	MD = 5.88	3.37 - 8.40	$p < 0.00001$
SEBT, posterior medial direction	MD = 5.47	3.40 - 7.54	$p < 0.00001$
SEBT, posterolateral direction	MD = 6.04	3.30 - 8.79	$p < 0.0001$

A source: author's development based on [9].

In the same meta-analysis, the most favorable results were obtained when performing programs lasting 4-6 weeks, 3 times a week, for 20-30 minutes. These parameters are typical for patients with chronic ankle instability and cannot be automatically applied to other injuries.

Functional exercises provide a transition from restoring individual physical qualities to the movements necessary for athletes in training and competitions. Running, jumping, landing, accelerating, decelerating, and changing directions are used, and tasks become more complex as you move from pre-planned movements to responding to external stimuli and changes in the environment.

One-leg jump tests are used to assess functional readiness, including the single-leg jump, triple jump, crossover triple jump, and timed jump. However, these tests should not be the only criteria for admission to sports. The Panther Symposium International Consensus recommends evaluating a range of indicators, such as strength, movement quality, range of motion, balance, and neuromuscular control [5].

An example of a criterion-based approach can be seen in a study on athletes with acute hip adductor muscle injuries. Before participating in sports rehabilitation, the participants had to complete sprints, direction tests, and exercises appropriate to their sport without experiencing pain [7].

In the later stages of rehabilitation, strength training, coordination exercises, and functional training are used together. Strength training helps to build the necessary physical strength, coordination tasks help to improve movement control, and functional exercises help to gradually bring the body closer to the demands of a specific sport. The transition to more challenging tasks is based on functional criteria, rather than just the time since the injury.

Thus, complex rehabilitation does not involve a mechanical combination of different exercises, but rather their sequential progression depending on the athlete's condition. At the final stage, the program should replicate the basic motor demands of a specific sport and include training in strength, movement quality, and functional readiness.

Despite the success in developing comprehensive recovery programs, there are still a number of unresolved issues in the field of physical rehabilitation of athletes. Firstly, for many types of injuries, there are no uniform criteria to determine exactly when an athlete is ready to return to the sport. Therefore, the decision to resume training and competitive activities should be made not only based on the time that has passed since the injury but also taking into account the results of functional tests, load tolerance, and the condition of the damaged area.

In this regard, it is especially important to continue developing individual rehabilitation programs that will take into account the characteristics of each athlete. A promising direction is the wider use of objective monitoring methods, such as functional testing and wearable sensors, which will allow an objective assessment of movement and exercise parameters.

Conclusions

The analysis shows that effective physical rehabilitation for athletes should be based on a complex and phased approach to various types of exercise. Strength training can help restore physical abilities, while coordination exercises can improve balance and neuromuscular control. Functional training ensures a gradual return to specific movements for a particular sport. It is advisable to transition to subsequent stages of rehabilitation based on the results of functional testing, tolerance to load, and the condition of the injured area. Further individualization of recovery programs and the use of objective methods to monitor the functional state of athletes can be promising directions.

References

1. Bangsbo J., Hostrup M., Hellsten Y. [et al.]. Consensus Statements - Optimizing Performance of the Elite Athlete // Scandinavian Journal of Medicine & Science in Sports. - 2025. - Vol. 35, No. 8. - Art. e70112. - DOI: 10.1111/sms.70112. - URL: https://pmc.ncbi.nlm.nih.gov/articles/PMC12334928/.

2. Clinical Practice Guideline on Rehabilitation after ACLR [Electronic resource] // Aspetar Orthopedic and Sports Medicine Hospital. - URL: https://www.aspetar.com/en/professionals/aspetar-clinical-guidelines/recommendations-on-rehabilitation-after-aclr.

3. Dhillon H., Dhillon S., Dhillon M.S. Current Concepts in Sports Injury Rehabilitation // Indian Journal of Orthopedics. - 2017. - Vol. 51, No. 5. - P. 529-536. - DOI: 10.4103/ortho.IJOrtho_226_17. - URL: https://pmc.ncbi.nlm.nih.gov/articles/PMC5609374/.

4. Martin R. L., Davenport T. E., Fraser J. J. [et al.]. Ankle Stability and Movement Coordination Impairments: Lateral Ankle Ligament Sprains Revision 2021 // Journal of Orthopedic & Sports Physical Therapy. - 2021. - Vol. 51, No. 4. - pp. CPG1-CPG80. - DOI: 10.2519/jospt.2021.0302. - URL: https://www.jospt.org/doi/10.2519/jospt.2021.0302.

5. Meredith S.J., Rauer T., Chmielewski T.L. [et al.]. Return to Sport After Anterior Cruciate Ligament Injury: Panther Symposium ACL Injury Return to Sport Consensus Group // Orthopedic Journal of Sports Medicine. - 2020. - Vol. 8, No. 6. - Art. 2325967120930829. - DOI: 10.1177/2325967120930829. - URL: https://pmc.ncbi.nlm.nih.gov/articles/PMC7328222/.

6. Paton B.M., Read P., van Dyk N. [et al.]. London International Consensus and Delphi study on hamstring injuries part 3: rehabilitation, running and return to sport // British Journal of Sports Medicine. - 2023. - Vol. 57, No. 5. - pp. 278-291. - DOI: 10.1136/bjsports-2021-105384. - URL: https://bjsm.bmj.com/content/57/5/278.

7. Serner A., Weir A., Tol J. L. [et al.]. Return to Sport After Criteria-Based Rehabilitation of Acute Adductor Injuries in Male Athletes: A Prospective Cohort Study // Orthopedic Journal of Sports Medicine. - 2020. - Vol. 8, No. 1. - Art. 2325967119897247. - DOI: 10.1177/2325967119897247. - URL: https://pmc.ncbi.nlm.nih.gov/articles/PMC6990618/.

8. Tamura A., Shimura K., Inoue Y. Hip Flexibility and Dynamic Balance Ability in Soccer Players with Functional Ankle Instability // Trauma Care. - 2021. - Vol. 1, No. 3. - pp. 206-214. - DOI: 10.3390/traumacare1030018. - URL: https://www.mdpi.com/2673-866X/1/3/18.

9. Tang F., Xiang M., Yin S., Li X., Gao P. Meta-analysis of the dosage of balance training on ankle function and dynamic balance ability in patients with chronic ankle instability // BMC Musculoskeletal Disorders. - 2024. - Vol. 25. - Art. 689. - DOI: 10.1186/s12891-024-07800-8. - URL: https://link.springer.com/article/10.1186/s12891-024-07800-8.

10. Zech A., Hübscher M., Vogt L., Banzer W., Hänsel F., Pfeifer K. Neuromuscular training for rehabilitation of sports injuries: a systematic review // Medicine & Science in Sports & Exercise. - 2009. - Vol. 41, No. 10. - pp. 1831-1841. - DOI: 10.1249/MSS.0b013e3181a3cf0d. - URL: https://pubmed.ncbi.nlm.nih.gov/19727032/.