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EFFECTIVENESS OF COMPREHENSIVE REHABILITATION USING MULLIGAN AND REDCORD CONCEPTS AFTER ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION IN ATHLETES

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Introduction.

Anterior cruciate ligament (ACL) injury is one of the most common and clinically significant musculoskeletal injuries among individuals engaged in high levels of physical activity, particularly professional athletes involved in team sports. The high demands placed on knee joint stability during rapid directional changes, jumping, and rotational loads significantly increase the risk of ACL injury. Surgical reconstruction using an autograft is considered the gold standard of treatment; however, the success of recovery largely depends on a properly structured postoperative rehabilitation program.

During the postoperative period, especially at 4–6 weeks, patients experience several functional limitations, including pain syndrome, edema, reduced range of motion, and muscle weakness, particularly of the quadriceps femoris. Additionally, proprioception and neuromuscular control are impaired, complicating recovery and increasing the risk of developing pathological movement patterns. Traditional rehabilitation approaches often rely on isolated muscle strengthening and passive interventions, which do not always ensure full restoration of functional joint stability, especially in high-level athletes.

In this context, the implementation of modern comprehensive rehabilitation

programs that integrate different therapeutic approaches is becoming increasingly relevant. The Mulligan concept, based on mobilization with movement within a pain-free range, effectively restores range of motion and reduces pain. Meanwhile, the Redcord system, utilizing suspension therapy and neuromuscular activation (Neurac), facilitates the restoration of proprioception, coordination, and dynamic joint stability.

Thus, investigating the effectiveness of combining these methods in post-ACL reconstruction rehabilitation represents a relevant and перспективний напрям (перекладено як “promising direction”) in modern sports medicine and physical therapy. Studying their impact on clinical and functional outcomes will allow optimization of the rehabilitation process and improvement of patients’ quality of life and athletic performance.

Aim of the Study.

The aim of this study is a comprehensive evaluation of the effectiveness of a developed physical rehabilitation program in patients after anterior cruciate ligament reconstruction using a hamstring autograft. The primary focus is on assessing the dynamics of clinical and functional parameters, including knee joint range of motion, pain intensity, and the degree of edema in the postoperative period.

The study is designed to determine the advantages of an integrated approach combining the Mulligan concept (mobilization with movement) and Redcord suspension therapy with neuromuscular activation, compared to a standard kinesitherapy program. Particular attention is given to restoring functional capacity of the knee joint in professional athletes, who require not only anatomical recovery of the ligament but also full return to high physical loads.

The obtained results aim to provide scientific justification for the use of comprehensive rehabilitation programs to optimize recovery time and improve functional outcomes.

Objectives of the Study.

To achieve the stated aim, the following objectives were defined:

- To perform an initial assessment of the clinical and functional condition

of patients at 4–6 weeks after ACL reconstruction.

- To analyze pain intensity using the Visual Analog Scale (VAS) and the KOOS Pain subscale.
- To determine knee joint range of motion using mechanical goniometry, with particular emphasis on extension deficit and flexion limitation.
- To assess the severity of clinical symptoms, including swelling and stiffness, using the KOOS Symptoms subscale.
- To evaluate muscle strength of the thigh using manual muscle testing and functional tests.
- To compare the effectiveness of the standard rehabilitation program with the experimental program incorporating Mulligan and Redcord techniques.
- To analyze the dynamics of changes during rehabilitation and formulate evidence-based conclusions regarding the feasibility of implementing a comprehensive approach.

Materials and Methods.

The study involved 20 male patients aged 25 to 40 years who were professional athletes (football and basketball players) and were at 4–6 weeks post anterior cruciate ligament reconstruction using a hamstring autograft.

Participants were randomly divided into two groups:

- Experimental group (n = 10)
- Control group (n = 10)

A комплекс (translated as “comprehensive set”) of clinical and instrumental methods was used to assess knee joint function. Pain intensity was evaluated using the VAS and KOOS (Pain), range of motion was measured using mechanical goniometry, and symptom severity (swelling and stiffness) was assessed using KOOS (Symptoms). Muscle strength was evaluated using manual muscle testing.

The control group followed a standard kinesitherapy program consisting of isolated muscle strengthening exercises and passive stretching. The experimental group underwent a comprehensive rehabilitation program combining Mulligan mobilization with movement and Redcord suspension training with elements of

neuromuscular activation (Neurac).

Statistical analysis included calculation of mean values, standard deviations, and assessment of the significance of differences between groups.

Results.

Analysis of baseline clinical and functional parameters revealed no statistically significant differences between the experimental and control groups ($p > 0.05$), indicating their homogeneity and comparability.

Both groups demonstrated moderate pain syndrome, with mean VAS scores of 4.7–4.8, which increased during functional нагрузка (translated as “functional loading”). KOOS (Pain) scores also indicated reduced functional comfort.

Knee joint range of motion was limited: extension deficit exceeded 5°, and maximum flexion was approximately 95°, which is typical for this stage of rehabilitation. Assessment using KOOS (Symptoms) revealed moderate swelling and stiffness.

Additionally, decreased quadriceps muscle strength and impaired proprioception were observed. These findings confirm the presence of functional limitations characteristic of the postoperative period following ACL reconstruction and highlight the need for specialized rehabilitation programs.

Conclusions. The results of the study indicate that patients at 4–6 weeks after ACL reconstruction exhibit significant impairments in knee joint function, including pain, limited range of motion, swelling, and decreased muscle strength.

The absence of statistically significant differences between groups at baseline confirms their homogeneity and ensures the validity of subsequent comparative analysis. The obtained data substantiate the need for a comprehensive rehabilitation approach that includes not only traditional kinesitherapy methods but also modern concepts of neuromuscular activation and mobilization with movement.

The use of Mulligan and Redcord techniques creates favorable conditions for more effective restoration of proprioception, dynamic stability, and functional capacity of the joint. This is particularly important for professional athletes, as it allows optimization of return-to-sport timelines and reduction of reinjury risk.

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