„GEORGE EMIL PALADE" UNIVERSITY OF MEDICINE,
PHARMACY, SCIENCE AND TECHNOLOGY OF TÂRGU MUREȘ

DOCTORAL SCHOOL

SUMMARY OF THE DOCTORAL THESIS

Scientific Influence of Sports Training through Biomechanical and Sports Medicine Research

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INTRODUCTION

Modern sport represents an interdisciplinary field in which performance results from the integration of biomechanical, physiological, sports medicine and training science knowledge. Technological progress and the development of functional analysis methods have enabled a deeper understanding of the mechanisms underlying athletic success, as well as of the factors involved in the occurrence of injuries. In this context, the biomechanical and medical–sports evaluation of athletes has become an essential tool both for optimizing training and for monitoring the recovery process following musculoskeletal trauma.

RATIONALE OF THE STUDY

The choice of this research topic is determined by the need for an integrated approach between biomechanics, sports medicine and orthopedics, fields that are often analyzed separately in the scientific literature. Interest in this research direction is also supported by the author's multidisciplinary professional experience, which combines the perspective of a performance athlete and coach with medical practice in orthopedics and traumatology. The development of modern functional and biomechanical assessment methods provides the possibility of correlating data regarding neuromuscular performance, post-traumatic recovery and the evolution of degenerative joint pathologies, facilitating the integrated analysis of these processes in the context of sports medicine and musculoskeletal pathology.

The aim of the thesis is to analyze the role of biomechanical and medical–sports assessments in optimizing the training process, monitoring functional recovery after musculoskeletal trauma and evaluating the effectiveness of modern therapeutic methods used in joint pathology. The research seeks to integrate biomechanical, functional and clinical data into an analytical model applicable both to performance athletes and to patients with musculoskeletal disorders.

The research hypothesis is based on the premise that the systematic use of biomechanical and functional evaluations allows the identification of injury risk factors, the objective monitoring of the recovery process and the optimization of functional outcomes in the treatment of musculoskeletal pathologies.

The first study, entitled "Monitoring the Romanian Women's U16 National Volleyball Team: Jump Efficiency, Physiological Tolerance to Effort and Injury Risk," analyzes the biomechanical parameters of jumping, such as jump height, ground contact time and the reactive strength index, in correlation with the physiological response to effort and training load, in a sport characterized by explosive actions and frequent repeated jumps. These variables have a significant influence on injury risk in performance athletes.

The second study, "Isokinetic Evaluation of Quadriceps and Hamstring Muscle Performance in the Rehabilitation Process after Anterior Cruciate Ligament Reconstruction," investigates the role of isokinetic testing in the assessment of functional recovery following surgical intervention. The analysis of muscle performance and the strength ratio between antagonistic muscle groups allows the identification of functional imbalances and the monitoring of progress during the rehabilitation process.

The third study, "Predicting Long-Term Benefits of Micro-Fragmented Adipose Tissue Therapy in Knee Osteoarthritis: A Three-Year Evaluation of Symptom Progression and Mobility Improvement," addresses the long-term consequences of joint trauma. Ligament injuries and damage to intra-articular structures may lead, over time, to degenerative changes of the knee joint and the development of post-traumatic knee osteoarthritis. In this context, the research analyzes the effectiveness of micro-fragmented adipose tissue therapy as a minimally invasive biological treatment method, evaluating the evolution of symptoms and joint function over a three-year period.

The results of the research highlight the usefulness of biomechanical and functional evaluations in the analysis of sports performance and in the management of musculoskeletal pathology. Monitoring biomechanical parameters allows the identification of factors associated with an increased risk of injury and provides objective information for training optimization. At the same time, the functional assessment of post-traumatic recovery and the use of biological therapies in the treatment of knee osteoarthritis contribute to the improvement of functional outcomes and to the development of modern strategies for the management of joint pathology.

The originality of the thesis lies in the integration of biomechanical analysis of sports performance, functional evaluation in post-traumatic recovery and regenerative therapy in degenerative joint pathology within a common research framework. By correlating these directions within an interdisciplinary model, the thesis proposes a unified perspective on the relationship between sports performance, joint trauma and the evolution of degenerative pathologies, highlighting the role of functional evaluations and biological treatments in sports medicine and orthopedics.