FUNCTIONAL AND BIOMECHANICAL REPATTERNING IN TRIATHLON: EVALUATION OF A PROFESSIONAL ATHLETE

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ABSTRACT

The present study evaluated the effects of a functional repatterning protocol on a professional Triathlon athlete, focusing on improving biomechanics and sports performance. The method involved applying interventions focused on postural correction, muscle strengthening, and increased mobility, conducted over five weeks with specific exercise sessions for swimming, cycling, and running. The biomechanical analysis compared kinetic and kinematic parameters before and after the intervention, using high-speed filming and force platforms. The results showed improvements in muscle strength, especially in the hip abductors and flexors, and in the range of motion of the hip and ankle joints, suggesting more efficient biomechanics and a possible reduction in injury risk. It is concluded that the functional repatterning protocol was effective in optimizing the athlete's performance in Triathlon.

Keywords: Triathlon; Functional Repatterning; Biomechanics; Athletic Performance.

INTRODUCTION

The performance analysis of Triathlon athletes involves a multifaceted approach, as the sport combines swimming, cycling, and running performed continuously. Evaluating performance in each modality requires considering complex biomechanical variables, which include kinetic and kinematic factors, since success in Triathlon depends on the efficiency and fluidity of movements in all stages (Etxebarria;Mujika;Pyne, 2019).

To optimize performance and minimize injury risk, many athletes adopt functional repatterning protocols, whose objective is to correct inadequate movement

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patterns and increase biomechanical efficiency (Olaya-Cuartero; Cejuel, 2021). These protocols are particularly relevant in high-demand sports like Triathlon, where biomechanical deviations can impact athlete performance and health.

Methods for collecting kinetic and kinematic data are used to monitor biomechanics before and after intervention, allowing for a detailed analysis of changes in performance (Pearson *et al.*, 2020). Studies indicate that functional repatterning can improve movement mechanics, such as correcting unwanted hip rotations in running or adjustments in swimming technique (Cross; Brughelli; Cronin, 2014; Weich; Jensen; Vieten, 2019; Mateus *et al.*, 2022). The analysis of these variables enables a deeper understanding of the impacts of these corrections on movement efficiency and muscle force production (Olaya-Cuartero;Cejuel, 2021).

The comparison of kinetic and kinematic data is fundamental for measuring the results of functional repatterning, especially regarding the improvement of efficiency and the reduction of biomechanical deviations, contributing to the increase in overall athletic performance (Mateus *et al.*, 2022).

This study aims to evaluate the effects of a functional repatterning protocol on a professional Triathlon athlete, focusing on improving biomechanics and sports performance.

METHODOLOGY

This case study is part of an umbrella project, approved by the Research Ethics Committee of the Federal University of Goiás (protocol 6.024.913), which involved a female professional Triathlon athlete, 21 years old, 44 kg and 1.53 m. The athlete complained of trapezius pain, associated with muscle tension resulting from training. In addition to seeking pain relief, her goal was to optimize sports performance and prevent injuries, which motivated the application of the functional repatterning protocol.

The intervention followed a protocol focused on correcting biomechanical imbalances, with sessions of muscle strengthening, postural correction, and mobility, aiming to optimize movement patterns in Triathlon. Biomechanics were evaluated before and after the intervention using high-speed filming and force platforms.

The functional repatterning protocol was developed by the authors of this study and applied in two weekly sessions over five weeks. The participant used the bicycle

daily, with a protocol of 3 minutes of bilateral pedaling and 6 minutes of unilateral pedaling on the left side. The program was structured as follows:

First week: Focus on mobility exercises for the hip, ankle, and thoracic spine joints, accompanied by manual therapy to release the diaphragm and the temporomandibular joint (TMJ). Three exercises for each joint were performed.

Second week: Introduction of stability exercises for the knee, plantar arch, and lumbar region, both bilateral and unilateral. Three exercises for each were performed, with mobilization of the diaphragm and TMJ.

Third week: The focus was on knee and hip dominance exercises, as well as push and pull exercises for the upper limbs, both unilateral and bilateral, with mobility of the diaphragm and TMJ.

Fourth week: Dynamic balance exercises were performed, including unilateral, horizontal, and vertical jumps, in addition to agility and speed training with changes of direction.

Fifth week: The focus was on muscle power training using a weighted vest, with posture transfer exercises and inclined treadmill running.

The three-dimensional kinematic evaluation was performed at the Center of Excellence for Movement of the Naves Queiroz Institute, using the *Research Pro IMU* system with seven inertial sensors (Noraxon, USA). The first assessment took place in September 2022, before the start of the repatterning protocol, and the second was conducted in December 2022, after the completion of the intervention. The analyzed activities included squatting, running on a treadmill inclined at 60 degrees, and vertical jump, with three valid attempts for each activity. The range of motion (ROM) was calculated based on the angular displacement of the hip, knee, and ankle joints, measured in degrees.

RESULTS

- Squat: Increased ROM of the right hip (48.87° to 55.67°) and dorsiflexion of the right ankle (7.96° to 10.41°), suggesting improved flexibility. There was a reduction in right knee flexion (47.07° to 42.59°) and in ankle inversion (7.23° to 3.98°), indicating a possible technical adjustment.

- Inclined treadmill running: Reduction in hip flexion (13.08° to 9.34°) and right knee flexion (48.48° to 28.88°), pointing to greater efficiency and stability in running. The decrease in ankle dorsiflexion suggests adaptation to the demands of inclined running.
- Vertical jump: Increase in hip flexion (16.28° to 22.93°) and ankle dorsiflexion (0.10° to 1.89°), suggesting improvement in the power generated during the jump.

The biomechanical analysis revealed significant data about the athlete's body mechanics, muscle function, and possible adaptations to the demands of her sports practice. The use of inertial sensors enabled a precise and objective evaluation, providing valuable information for personalizing the treatment and training program.

Isometric dynamometry was applied to evaluate muscle strength in various muscle groups. There was a significant reduction in the strength of the hip abductors, from 14 to approximately 10 Newtons, suggesting an optimization in muscle activation and force redistribution. In the hip rotators, the strength dropped from 5 Newtons in the pre-test, indicating possible adjustments in motor coordination. The adductors showed a varied response, with some measurements increasing and others decreasing, reflecting the complexity of the muscle group.

These changes in muscle strength and activation provide information about the functional adaptations of the hip in response to the intervention protocol, suggesting biomechanical and kinetic adjustments that influence the athlete's performance.

These findings highlight the importance of ROM assessment as an integral part of the intervention process, aiming to optimize athletic performance and prevent injuries.

CONCLUSION

Functional repatterning proved effective in improving muscle strength and range of motion in a Triathlon athlete, resulting in important biomechanical adjustments for this sport. The intervention provided greater efficiency and stability, especially in activities requiring coordination and muscle power. Further studies are needed to fully understand the impact of these changes on the performance of elite athletes.

REFERENCES

CROSS, M.R.; BRUGHELLI, M. E.; CRONIN, J. B. Effectsofvestloadingonsprintkineticsandkinematics. **The JournalofStrength&ConditioningResearch,** v. 28, n. 7, p. 1867-1874, 2014.

ETXEBARRIA, N.; MUJIKA, I.; PYNE, D. B. Training andcompetitionreadiness in triathlon. **Sports**, v. 7, n. 5, p. 101, 2019.

MATEUS, G. A. S. et al. Effectof Fatigue andGradedRunningonKinematicsandKineticsParameters in Triathletes. **InternationalJournalof Sports Medicine**, p. 797-803, 2022.

OLAYA-CUARTERO, J.; CEJUELA, R. Influenceofbiomechanicalparameterson performance in elite triathletesalong 29 weeksof training. **AppliedSciences**, v. 11, n. 3, p. 1050, 2021.

PEARSON, M. et al. Velocitylossthresholdsreliablycontrolkineticandkinematic outputs duringfreeweightresistance training**. InternationalJournalof Environmental ResearchandPublic Health**, v. 17, n. 18, p. 6509, 2020.

WEICH, C.; JENSEN, R. L.; VIETEN, M. Triathlontransitionstudy: Quantifyingdifferences in runningmovementpatternandprecisionafterbikeruntransition. **Sports biomechanics**, v. 18, n. 2, p. 215-228, 2019.