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COMPARATIVE ANALYSIS OF ANGLES IN THE SPINSHOT THROWS TOWARDS THE GOAL IN BEACH HANDBALL

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ABSTRACT. Beach handball game is a dynamic sport with high intensity, conducted on a sand court. The inclusion of this sports branch in the Youth Olympic Games program in 2018 held in Buenos Aires, Argentina, elevated the profile of this international sports branch and underscores an increased need for a multitude of performance factors in this sport. **The research aim.** The research aim was to conduct a comparative analysis of the spinshot technique between an advanced player and a beginner, aiming to gather useful information regarding a technical profile for spinning shots in beach handball and to guide training for enhanced efficiency in this throwing technique. **Objectives.** Objectives encompassed the analysis of video recordings of two players concerning the angles between body segments and between the body and the ground at various moments during the execution of the technique. **Methods and means.** For the analysis of throws, video recordings of the executions were performed on two subjects, both beach handball players – one being an advanced player, and the other a beginner. To measure the parameters to be analyzed, including angular characteristics of body segments at key moments during the execution of the spinning shot technique, and the execution times of the two players, Kinovea software v 0.9.5 was utilized. Additionally, trajectory analysis and execution time were examined. **Results.** In the video analysis of the movement, the force generated by the players is not visible, but it aids in understanding the action and the effects of internal forces (muscle action) and external forces (gravity and friction) on the moving players. The discrepancy between the advanced and beginner players in achieving a half (180^0) spin in the technical procedure of the spinsshot lies in the flight phase. Execution times are close between the two players, but video analysis revealed differences in the quality of their executions regarding the correct implementation of the spinning shot. **Conclusions.**

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The analysis results highlight significant differences in joint amplitude between the two players during spinning shot executions, potentially caused by insufficient muscle group strength, reduced joint mobility, or incorrect mastery of the throwing technique.

Keywords: *beach handball, spinshot, angles movement, kinovea*

REZUMAT ***Analiză comparativă privind unghiurile realizate în aruncarea la poartă din piruetă din jocul de beach handball.*** **Jocul de beach handball este un sport dinamic, cu o intensitate mare, ce se desfăşoară pe un teren de nisip.** Includerea acestei ramuri sportive în programul Jocurilor Olimpice pentru Tineret în 2018 desfăşurate în oraşul Buenos Aires din Argentina, a ridicat profilul acestei ramuri sportive internaţionale şi plasează o necesitate crescută a multitudinii de factori de obţinere a performanţelor în acest sport. **Scopul cercetării.** Scopul acestei cercetări a fost să realizăm o analiză comparativă asupra tehnicii de aruncare la poartă din piruetă a unei jucătoare avansate şi a unei jucătoare începătoare, dar şi pentru dirijarea antrenamentelor în vederea creşterii eficienţei acestui procedeu de aruncare. **Obiective.** Analiza înregistrărilor video a execuţiilor a două sportive din punctul de vedere al unghiurilor dintre segmente ale corpului, dar şi dintre corp şi sol, în diferite momente ale execuţiei procedeului, şi analiza traiectoriei şi a timpului de execuţie. **Metode şi mijloace.** Pentru analiza aruncărilor au fost efectuate înregistrări video ale execuţiilor a doi subiecţi, jucătoare de beach handball – una fiind jucătoare avansată, cealaltă jucătoare începătoare. În vederea măsurării parametrilor ce urmează a fi analizaţi, a caracteristicilor unghiulare ale segmentelor corpului în momentele cheie ale execuţiei procedeului tehnic de aruncare la poartă din piruetă şi a timpilor de execuţie la celor două sportive s-a utilizat software-ul Kinovea v 0.9.5. **Rezultate.** În analiza video a mişcării nu se poate vedea forţa produsă de către sportive, însă ne ajută să înţelegem acţiunea şi efectele forţelor interne (acţiunea muşchilor) şi externe (gravitatea şi fricţiunea) asupra sportivelor aflate în mişcare. Diferenţa dintre jucătoarea avansată şi jucătoarea începătoare la realizarea pe jumătate (180^0) a procedeului tehnic de aruncare la poartă din piruetă o face faza de zbor. Timpii de execuţie sunt apropiaţi între cele două jucătoare, însă prin analiza video am reuşit să observăm şi calitatea execuţiilor a acestora în ceea ce priveşte realizarea corectă a aruncării la poartă din piruetă. **Concluzii.** Rezultatele analizei evidenţiază diferenţe mari de amplitudine articulară între cele două jucătoare în timpul execuţiilor de aruncare la poartă din piruetă, care pot fi cauzate de forţa insuficientă a grupelor musculare implicate, mobilitatea articulară redusă sau însuşirea incorectă a tehnicii de aruncare.

Cuvinte-cheie: *beach handball, aruncarea la poartă din piruetă, unghiurile de mişcare, kinovea*

INTRODUCTION

Beach handball is a dynamic sport characterized by high intensity, conducted on a sand court. The incorporation of this sporting discipline into the Youth Olympic Games program in 2018, held in the city of Buenos Aires, Argentina, elevated the profile of this international sports branch and underscores an augmented necessity of a multitude of performance-acquiring factors within this sport.

Unlike other sports played on sand, such as volleyball and soccer, there is a dearth of scientific research on beach handball to date. Specifically, there is scant data regarding major tournaments like the World and European Championships (Gehrer & Posada, 2010; Gruic et al., 2011; Tezcan, 2013; Skandalis et al., 2017; Zapardiel, 2018). On the other hand, there is a growing interest among specialists in this field for information pertaining to the technical and tactical aspects of beach handball.

Success in beach handball is contingent upon numerous internal and external factors, including anthropometric characteristics, physical capacity, technical and tactical abilities, as well as psychological factors (Ronglan et al., 2006; Srhoj et al., 2002).

An equally underexplored area pertains to the match technique and tactics in beach handball. Most studies have focused on goal-scoring actions and their efficiency, conducted within European or World Championships. Strategies employed in traditional handball cannot be seamlessly applied in beach handball due to the substantial differences in rules and competition format.

Research on the relationship between cognitive functions and specific motor skills of beach handball players indicates that attention, perception, the ability to track multiple objects simultaneously, are positively associated with sprinting, ball control, dribbling, and directional changes (Little & Williams, 2005; Jovanovic et al., 2011; Nesen et al., 2018).

In beach handball competitions, athletes employ various technical procedures for shooting while running or jumping (with or without a spinshot), with the key to performance lying in their efficiency (Wagner et al., 2011; Raeder et al., 2015; Zapardiel & Asin-Izquierdo, 2020).

Mastery of the spinshot throw technique, as well as all other throwing procedures employed by a player, necessitates the accurate and efficient execution of all movements.

We consider it crucial that, to optimize the effectiveness of throws, each player is analyzed from the moment of ground contact until the completion of the throw, including the full rotation (360 degrees). The spinshot throw technique

is highly intricate in its execution. Players must coordinate each step and every segment of their body to execute this technical procedure correctly and efficiently. Consequently, a detailed analysis of movements is necessary, highlighting crucial moments and key points in the executions.

THE RESEARCH AIM

The research aim was to conduct a comparative analysis of the spinshot technique between an advanced player and a beginner, aiming to gather useful information regarding a technical profile for spinning shots in beach handball and to guide training for enhanced efficiency in this throwing technique.

OBJECTIVES

- The analysis of video recordings of the executions of two athletes (novice and advanced) involves examining the angles between body segments as well as between the body and the ground at various stages of the procedure.
- The analysis includes examining the trajectory and rotation time (execution time) of the spinshot throw for both athletes.

METHODS AND MEANS

For the analysis of throws, video recordings of the executions of two subjects, both beach handball players - one being an advanced player, and the other a beginner - were conducted. To measure the parameters to be analyzed, including angular characteristics of body segments at key moments of the technical procedure of the spinshot throw, and the execution times for both athletes, Kinovea v 0.9.5 software was utilized.

The recorded parameters for the specific movement of the spinshot throw towards the goal were as follows:

- The angle between the ground and the lower leg at the moment of propulsion.
- The angle between the thigh and the lower leg at the moment of propulsion.
- The angle between the trunk and the ground at the moment of propulsion.
- The angle between the trunk and the thigh after a 180^0 rotation.
- The execution time.

Landmarks on the subjects' bodies were identified and marked. To obtain data regarding angular amplitude and execution time for both subjects, the software processed these data and provided the necessary information about the areas of interest involved in the spinshot throw in beach handball.

RESULTS

Initially, we analyzed the angles at the level of the lower limbs (propulsion angle, angle between the thigh and lower leg) and the angle between the trunk and thigh at the moment of the step before takeoff, attempting to identify whether the created angles are decisive in the spinshot throw towards the goal.

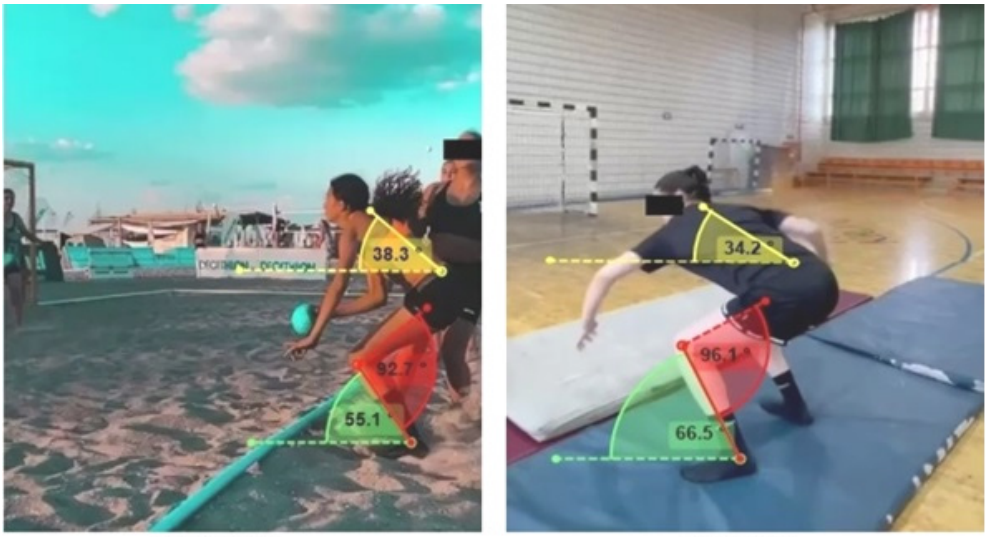

Fig 1. The differences in angles at the moment of the step

In Figure 1, the angles at the moment of the step for the two beach handball players are represented by different colors.

The propulsion angle is represented by the green color, which differs between the two players. For the advanced player, the angle is 55.1^0, while for the novice player, it is 66.5^0. In theory, a smaller propulsion angle may not generate sufficient lift for executing the spinshot throw towards the goal, with the novice player having a larger angle that allows for an easier execution of the flight phase.

In the video analysis of the movement, the force exerted by the athletes cannot be visually observed. However, it aids in comprehending the action and the effects of internal forces (muscle action) and external forces (gravity and friction) on the athletes in motion.

The angle represented by the red color is the angle between the thigh and lower leg. The advanced player has an angle of 92.7^0, while the novice player has an angle of 96.1^0. The angle between the thigh and lower leg should be smaller, indicating a load and preparation for an efficient takeoff. The advanced player has the capacity to generate a more powerful jump, correlating with the minimal force and power achieved during the landing phase of the jump. The magnitude of this angle is also influenced by the height of the general center of gravity (CGG) relative to the support surface (ground).

The angle between the trunk and the ground (yellow) for the advanced player is 38.3^0, while for the novice player it is 34.2^0. To execute a complete and high rotation, the trunk should not be excessively bent forward. The tendency of the players to take off horizontally rather than vertically is attributed to the small angle between the trunk and the ground at the moment of propulsion. This angle, in turn, is influenced by the position of the center of gravity, which is pushed forward. Stability during the initial landing before the actual jump can provide insights into the optimal conditions for executing the complete procedure by analyzing the force couple.

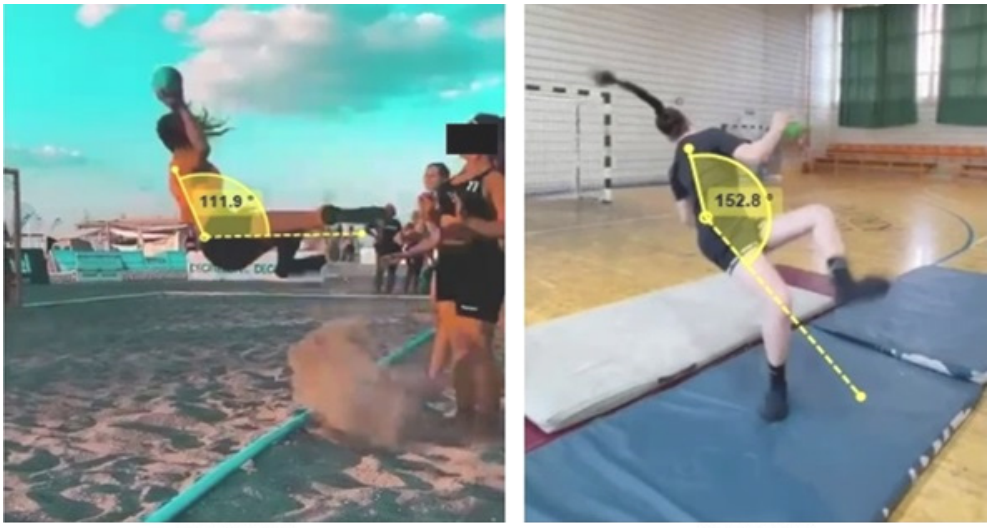

Fig. 2. The angle between the trunk and thigh before the execution of the throw

The distinction between the advanced and novice players in the halfway (180^0) completion of the technical procedure of the spinshot throw lies in the flight phase. In Figure 2, it can be observed that the advanced player attains the necessary height to finalize the procedure, with her legs pushed upward, and her throwing arm elevated and ready for the ball release. The novice player accomplishes the trunk rotation at 180^0, but her legs lag behind, with the right foot still on the ground, and the throwing arm is not prepared for completion. Equally significant is the angle between the trunk and thigh at the moment of the 180^0 rotation, as a larger angle makes it more challenging to achieve a complete trunk rotation.

The anterior-posterior impulse and the pushing force are parameters that indicate the future position of the players towards the goal during the execution of the procedure, providing precise data on the flight direction and jump height.

Fig. 3. The execution time of the spinshot throw

Execution time and force contribute as significant factors in the completion of the spinshot throw procedure in beach handball.

In addition to the correct technique mastered by each player, the execution speed of a technical finishing procedure towards the goal is crucial in achieving and validating a scored goal. Any tactical attacking action has an ultimate goal, and the player in the position to score must execute the throw as accurately and swiftly as possible, regardless of the chosen technical procedure. Otherwise, they may be intercepted and blocked by a defender.

In Figure 3, we observe similar execution times between the two players, but through video analysis, we managed to discern the quality of their executions concerning the accurate completion of the spinshot throw towards the goal.

DISCUSSIONS

The aim of this study was to identify the angles involved in the spinshot throw towards the goal performed by an advanced player and a novice player. Additionally, the study aimed to guide training sessions to achieve increased efficiency in the procedure. In beach handball, the execution of the spinshot throw towards the goal is crucial for scoring a 2-point goal, and it must be performed with precision to enhance its effectiveness.

The differences in angles at the moment of the step can provide significant insights into how beach handball players manage and execute the spinshot throw towards the goal. These variations may impact the trajectory, accuracy, and force of the throw. Analyzing these differences can contribute to understanding the technical and tactical aspects of the procedure and identifying key points that can be enhanced in the athletes' training regimen.

The obtained results revealed a significant difference between the two players in key moments of their executions. Previous studies (Zapardiel, 2018a; 2018b) have observed that the top team in the final ranking of a U17 women's championship achieved greater total points from spinshot throws. Similar trends were noted in the men's category (Saavedra et al., 2019).

One of the methods employed in the development of jumping ability is plyometrics. Through the application of these types of exercises, an athlete is exposed to levels of tension and contraction speeds that are unprecedented, compelling them to tap into their available energy resources, which are typically underutilized.

Saez de Villareal et al. (2009) highlight that athletes with greater experience in a specific sport discipline respond more effectively to certain combinations of plyometric exercise forms, yielding superior outcomes in jump enhancements. However, this does not imply that athletes in good physical condition cannot derive similar benefits from plyometric methods.

Various studies have indicated that plyometric training has a positive impact on explosive strength during jumping, with Rousanoglou et al. (2014) highlighting a 14% increase in explosive strength after 4 weeks of training.

Various types of vertical jumps have served as models for studying different biomechanical and neurophysiological phenomena. Currently, it is recognized that jump height is a predictor of muscular power, leading to the utilization of various types of vertical jumps to enhance athletes' performance (Bosco et al., 1983; Vandewalle et al., 1987; Wilson et al., 1991; Driss et al., 1998; Radcliffe & Farentinos, 1999; Saez de Villarreal, 2010).

Therefore, the ability to jump, along with the strength and power of the lower extremities, becomes crucial elements in the athlete's performance during the game, encompassing rapid movements, and specific throwing jumps (such as spinshot or inflight shots).

CONCLUSIONS

The aim of the study was to analyze the technique of the spinshot throw towards the goal by comparing the technical executions of an advanced player and a novice player, with the goal of developing and implementing an intervention program to enhance the efficiency of this throwing procedure.

This analysis led to the identification of the muscles involved in the execution of the spinshot throw towards the goal, the manner of their engagement, the execution times, as well as the ground forces required for this execution.

The results of the analysis highlight significant differences in joint amplitude between the two players during the executions of the spinshot throw towards the goal. These differences could be attributed to insufficient strength in the involved muscle groups, reduced joint mobility, or incorrect mastery of the throwing technique.

Stability at the moment of the step is a crucial factor in executing the takeoff; the players' legs should not be too widely spread. Ground instability can result in a loss of propulsion force and hinder vertical takeoff.

Regarding the mechanical work performed through energy consumption, the advanced player achieves a complete rotation during the flight phase compared to the novice player. This aspect is essential for reaching the ball release phase facing the goal.

The flight direction (vertical) and jump height (as high as possible) are crucial variables in executing the spinshot throw towards the goal. These are influenced by the anterior-posterior impulse and ground reaction force, with the advanced player exhibiting a vertical flight direction and significantly higher jump height compared to the novice player.

To enhance the performance of novice players and improve their efficiency in executing the spinshot throw towards the goal, it is necessary to implement a well-structured training program. This program should focus on refining the execution technique, increasing ground forces, while also preventing injuries resulting from incorrect executions.

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