Analyzing Shooting Measurements in Football: An Exhaustive Review and Novel Findings

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Systematic Review Article

ABSTRACT

This article comprehensively reviews football shooting analysis, discussing the most recent techniques and tools and proposing new ways to investigate shooting performance. The analysis demonstrates that measuring shooting parameters using various tools and techniques is possible precisely. However, most of these methods have limitations, such as expensive apparatus, a lack of real-time feedback, or the need for manual data processing. Wearable sensors and data integration are proposed as solutions for overcoming these obstacles. The review highlights the significance of shooting analysis in football and the potential of new technologies to enhance this process, thereby providing coaches and players with valuable insights. Validating these approaches and exploring their maximum potential in football analysis requires additional research.

Moreover, the approaches proposed in this study have the potential to increase the performance of individual players and team tactics. Coaches and players can better understand the team's strengths and weaknesses by combining shooting data with other performance metrics, such as player movement and team tactics. It can improve game-time decision-making and ultimately

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enhance the team's overall performance. The ability to monitor player fatigue and injury risk is another potential advantage of using wearable sensors and real-time feedback in shooting analysis. By consistently measuring shooting parameters, coaches and medical personnel can determine when a player's shooting technique is compromised due to fatigue or injury. Additional research is required to validate and realize these proposed approaches' potential thoroughly.

Keywords: Shooting; football; performance; skill.

1. INTRODUCTION

Accurate shooting is an essential skill for any football participant. You require various physical and mental abilities, including strength, accuracy, coordination, and the capacity to make fast decisions. For accurate shooting, technical and tactical skills such as ball control, footwork, firing technique, and situational awareness are required. In addition to player position, fatigue, duress, and opponent strategy, other factors affecting shooting performance include player fatigue, player lethargy, and opponent strategy [1]. Therefore, by analyzing statistical data, coaches can tremendously benefit from a deeper understanding of their students' and teams' shooting abilities.

Researchers and practitioners have employed various techniques, from measuring ball speed to complex motion capture systems, to obtain accurate information on shooters' abilities [2]. For instance, researchers in various disciplines have used radar weapons and high-speed cameras to track projectiles in flight. Other studies have utilized GPS or motion-capture sensors to monitor the shooter and the ball. With these techniques, the release angle, impact location, and projectile rotation rate can all be determined [3].

According to [4], analysis of a shooter's performance can reveal more than just technical metrics; it can also reveal elements of their thought process, such as decision-making, anticipation, and visual attention. Eye-tracking research has revealed, for instance, that experienced players use a distinct gaze pattern when aiming than novices. Professional players frequently keep a watch on their surroundings while concentrating on the goal or the goalkeeper. However, novice players tend to have a more dispersed gaze pattern and concentrate excessively on the ball.

Applying marksmanship analysis to football has repercussions for both practice and game outcomes. Using shooting data collected, coaches can monitor player development, identify problem areas, and customize training regimens for each player [5]. For instance, if a player has difficulty making shots, the coach can work with him or her to improve their agility, body position, and shooting technique. In addition, coaches can evaluate the effectiveness of various training strategies, such as strength and mental exercises, using shooting data [6].

With knowledge of the opposing team's shooting performance, decisions such as player selection, formation, and game strategy can all be enhanced. By analyzing their shooting data, instructors can better adapt their strategies to the opposition. When facing a goaltender with a high save percentage for shots from a particular angle or distance, coaches can encourage their players to fire from those angles and distances [5]. In addition, coaches can use shooting analysis to assess the effectiveness of their own team's shooting strategies, such as crossing and set pieces.

Analyzing shooting data presents numerous difficulties, including data integrity, sample size, and context dependence. For instance, laboratory shooting data may not adequately represent the complexity and variety of shooting situations. The same could be said for data on football shooting collected from a limited population subset. A shooter's performance can also be affected by match pressure, opponent strategy, and weather. Consequently, these caveats must be considered when interpreting and employing football gunshot analysis.

In conclusion, analyzing football shooting statistics is an effective method for enhancing individual and team performance. It requires considering photography's technical and mental aspects and employing a broad range of tools and techniques [7,8]. Utilizing shooting performance data during practice and competitions can benefit coaching decisions and player development. Although football gunshot data has evident implications, there is still much

to learn about the best methods for shooting analysis [9].

2. METHODOLOGY

The review utilized Google Scholar, Scopus, and PubMed, among others, to comprehensively review the literature on football shot analysis. The review used the search terms "football shooting analysis," "ball speed measurement," "shot accuracy," and "trajectory analysis" to locate the desired literature. The review included studies that quantified shot parameters using motion capture techniques, high-speed cameras, and ball-tracking sensors. In addition, the review analyzed the limitations and obstacles of existing methodologies and proposed new strategies to surmount them.

When evaluating gunshot data, the measuring instruments' precision and dependability are significant obstacles. Researchers have used motion capture technology to examine the movement of participants and the ball during the shooting process. These systems can be costly and require a controlled environment, limiting their applicability in real-world scenarios despite the precision of the information they provide. Prior research has recorded the ball's path and velocity using high-speed cameras, but these cameras are susceptible to error due to illumination and viewing angle.

Several researchers have begun employing ball-tracking sensors to measure discharge parameters to circumvent these restrictions. With the aid of these sensors, coaches and athletes can obtain accurate, real-time data to evaluate progress more accurately. However, these sensors can be costly and not affordable for all businesses or players.

Data interpretation represents a second difficulty in discharge analysis. Examining numbers such as projectile velocity and accuracy does not reveal much about a player's skill level. Numerous other factors can significantly impact a shooter's success, such as the player's location, the gaming strategy employed, and the shooter's mental state [10]. Consequently, it is essential to evaluate firing statistics in the context of the entire game and player actions.

To address these issues, some researchers have proposed a more comprehensive discharge analysis method incorporating a broader range of data, including physiological and psychological measurements. This method may aid coaches and players in gaining a greater comprehension of shooting performance, resulting in more refined and effective training techniques.

Finally, after conducting a comprehensive literature review on football gunshot analysis, the review analyzed the advantages and disadvantages of current methods and proposed new approaches to address these obstacles. It is essential to measure shooting parameters accurately and interpret the data within the context of a game in order to obtain valuable insights into player performance and team strategies. Multiple data sources, including physiological and psychological markers, can aid coaches and players in gaining a more profound comprehension of shooting performance, resulting in more effective training and game strategy [11].

3. RESULTS

The use of high-speed cameras and ball-tracking sensors in shooting analysis studies is pervasive. These techniques enable precise measurements of the ball's velocity, trajectory, and rotation, which can shed light on the effectiveness of individual players. As quicker shots are more difficult for goalkeepers to stop, ball velocity has been identified as an essential factor in goal-scoring success. In addition, it has been demonstrated that spin affects the ball's trajectory, which impacts striking accuracy [12,13].

By goal-line technology and video analysis, shooting analysis determines the accuracy of a player's strikes. Goal-line technology uses cameras and sensors to determine if a ball has crossed the goal line, whereas video analysis necessitates manually tracking the ball's path using software. When determining whether or not the ball has crossed the goal line, goal-line technology is more reliable, whereas video analysis can cast light on the quality of a shot.

Although there are benefits to these approaches, their application in the real world is limited. For example, high-speed cameras and ball-tracking sensors can be prohibitively costly, limiting their use to the wealthiest teams. Due to a lack of real-time feedback, players and coaches may be unable to adjust their performance quickly. Not only is manual data processing labor-intensive, but it can also introduce analytical errors.

Wearable sensors, such as inertial measurement units (IMUs), are recommended to enhance precision and efficacy. IMUs are small, lightweight sensors worn on the body to measure acceleration, orientation, and angular velocity. IMUs enable instructors and players to obtain real-time information on their shooting form, allowing them to adjust during practice or competition. In addition, integrating shooting data with other performance metrics, such as player mobility and team strategies, allows for a more in-depth examination of the game and improved decision-making.

Recent research has proposed methodologies for analyzing gunfire that does not rely on IMUs. Camera- and sensor-based motion capture systems have found use in numerous disciplines, including the study of shooting mechanics and the determination of key performance indicators (KPIs). In addition, virtual reality has been used to simulate realistic firing conditions for more realistic and practical training.

The findings show that football teams and individual players can significantly benefit from shooting analysis. Coaches and athletes can identify areas for improvement and customize their instruction in response to precise measurements of crucial shooting metrics and immediate feedback. In order to overcome obstacles and have a more significant impact in the actual world, additional research is required to enhance and develop brand-new approaches.

The review also revealed an essential fact: a player's shooting performance can vary based on his or her position and role on the team. Forwards typically possess superior shooting accuracy and object speed than defenders and midfielders. It is because forwards are frequently required to specialize in shooting and are given more opportunities. However, defenders and midfielders are frequently requested to perform additional tasks, such as passing and object retention, which can hinder their ability to shoot effectively.

Finally, the review discovered that exhaustion, stress, and the encircling environment can affect a person's shooting ability. For instance, as the game progresses, a player's fatigue may result in declining gunfire accuracy, hurting their performance. Similarly, the pressure a player feels from the crowd, opponents, or instructors can influence their shooting decision and execution. In addition, external conditions such as wind, moisture, and sunlight can influence the trajectory and spin of the ball, resulting in varying degrees of success when shooting.

The review also revealed the relevance of including gunshot data in in-game strategy and tactics. Instructors and analysts can modify their approach to firearms by analyzing patterns and results. For instance, if a team struggles to convert attempts into goals, they may need to improve their shooting accuracy or generate more scoring opportunities. Alternatively, if a team's counterattacks or set pieces are their most vital points, they may need to emphasize these aspects more in their game plan.

The current state of gunshot analysis in football is examined, and new techniques for enhancing accuracy, efficiency, and tactical outcomes are proposed. By utilizing cutting-edge technologies and integrating shooting data with other performance indicators, the complication of shooting and its importance to the outcome of a game can be better comprehended.

4. DISCUSSION

The development of standardized metrics for firearms performance is a promising area for growth. Although there are several measurable parameters, such as ball speed, trajectory, and rotation, there is no consensus on which ones are the most important for game analysis. Therefore, it is essential to establish a set of standardized metrics that can be applied consistently across studies and teams. Not only would this facilitate comparisons and meta-analyses, but it would also provide coaches, players, and analysts with a common language for improving shooting abilities.

Variability in firing opportunities and contexts further complicates the analysis of gunfire. Different types of strikes, including free kicks, penalties, and open play, have rules and requirements. Therefore, it is necessary to differentiate between these scenarios and analyze firing performance accordingly. For example, a player's accuracy and decision-making may vary between a penalty kick, where the goal is undefended, and an open play shot, where the player must evade defenders and goalkeepers.

In addition, firearms analysis should consider each participant's unique characteristics and strengths. Although shooting is a fundamental

skill in football, not all players excel, so their roles and responsibilities can vary. Therefore, instructors and analysts must customize their feedback and training strategies to each player's preferences and needs. Some players may benefit more from refining their accuracy, while others may need to focus on their power or trajectory.

One of the limitations of current gunshot analysis methodologies is the lack of real-time feedback. Most extant techniques necessitate manual data processing and post-game analysis, neither of which can offer immediate insights or intervention opportunities. Therefore, wearable sensors and other real-time monitoring tools can enhance shooting analysis by providing immediate feedback and allowing players and coaches to adjust their performance during the game. IMUs can measure the orientation, acceleration, and velocity of a player's extremities and thorax to provide real-time data on shooting technique and form, for instance.

To provide a more comprehensive view of game performance, shooting analysis should be combined with other performance metrics, such as player movement, possession of the object, and team tactics. Using a combination of shooting data and transit network data, for instance, it is possible to identify participant relationships and optimize team strategy. In addition, marksmanship analysis can be combined with physical activity and exertion data to monitor player fatigue and prevent injuries.

In summation, shooting analysis is an essential component of football performance and can provide valuable insight into players' and teams' strengths and weaknesses. New technologies like wearable sensors and real-time surveillance could enhance gunshot analysis and game outcomes. However, obstacles and constraints must be addressed, such as the need to standardize metrics and the variance in termination opportunities. By employing an integrated and individualized approach to shooting analysis, instructors, players, and analysts can better grasp the complexity of this skill and optimize game strategies accordingly.

In addition, wearable sensors, such as IMUs, can provide a wealth of information beyond the scope of traditional gunshot analysis. IMUs can measure the body's orientation, acceleration, and angular velocity during the firing motion, casting

light on the biomechanics of the technique. This information can help instructors and athletes identify technique flaws, such as improper body positioning or inefficient energy transfer, and work to correct them.

Another benefit of wearable sensors is their ability to capture real-time data. This feature is handy for shooting analysis because it provides immediate feedback on the shot's quality, including the ball's speed and accuracy. Real-time feedback can also help participants modify their technique during training sessions or games, resulting in accelerated development and improved performance. Moreover, wearable sensors can reduce the need for manual data processing, which is time-consuming and prone to error.

Incorporating shooting data with other performance metrics can give instructors a more comprehensive tactical perspective of player and team performance. For instance, combining shooting data with player movement data can reveal offensive play patterns, such as shooting frequency and success rate from specific field areas. This information can assist instructors in adjusting their game strategies, such as instructing certain players to take more shots from specific locations or altering the team's formation. In addition, analyzing shooting data in conjunction with defensive statistics such as interceptions and tackles can disclose the team's defensive strengths and weaknesses.

However, there are still obstacles to surmount in gunshot analysis, such as the absence of standardized measurement protocols and the need for more advanced data analysis techniques. Standardization of measurement protocols can facilitate the accumulation of consistent data across multiple studies, thereby facilitating a more precise comparison and synthesis of results. Moreover, developing innovative data analysis techniques like machine learning algorithms can facilitate extracting insightful information from large and complex datasets.

In conclusion, football goal analysis is integral to player and team performance evaluation. Innovative techniques such as high-speed cameras, ball-tracking sensors, and wearable sensors provide precise and exhaustive measurements of shooting parameters, allowing coaches and athletes to identify areas for improvement and adjust their strategies.

Integration of shooting data with other performance metrics can provide a more comprehensive picture of player and team performance, thereby improving game outcomes. However, additional research is necessary to resolve the remaining shooting analysis obstacles and develop innovative data collection and analysis techniques.

5. CONCLUSION

In conclusion, the analysis of shooting performance is a crucial part of football analysis and can provide valuable insight into player strengths and weaknesses, team tactics, and overall game strategy. Methods such as high-speed cameras, ball-tracking sensors, and goal-line technology have proven effective for measuring shooting parameters such as ball speed, trajectory, accuracy, and rotation. However, these methods have limitations, including expensive equipment, a lack of real-time feedback, and the need for manual data processing.

New technologies, such as wearable sensors and data integration, have the potential to overcome these obstacles and provide real-time feedback to coaches and participants. Utilizing inertial measurement units (IMUs) can provide accurate and trustworthy data on player movements, firing mechanics, and biomechanics. Integrating shooting data with other performance metrics, such as player movement and team tactics, can provide a more comprehensive view of player and team performance, enhancing game outcomes.

However, additional research must validate these methods and determine their utmost potential for football analysis. The precision, dependability, and validity of the use of wearable sensors for discharge analysis must be determined through research. In addition, advancing machine learning algorithms and artificial intelligence can automate data processing and analysis, reducing the need for human intervention.

Incorporating new technologies and data in shooting analysis can revolutionize football analysis and provide valuable insights to coaches, players, and analysts. We anticipate significant improvements in firearm performance and game outcomes due to this field's ongoing technological development and research.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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