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Influence of Dynamic Postural Control on Shooting Precision During Static and Transitional Play in Skilled Soccer Players

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Abstract

The study aims to explore the relationship between dynamic stability and shooting accuracy in stationary and moving conditions among advanced soccer players in the city of Samarra, Iraq. This study used a descriptive-analytical method with a correlational design. The study consisted of 54 participants, chosen from premier football teams in Iraq. Two tests were conducted in the field to assess the accuracy of shooting in stationary and movement situations. The study found that the accuracy of shooting in stationary situations is significantly higher than in movement situations. On the other hand, the study found that the accuracy of shooting is significantly influenced by knee angle, contact time, center of mass deviation, and trunk oscillation in both stationary and movement situations, whereas ankle angle and execution time are significantly influenced in movement situations only. The study also found that the proposed model is able to explain 58% and 64% of the total variance in shooting accuracy in stationary and movement situations, respectively, using multiple regression analysis, whereas the results showed statistically significant differences in favor of stationary shooting using repeated-measure ANOVA. The study concluded that the accuracy of shooting is significantly influenced by dynamic balance, and this is an important factor in the accuracy of shooting in soccer games. Thus, coaches must focus on the optimization of knee angle, regulation of contact time, and improvement of dynamic balance in training programs to enhance the accuracy of shooting in soccer players. In addition, the study also found that the use of Kenova software in the Iraqi sports arena is effective in producing reliable results, which can be used by coaches in improving the accuracy of shooting in soccer players.

Keywords: Dynamic Postural Control, Shooting Precision, Static Play, Transitional Play, Skilled Soccer Players.

Introduction

Football is one of the most widely played and watched sports in the world (Kuswoyo, 2017). Its competitive nature demands not only high physical capacity, but also refined technical execution

(Abarghoueinejad et al., 2021; Abduh et al., 2024). Among the many technical skills required in football, shooting is one of the most decisive because it directly determines whether a team can convert opportunities into goals(Aftab et al., 2020; Akinsemolu & Onyeaka, 2025). For that reason, shooting performance is often used as an important indicator of a player's effectiveness during competition.

Successful shooting is influenced by several interrelated factors, including technique, coordination, lower-limb strength, timing, and body control(Bagus Wahyu Prastyo et al., 2017; Budiman et al., 2024; McGill et al., 2014). One factor that deserves particular attention is dynamic stability. In football, players rarely perform skills in perfectly balanced or static situations. Instead, they must control their posture while accelerating, changing direction, avoiding opponents, and executing the ball under pressure. Dynamic stability allows players to maintain control of their body position and center of mass during these changing movement conditions. This ability is especially important during shooting, where even a small loss of balance may reduce shot accuracy and alter ball direction.

Dynamic stability should not be viewed only as a physical component(Bryant et al., 2021; Piotrowski et al., 2025). It also reflects the interaction between neuromuscular coordination and the player's ability to organize movement efficiently in response to task demands. A player with better dynamic stability is more likely to maintain proper alignment of the support leg, trunk, and kicking limb, which in turn may contribute to more accurate shooting performance. Previous studies have suggested that balance-related qualities are closely linked to successful technical execution in football and may distinguish more skilled players from less skilled ones.

Despite its importance, the relationship between dynamic stability and shooting accuracy has not been sufficiently explored in many local football settings, particularly in Iraq. One major reason is the limited availability of advanced biomechanical equipment such as force plates and three-dimensional motion capture systems. In practice, many clubs and researchers must work under field conditions with restricted technological support. As a result, performance evaluation often depends on observation alone, which may reduce measurement accuracy and make it difficult to design training programs based on objective data.

In this situation, accessible video-based tools such as Kinovea and MediaPipe offer a practical alternative. These tools make it possible to estimate movement-related biomechanical variables without relying on expensive laboratory instruments. Their use can support a more realistic field-based assessment of dynamic stability and technical performance, especially in environments where resources are limited. This approach is valuable not only for research purposes but also for coaches who need simple and affordable methods to monitor player performance.

Based on this background, the present study examines the relationship between dynamic stability and shooting accuracy in both stationary and moving conditions among elite soccer players(Abarghoueinejad et al., 2021, 2021; Hemmersbach, n.d.). The study also aims to identify differences in shooting accuracy between the two performance conditions. By doing so, this research is expected to contribute to applied sports biomechanics and provide evidence that can be used to develop more targeted training programs for balance and shooting performance. In addition, this study offers a practical model for evaluating dynamic stability in football using accessible field-based technology, which may be particularly relevant for clubs and researchers working in.

Methodology

Study Participants

This study employed a descriptive–analytical design with a correlational approach to examine the relationship between dynamic stability and shooting accuracy among elite football players in Samarra. The target population consisted of registered players from elite football clubs in Samarra city. Participants were selected purposively to represent advanced-level football players who met the requirements of the study. To be included, players had to be officially registered with their clubs and have at least five years of training and competitive experience. These criteria were applied to ensure relative homogeneity in playing level, technical competence, and competitive background .

A total of 54 elite football players participated in the study. Sample homogeneity was examined using age, height, body mass, and playing experience. The descriptive results showed that the mean age of the participants was 23.7 years (SD = 2.4), mean height was 177.2 cm (SD = 4.8), mean body mass was 73.5 kg (SD = 3.6), and mean playing experience was 6.9 years (SD = 1.3). The skewness and kurtosis values for these variables were within the acceptable range of ±1, indicating that the data were normally distributed and that the sample was sufficiently homogeneous for correlational analysis .

Study Organization

The study was carried out in July 2025 during the pre-season period of the 2025–2026 competitive season at Samarra Sports Club Stadium. The research was organized under field conditions to allow biomechanical and performance assessment in a practical football setting. The instruments and equipment used in the study included Kinovea motion analysis software, two smartphones with 60 fps recording capability, two tripod stands, a measuring tape, a ruler, footballs, marker cones, goal-sectioning tape, an electronic stopwatch, a whistle, and a structured data recording form .

In this study, a set of biomechanical variables was selected to represent dynamic stability during shooting performance. The selected variables included knee angle, ankle angle, contact time, execution time, recovery time, center of mass deviation, and trunk oscillation. These variables were chosen based on previous literature addressing the relationship between movement stability and football shooting performance and were considered appropriate for field-based biomechanical analysis in settings with limited access to advanced laboratory technology .

The study used two performance tests, namely the stationary shooting accuracy test and the shooting accuracy test during movement. In the stationary shooting test, each participant stood behind a designated line facing a wall marked with three nested rectangular targets and performed five consecutive shots using either foot. A score of 3 points was awarded when the ball hit the smallest rectangle, 2 points for the middle rectangle, 1 point for the largest rectangle, and 0 points when the ball landed outside all target zones .

In the shooting accuracy test during movement, six cones were arranged in a straight line with a distance of 2 m between each cone. The participant started from a line placed 2 m before the first cone, dribbled through the cone sequence, and then shot at the goal from outside the penalty area without a goalkeeper. The goal was divided into three scoring sections. A score of 2 points was awarded if the ball

entered either side section, 1 point if it entered the middle section, and 0 points if the shot missed the goal. Each player completed four attempts, consisting of two shots with the right foot and two with the left foot .

All shooting attempts were recorded simultaneously from two camera angles. The side-view camera was used to capture joint movements, including knee, ankle, hip, and trunk actions, while the second camera was used to observe center of mass deviation and trunk oscillation during shooting execution. After data collection, the video recordings were trimmed, coded, and analyzed using Kinovea software to extract the biomechanical variables related to dynamic stability. The resulting data were then entered into statistical tables for further analysis .

Statistical Analysis

The data were analyzed using SPSS and Microsoft Excel. Descriptive statistics, including mean, standard deviation, skewness, and kurtosis, were used to describe participant characteristics and assess data distribution. To test the relationships between biomechanical indicators of dynamic stability and shooting accuracy under stationary and moving conditions, Pearson product–moment correlation analysis was applied. A paired-samples t-test was used to determine differences in shooting accuracy between stationary and moving conditions. In addition, simple and multiple linear regression analyses were conducted to identify the predictive contribution of dynamic stability indicators to shooting accuracy. Analysis of variance was also applied where required to support the interpretation of the findings.

Results

3.1 Simple Linear Regression Between Kinematic Variables and Shooting Accuracy During Movement

The simple linear regression analysis showed that several kinematic variables were significantly associated with shooting accuracy during movement. Knee angle had a positive and significant effect on shooting accuracy ($B = 0.145$, $\beta = 0.46$, $t = 3.06$, $p = 0.004$), indicating that a more favorable knee position was associated with better shooting performance. Ankle angle also showed a significant positive relationship with shooting accuracy ($B = 0.112$, $\beta = 0.30$, $t = 2.07$, $p = 0.044$). In contrast, contact time, execution time, center of mass deviation, and trunk oscillation had significant negative effects, suggesting that longer movement duration and greater instability were associated with lower shooting accuracy. Recovery time was not significantly related to shooting accuracy during movement.

Table 7. Simple Linear Regression Results Between Kinematic Variables and Shooting Accuracy During Movement

Indicator	B	Beta	t	p-value
Knee Angle	0.145	0.46	3.06	0.004
Ankle Angle	0.112	0.30	2.07	0.044
Contact Time	-4.98	-0.48	-3.21	0.002

Indicator	B	Beta	t	p-value
Execution Time	-3.42	-0.36	-2.36	0.022
Recovery Time	-1.16	-0.23	-1.67	0.101
Center of Mass Deviation	-0.81	-0.52	-3.29	0.002
Trunk Oscillation	-0.60	-0.45	-2.93	0.005

3.2 Multiple Regression Analysis for Kinematic Variables and Shooting Accuracy from a Stationary Position

The multiple regression model for stationary shooting accuracy was statistically significant and explained 58% of the total variance in performance ($R^2 = 0.58$, $F(7, 46) = 9.06$, $p < 0.001$). Knee angle, contact time, center of mass deviation, and trunk oscillation emerged as significant predictors. Meanwhile, ankle angle, execution time, and recovery time did not reach statistical significance. These findings indicate that body alignment and postural control were the main contributors to shooting accuracy under stationary conditions.

Table 8. Results of Multiple Linear Regression Relating Kinematic Variables to Shooting Accuracy from a Stationary Position

Indicator	B	Beta	t	p-value
Knee Angle	0.155	0.41	2.94	0.006
Ankle Angle	0.088	0.22	1.77	0.082
Contact Time	-4.41	-0.41	-2.68	0.010
Execution Time	-2.86	-0.25	-1.95	0.057
Recovery Time	-0.96	-0.15	-1.40	0.167
Center of Mass Deviation	-0.69	-0.39	-2.60	0.012
Trunk Oscillation	-0.52	-0.35	-2.44	0.018

$R^2 = 0.58, F(7, 46) = 9.06, p < 0.001$

3.3 Multiple Regression Analysis for Kinematic Variables and Shooting Accuracy During Movement

The multiple regression analysis for movement shooting accuracy showed that the model was statistically significant and explained 64% of the variance in shooting performance ($R^2 = 0.64$, $F(7, 46) = 11.65$, $p < 0.001$). Knee angle, ankle angle, contact time, execution time, center of mass deviation, and trunk oscillation were all significant predictors. Recovery time remained non-significant. Compared with the stationary

condition, the movement condition involved more significant predictors, indicating that shooting while moving requires more complex coordination and greater control of body stability.

Table 9. Results of Multiple Regression Between Kinematic Variables and Shooting Accuracy During Movement

Indicator	B	Beta	t	p-value
Knee Angle	0.137	0.39	2.80	0.008
Ankle Angle	0.109	0.26	2.05	0.045
Contact Time	-4.86	-0.42	-3.01	0.004
Execution Time	-3.21	-0.27	-2.26	0.028
Recovery Time	-1.03	-0.16	-1.59	0.119
Center of Mass Deviation	-0.77	-0.41	-2.88	0.006
Trunk Oscillation	-0.57	-0.36	-2.57	0.013

$R^2 = 0.64, F(7, 46) = 11.65, p < 0.001$

3.4 Difference in Accuracy Between Stationary and Moving Shooting

The repeated-measures ANOVA demonstrated a statistically significant difference in shooting accuracy between stationary and movement conditions. Stationary shooting produced higher accuracy scores than movement shooting ($F = 8.70$, $p = 0.004$). This result indicates that additional movement demands reduce shooting precision.

Table 10. Analysis of Variance (ANOVA) for Stationary versus Moving Shooting

Indicator	Sum of Squares	Degrees of Freedom	Mean Square	F Value	p Value
Condition (Stationary / Movement)	28.9	1	28.9	8.70	0.004
Error (Within Subjects)	175.7	53	3.32	–	–
Total	204.6	54	–	–	–

As shown in Table 10, statistically significant differences were found in accuracy between stationary and moving shooting, with stationary shooting showing higher accuracy than movement shooting at $p < 0.01$.

4. Discussion

The results obtained in this study revealed that stationary shooting accuracy is higher than when movement is involved in the shooting process. This can be explained by considering the ability of stationary conditions to provide stability in body posture prior to ball contact. As Blair et al. (2020) found in their study, stability in conditions provides optimal joint angle and trajectory control.

In movement conditions, it is required for shooters to perform coordination tasks among different body segments at the same time, including lower limbs and trunk segments. Increased coordination demands in movement conditions might lead to higher center of mass movement during the shooting process, which can affect accuracy in a negative way.

The results obtained in this study revealed a significant correlation between knee angle and shooting accuracy in both conditions. However, ankle angle showed a moderate correlation with shooting accuracy in movement conditions only at a significant level. As Donofrio et al. (2023) emphasized in their study, knee joint angle plays a critical role in ball trajectory, while ankle joint angle affects only the orientation of the feet during kicking movement.

Another important result was related to contact time, which was found to be significantly related to shooting accuracy. This indicates the importance of controlling the supporting foot at the time of ball contact with the ground, as this affects the accuracy of the shot. Similarly, Moriyama et al. (2024) found anticipatory postural adjustments to be important in enhancing motor control during complex sports skills.

Recovery time was not found to be significantly related to shooting accuracy, suggesting that this period might not be as important as the previous phases in controlling the ball's accuracy, both before and at the time of contact with the ground. Similar findings were reported by Epifano et al. (2025.(

Negative relationships were also found between center of mass deviation, trunk oscillation, and shooting accuracy, suggesting that excessive movements of the body during the kicking process might affect the distribution of forces to the ball, hence affecting the accuracy of the shot.

These findings suggest the importance of angular control and dynamic stability as fundamental aspects of controlling the ball during a shot in soccer. Consequently, training programs should emphasize exercises that improve supporting-leg stability, trunk control, and coordination during the kicking action.

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