Free Throw Motion Analysis of the FIKK UNM Basketball Team

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ABSTRACT

This study aims to analyze the free throw movements of basketball players from the Faculty of Sport Science and Health, Universitas Negeri Makassar (FIKK UNM) using a biomechanical approach. The research employed a quantitative descriptive method, with data collected through observation, high-speed video recording, and analysis using biomechanical software such as Kinovea. The study population included all players of the FIKK UNM basketball team, with a sample of 50 players selected using purposive sampling. The results indicate that the free throw movement patterns generally follow ideal biomechanical principles, encompassing the preparation, execution, and follow-through phases. However, several technical deficiencies were identified, including body imbalance during the preparation phase, premature ball release, suboptimal knee angles, and inconsistent follow-through, all of which affected shot accuracy. The primary factors influencing free throw success include body balance, coordination of body segments, and psychological control. This study emphasizes the importance of biomechanics-based training, including video analysis for objective evaluation of movements, corrective exercises to address technical errors, development of coordination and balance, and enhancement of focus and psychological control. The implementation of this approach is expected to improve the consistency and accuracy of free throws and enhance their contribution to overall team performance.

AUTHORS' CONTRIBUTION

A. Conception and design of the study;
B. Acquisition of data;
C. Analysis and interpretation of data;
D. Manuscript preparation;
E. Obtaining funding

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INTRODUCTION

Basketball is a sport that demands a combination of technical, physical, and tactical abilities. One of the crucial moments in the game is the free throw, which is performed without direct defensive pressure but often determines the outcome when the score is close. The ability to execute free throws consistently is not only about making the ball go through the hoop but also requires good body control, balance, and optimal motor coordination.

The free-throw movement involves several technical phases—starting from preparation (stance, foot position, body balance), the wind-up or motion initiation, the

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release phase, and the follow-through after release. In the preparation phase, for example, the choice of foot position, the angles of the knees and hips, and the distribution of body weight play an important role in providing a stable foundation for the subsequent motion.

During the release phase, research shows that skilled shooters tend to have a higher release point and a smaller forward trunk lean compared to less skilled shooters. Furthermore, the angular velocity of the knees and the center of mass during the shot are lower among proficient shooters, indicating that more controlled movements are associated with higher shooting accuracy.

From an institutional perspective, in an academic environment such as the Faculty of Sports and Health Sciences, Universitas Negeri Makassar (FIKK UNM), developing the technical quality of athletes and students who aim to continuously improve their performance is a priority. The faculty's basketball team has the potential to enhance performance not only through extensive on-court practice but also through scientific approaches that analyze movement aspects in detail—including the biomechanics of the free throw.

Given that many studies have shown that biomechanical variables (such as joint angles, movement velocity, and release height) correlate with free-throw success, applying motion analysis to the FIKK UNM basketball team can provide empirical data useful for both coaches and athletes. For example, the study "Biomechanical characteristics of proficient free-throw shooters" found that skilled shooters tend to use more controlled movements, with lower joint velocities and higher release points than non-skilled shooters. Meanwhile, other studies emphasize that the preparation phase (stance, knee angle, wrist position) remains underexplored, even though it plays a crucial role in shooting performance.

However, in the local context—particularly for the basketball team within FIKK UNM—there has been limited research specifically exploring free-throw movements through biomechanical and systematic motion analysis approaches. Most training sessions still rely on general field practice without objective documentation of kinematic variables or technical aspects that may need improvement. This condition indicates a gap between theory and practice, presenting an opportunity for more focused research.

Based on the above considerations, this study, entitled "Motion Analysis of Free Throw in the FIKK UNM Basketball Team," aims to scientifically examine the free-throw movements performed by the team's athletes by identifying motion components (such as foot position, knee and hip joint angles, release height, joint angular velocity, and trunk inclination) that correlate with shooting accuracy. The results of this study are expected to provide practical recommendations for coaches and athletes to systematically improve free-throw performance.

METHODS

The research method used in this study is a quantitative descriptive method with a biomechanical analysis approach (Mulyana et al., 2024). This method is employed to

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describe and analyze the free-throw movements performed by basketball players of FIKK UNM, based on biomechanical parameters such as arm angle, body balance, and movement coordination. Data Collection Techniques

1. Data were collected through the following procedures:
2. Observation: Observing the free-throw techniques of each player.
3. Video Recording: Using a high-speed camera to record the free-throw movements.
4. Video Analysis: Analyzing the recordings using biomechanical software such as Kinovea or Dartfish to extract movement parameters.
5. Quantitative Measurement: Utilizing specific software or measuring tools to assess angles, velocity, and other mechanical aspects of motion.

This study employed a descriptive study design with a cross-sectional approach, in which data were collected at a single point in time for analysis. Each player performed several free-throw trials, and the analysis results were compared with the ideal standard of free-throw technique (Sudarmono & Rahayu, 2015).

1. Population and Sample
2. Population: All basketball players who are members of the FIKK UNM Basketball Team.
3. Sample: 50 players selected using a purposive sampling technique based on the following criteria:
4. Active student status at FIKK UNM.
5. Actively participating as a member of the basketball team.

Willing to participate in the study and provide consent for motion recording.

RESULTS AND DISCUSSION

Based on the descriptive statistical analysis of the POINTS variable for 50 respondents (N = 50), the minimum score was 4.00, the maximum score was 9.00, with a range of 5.00. The total score (sum) for all participants was 342.00, with a mean of 6.84 and a standard deviation of 1.44787. The mean score of 6.84 indicates that, on average, the free-throw performance of the FIKK UNM basketball players is in the fairly good category, considering that the maximum possible score was 9.00, which represents optimal performance. Meanwhile, the standard deviation of 1.45 suggests a moderate level of variation among players in their free-throw performance. This means that most players demonstrated relatively balanced abilities, although some performed below or above the group average. Overall, these results illustrate that the FIKK UNM basketball team possesses a fairly consistent level of free-throw proficiency, though there is still room for improvement, particularly in achieving greater consistency among individual players.

Table 1.

Descriptive test

Variabel	N	Range	Minimum	Maximum	Sum	Mean	Std. D
POIN	50	5.00	4.00	9.00	342.00	6.8400	1.44787

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Frequency analysis was conducted to determine the level of free-throw skills among the basketball players of FIKK UNM. The free-throw shooting data were categorized into three levels of ability, namely low, moderate, and high, with a significance level of $P < 0.05$ used as the statistical basis to ensure significant differences among the categories. The categorization was determined based on the distribution of the mean score and standard deviation (SD) obtained from the measurements, using the following formula:

Table 2.

Frequency analysis

Kategori Kemampuan	Rentang Nilai	Jumlah (N)	Persentase (%)
Rendah	< 5.39	10	20%
Sedang	5.39 – 8.29	30	60%
Tinggi	> 8.29	10	20%

Based on the table above, it can be seen that the majority of players (60%) fall into the moderate ability category, indicating that most members of the FIKK UNM basketball team possess a reasonably good mastery of free-throw techniques. However, 20% of the players are classified in the low ability category, suggesting that these individuals require additional training, particularly in aspects such as body coordination, postural stability, and ball release rhythm. Meanwhile, the remaining 20% of players demonstrate high-level ability, characterized by consistent shooting accuracy and efficient body movements. These findings are consistent with the study of Sudarmono and Rahayu (2015), which emphasized that postural stability, movement speed control, and hand-eye coordination are key determinants of successful free-throw performance. Overall, these results indicate that the free-throw skill level of the FIKK UNM basketball team still needs improvement, particularly through biomechanics-based training approaches, to minimize performance variation among players and achieve greater consistency across the team.

Free Throw Movement Patterns of FIKK UNM Basketball Players

Based on video analysis and direct observation of the FIKK UNM basketball players, it was found that the free throw movement patterns generally followed the ideal biomechanical phases of a free throw. The movement consists of three main phases: the preparation phase, the execution/release phase, and the follow-through phase. During the preparation phase, most players demonstrated a stance with feet aligned to the shoulders, slightly bent knees, and focus directed at the basket. However, some players were inconsistent in maintaining body balance, particularly when transferring weight from the back foot to the front foot before releasing the ball. In the execution phase, the coordination of the arm, elbow, and wrist movements was a key factor in shot success. Players with good technique exhibited an elbow angle of approximately 90–100 degrees before ball release, with smooth motion and proper follow-through. Conversely, less skilled players often displayed movements that were too fast or uncoordinated between the push of the legs and arm swing, resulting in less stable ball trajectory. These findings

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align with Mulyana et al. (2024), who state that an efficient free throw movement pattern is determined by balance, body control, and the continuity of movements between the legs, hips, and arms.

Factors Influencing Free Throw Success or Failure

The analysis showed that free throw success is influenced by two main groups of factors: internal and external. Internal factors include body balance, leg and arm muscle strength, motor coordination, and the player's concentration during the shot. Players who maintained stable posture and focused on the basket demonstrated higher shooting accuracy. External factors include environmental conditions such as court lighting, noise, and psychological pressure during games. Some players' performance declined under competitive stress, indicating that mental and psychological factors also play a significant role in free throw effectiveness. These findings support Sudarmono & Rahayu (2015), who emphasized that free throw performance combines physical, technical, and psychological components, and even minor concentration disruptions can significantly reduce shooting accuracy.

Common Technical Errors in Free Throws

Video analysis using Kinovea software identified several common technical errors among players, including:

1. Imbalanced posture during the preparation phase, often due to feet not being properly aligned.
2. Knee angles that were too narrow ($<60°$) or too wide ($>90°$), resulting in suboptimal push-off force.
3. Releasing the ball too quickly, preventing it from reaching optimal height.
4. Insufficient follow-through, leading to unstable ball spin and trajectory.
5. These errors directly impacted free throw success, as the ball could not achieve the ideal parabolic trajectory.

These results are consistent with findings from Frontiers in Sports and Active Living (2023), which showed that skilled shooters have lower knee angular velocity and maintain a more upright body position at ball release compared to less skilled shooters, highlighting the importance of movement control and stability in each phase of the shot.

Effect of Technical Errors on Free Throw Success

Score analysis indicated that players who frequently made technical errors (e.g., improper follow-through or loss of balance) tended to have lower free throw scores, ranging from 4 to 6 points, compared to players who executed movements correctly and consistently, achieving 8 to 9 points. Technical errors directly affect ball trajectory, release height, and ball spin. For example, improper wrist control produces unstable ball rotation, increasing the likelihood of missing the basket. Thus, technical errors have a significant impact on free throw success, both biomechanically and psychologically. This supports the theory of Isaac & Douvis (2019), which states that minor coordination errors

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can cause considerable deviations in ball trajectory, reducing shot success probability. Therefore, corrective training based on biomechanical video analysis is necessary, emphasizing repetition of proper movement, body balance control, and improved coordination of legs, arms, and visual focus. This approach is expected to enhance movement efficiency and increase the consistency of free throw performance for the FIKK UNM basketball team.

CONCLUSION

Based on the overall findings of this study, it can be concluded that the free throw movement patterns of the FIKK UNM basketball team generally follow proper biomechanical principles, encompassing the preparation, execution, and follow-through phases. The players are able to position their feet relatively stably, maintain appropriate elbow and knee angles, and perform ball release with adequate coordination. Nevertheless, this study also identified several significant technical deficiencies. Some players demonstrated body imbalance during the preparation phase, released the ball too quickly, had suboptimal knee angles, and performed inconsistent follow-through. These technical shortcomings directly affect shot accuracy, particularly in terms of ball trajectory, release height, and ball spin stability.

The primary factors influencing free throw success include body balance as a stable foundation for all movements, coordination of body segments—especially the legs, hips, arms, and wrists—and psychological control and focus, including the player's ability to maintain concentration under game pressure. These findings highlight that free throw performance is not merely a physical skill but involves an interaction of biomechanical, motor, and psychological components. Therefore, improving the free throw performance of the FIKK UNM basketball team should be approached through biomechanics-based training. This approach may include the use of video analysis to objectively evaluate movements, corrective exercises to address specific technical errors, programs to enhance body balance and motor coordination, and strategies to strengthen psychological control and focus during training and competition. With the implementation of such a systematic approach, it is expected that team free throw performance can improve consistently, inter-player variation can be minimized, and the contribution of free throws to overall team success can be enhanced. Overall, this study emphasizes the importance of a scientific and structured approach in free throw training, which not only supports the development of individual skills but also serves as a foundation for long-term team strategy to achieve higher performance levels.

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