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EFFECTIVENESS OF IMPROVING SHOT PUT TECHNIQUE BASED ON BIOMECHANICAL ANALYSIS

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Abstract: This article explores the effectiveness of biomechanical analysis in enhancing shot put techniques. By examining recent studies, the review identifies key biomechanical parameters influencing shot put performance and discusses how biomechanical assessments can inform training interventions. The findings suggest that targeted biomechanical analysis can lead to significant improvements in throwing distance and technique efficiency.

Key words: shot put, biomechanics, kinematic analysis, electromyography, athletic performance

Introduction

Shot put performance is influenced by various biomechanical factors, including release velocity, angle of release, and muscle activation patterns. Understanding these parameters is crucial for optimizing throwing techniques and enhancing athletic performance. This review synthesizes current literature on the role of biomechanical analysis in improving shot put techniques.

Methods

A comprehensive literature search was conducted using databases such as PubMed, ScienceDirect, and Google Scholar. Keywords included "shot put biomechanics," "kinematic analysis," "electromyography in shot put," and "biomechanical training interventions." Studies published between 2008 and 2024 were considered, focusing on research that examined biomechanical factors influencing shot put performance.

Results

Release velocity and the angle of release are two of the most influential biomechanical variables in shot put performance. The literature consistently shows that a higher release velocity, when combined with an optimal release angle (typically around 37° to 42°), contributes to longer throw distances (Young, 2013; Schaa, 2011). In elite athletes, even small improvements in velocity at the point of release can result in measurable gains in distance (Hashimoto et al., 2024). Furthermore, researchers have noted that the path of the shot before release should be as linear

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and direct as possible to reduce unnecessary energy loss (Hashimoto et al., 2023).

Biomechanical studies using motion capture and force plate analysis have confirmed that athletes who optimize the timing of leg and trunk extension in coordination with arm motion are better able to generate horizontal and vertical impulse at the right moment (Schofield et al., 2022). This coordination is crucial in both the glide and rotational techniques.

Electromyography (EMG) has become a valuable tool in understanding muscle engagement during the shot put motion. Multiple studies (Hashimoto et al., 2024; Nakajima et al., 2020) have identified key muscle groups—including the gluteus maximus, rectus femoris, pectoralis major, deltoids, and triceps brachii—as primary contributors to effective throws. Athletes who activate these muscles at optimal phases of the throw show more efficient force transfer from the ground to the shot. An important observation is that experienced throwers tend to engage proximal muscle groups (hip extensors and core muscles) earlier and more intensely than less experienced ones, who often rely excessively on upper body force (Ciacci and Di Michele, 2013). This highlights the importance of whole-body coordination, not just arm strength.

Another relevant outcome from recent biomechanical literature is the relationship between movement consistency and performance. Ciacci and Di Michele (2013) compared the glide and rotational techniques, showing that athletes using the glide technique often display less movement variability. While the rotational style may allow for more angular momentum and potentially longer throws, it requires much more technical precision and has a steeper learning curve. Studies analyzing intra-athlete variation across throws found that lower variability in joint angles and sequencing led to more consistent and higher-quality outcomes (Zatsiorsky, 1990). This suggests that biomechanical analysis is especially useful in helping athletes reduce unnecessary deviations and stabilize their technique under competition pressure.

Discussion

The integration of biomechanical analysis into training regimens offers valuable insights for improving shot put techniques. By focusing on key performance parameters such as release velocity, angle, and muscle activation patterns, athletes can enhance their throwing efficiency. Biomechanical assessments allow for the identification of technical flaws and the development of targeted interventions.

Moreover, the use of EMG provides a deeper understanding of muscle engagement during the throw, enabling coaches to tailor strength and conditioning programs accordingly. The consistency in technique, as highlighted by variability studies, underscores the importance of repeatable and efficient movement patterns, which can be achieved through biomechanical monitoring.

Conclusion

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Biomechanical analysis serves as a crucial tool in the enhancement of shot put techniques. By identifying and optimizing key performance parameters, athletes can achieve significant improvements in throwing distance and efficiency. Future research should continue to explore the application of biomechanical assessments in training programs to further refine shot put techniques.

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