

Rotational versus glide technique in elite shot put: Trend analysis in the 21st century

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ABSTRACT

Objective. The aim of this study was to analyse the trend in the use of rotational vs. glide shot-put techniques in World Championships in the last two decades and their association with shot-put performance. **Methods.** The technique used, and the throwing distance obtained by the finalists in the shot-put competitions (56 men and 55 women) in the World Championships between 2001 to 2019 were analysed. **Results.** In men, the use of the glide technique was less frequent than in women (30.6 vs. 87.7%; $p < .01$). In men, there has been a progressive reduction in the use of the glide technique (from 7 out of 10 shot putters in Paris in 2003 to 0 out of 12 shot putters in Doha in 2019). Although a similar tendency is observed in women athletes, the glide technique is still the principal style employed by women throwers (7 out of 12 women shot putters in Doha 2019). Throwing distance was similar between glide throwers and rotational shot putters in both men (20.66 ± 0.67 vs. 20.92 ± 0.88 m; $d = 0.32$; $p = .128$) and women athletes (18.85 ± 0.91 vs. 18.75 ± 0.71 m; $d = 0.10$; $p = .753$). In summary, the use of the rotational style in shot-put has increased in men athletes. A clear trend towards the use of the rotational technique is also present in women although the glide style is still the most prevalent. However, there are no differences in shot-put performance between techniques that justify the use of the rotational over the glide technique.

Keywords: Elite athlete; Exercise performance; Biomechanics; Strength; Sports performance.

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INTRODUCTION

From a simple biomechanical perspective, shot put performance mainly depends on the angle of release, the height at which the shot is released and the velocity of release (Gutiérrez-Davila et al., 2009; Rodríguez et al., 2002). Traditionally, two shot put techniques -the *glide* technique and the rotational or *spin* style- have been employed to optimise these variables of release, which aim for the maximisation of force application, stability and projectile motion while keeping balance within the shot put circle. The glide technique appeared in the 1950s and was the selected shot put technique in elite competition for many years (Dinsdale et al., 2017a). In the glide technique, a right-handed thrower places the right foot near the back edge of the circle, with a knee flexion of ~90 degrees. This preparatory position allows the thrower to project their shoulders and the shot out of the circle, increasing the linear distance from the start position of the shot to the point where the shot will be released. In this position, the glide starts with an explosive swing back and out across the circle while the right leg pushes off in the throwing direction (O'Shea & Elam, 1984). Once the shot putter has landed after the swing back, he/she rotates with the feet on the ground to apply a synergistic and progressive action of lower and upper body parts to release the shot under optimal conditions and with the highest velocity. The glide technique is then characterised by a linear motion of the shot with a progressive acceleration during all phases of the movement.

The rotational technique was introduced in the 1970s and is the most prevalent nowadays (Dinsdale et al., 2017a). In the rotational technique, the shot putter turns around his/her longitudinal axis twice in the movement towards the circle, pivoting from the left foot (for a right-handed thrower) in the first rotation and from the right foot in the second rotation, executing a rotation-pattern similar to the discus throw technique. Once the shot putter has completed the rotation on the right foot, he/she fixes both feet on the ground to continue the rotation with the upper body to follow through the whole kinetic chain until release. While the locomotion, the movements of the body parts and the speed dynamics are different between the two techniques, the final push-like movement and the drive are quite similar between styles (Gutiérrez-Davila et al., 2009).

It is clear that both techniques allow the production of large forces, but coaches and athletes have wondered for many years which technique allows a better performance in this athletic discipline. To date, there is still ample debate about the most beneficial technique while only one technique prevails at the elite level in the remaining throwing disciplines. Those who support the glide technique as the preferable one argue that this style allows a more balanced position in the power phase, and a more lineal displacement of the shot during the movement (Gutiérrez-Davila et al., 2009; Rodríguez et al., 2002). In addition, the glide technique is less demanding, and its training at the elite level requires less time than the rotational technique (Čoh et al., 2008; Stepanek, 1986). On the other hand, it has been suggested that the rotational technique permits a longer throw pathway, and a higher angular velocity of the shoulder in the final phase of acceleration (Hommel, 2009; Wilko Schaa, 2010). Another important aspect of the comparison between shot put techniques, beyond their abilities to allow optimal release variables, is the frequency of fouls committed during competition with each technique. In the rotational technique, the rotational movement has to be transferred to a linear movement for the delivery of the shot and the inability of the athlete to avoid over-rotation after delivery might create a higher rate of foul throws.

Despite the debate, there is no strong evidence that supports a clear advantage or disadvantage of one style over the other. Perhaps this is because the time necessary to change from one style to the other has prevented the use of crossover experimental designs to definitively ascertain the most effective technique for the shot put. Although differences in shot put performance cannot be attributed only to the technique

employed, the study of the frequency of athletes that used each style in recent elite competitions, in addition to the throwing distance and the proportion of medals obtained with each style, might help to unveil why the rotational style is gaining importance in both men and women athletes. So, the aim of this study was to analyse the trend in the use of rotational vs. glide shot put techniques in World Championships in the last two decades and their association with shot put performance.

MATERIALS AND METHODS

Participants

All finalists in the shot put of the World Championships between Edmonton 2001 and Doha 2019 were included in the investigation. Overall, 111 athletes (56 men and 55 women) were classified in the different final rounds. However, because several athletes competed in different championships, we have used one data point for each participation for a total of 222 participations (108 men's and 114 women's participations).

Measures and Procedures

The official results for each men's and women's World Championship shot put competition were obtained from the World Athletics Federation web page (World Athletics Championships | Results, 2020). The results were gathered from this website in October 2019 and the medallists and ranking positions of the finalists in each championship at this date were used for analysis (athletes disqualified due to doping sanctions were removed from the analysis). The throwing distance of the valid attempts and the number of fouls and ranking position were recorded for each athlete. The shot put technique employed by each shot putter in the championship was observed by duplicate video-analysis and categorised as glide or rotational technique.

Analysis

The frequency of shot put technique (glide, rotation or switch-glide) was calculated from the number of men and women shot putters using each technique and the total number of finalists. An analysis of overall frequency between 2001 and 2019 and a specific analysis of frequency per championship was carried out. Cross tables with Chi square tests were employed to compare the frequencies in men and women shot putters. Due to the different frequencies in the use of the shot put techniques, the proportion of medals won with each technique was calculated by dividing the number of medals by the number of shot putters within each technique. The comparison in the proportion of medals/shot putters between the glide and rotational techniques was performed with Chi Square tests. Throwing distance, in meters, was used as the main indicator of shot put performance and it showed normal distribution in the Kolmogorov-Smirnov test ($p = .97$ in men and $p = .25$ in women). The comparison of throwing distance between the glide and rotational techniques was performed with an independent t test. Finally, Chi square tests were used to compare the frequency of foul throws between glide and rotational shot put techniques. All the statistical analyses were made with SPSS 20.0 for iOS.

RESULTS

In men, the use of the glide technique was less frequent than in women (30.6 vs. 87.7%; $p < .05$). Consequently, men shot putters were more prone to using the rotational technique (69.4 vs. 12.3%; $p < .05$; Figure 1).

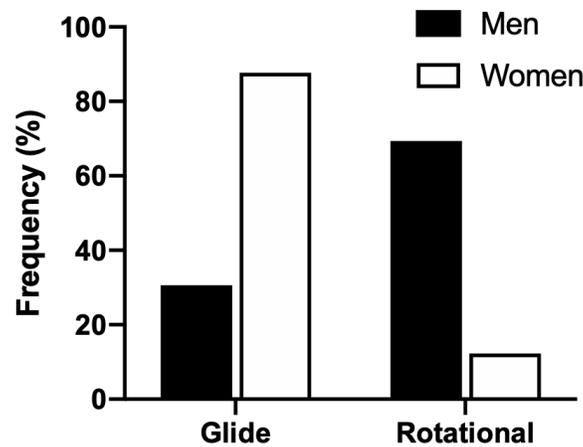


Figure 1. Number of men and women athletes according to shot put style.

Figure 2 depicts the percentage of men shot putters in each championship from 2001 to 2019. In Paris 2003, 70% of the athletes used the glide technique while a progressive reduction in the use of this technique was present afterwards. In Doha 2019, all finalists used the rotational technique. In women, all finalists used the glide style until Osaka 2007 although the glide style still represented the highest proportion in Doha 2019 (58% of women shot putters).

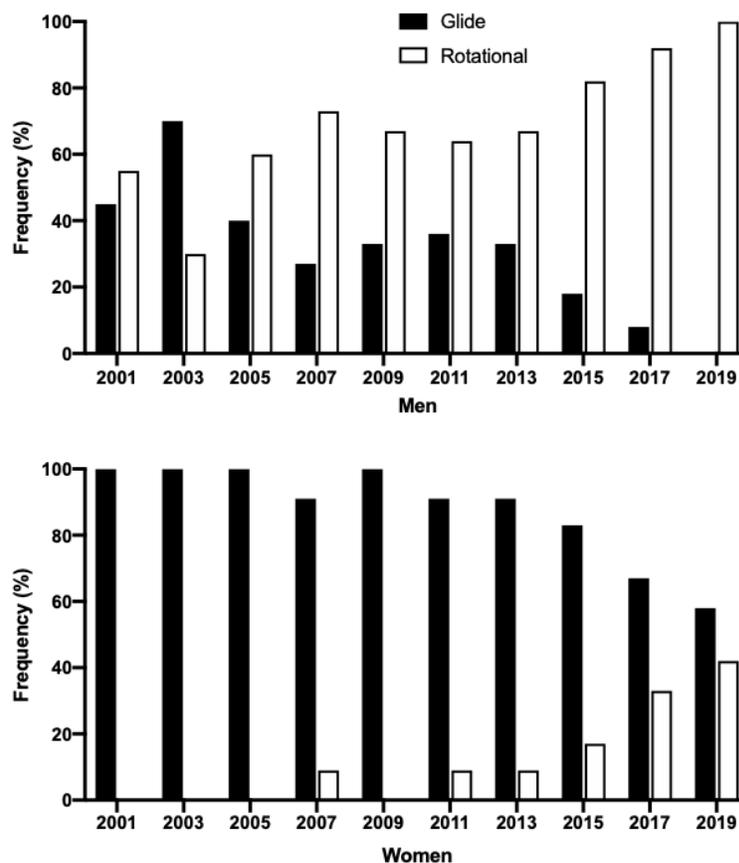
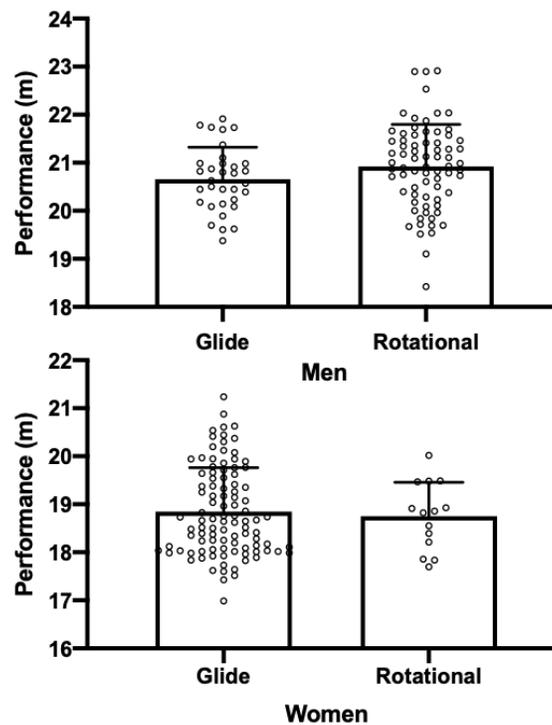


Figure 2. Frequency of men (upper panel) and women (lower panel) athletes in World Championships in Athletics according to shot put technique.

Overall, the throwing distance obtained by glide throwers was similar to the distance obtained by rotational shot putters in both men (20.66 ± 0.67 m for glide vs. 20.92 ± 0.88 m for rotational throwers; $p = .128$) and women athletes (18.85 ± 0.91 m for glide vs. 18.75 ± 0.71 m for rotational throwers; $p = .715$). The best individual performances were obtained with the rotational style in men. In contrast, the best individual performances were attained with the glide technique in women (Figure 3).



Note: Bars and error bars are mean and standard deviation. Circles show individual data for each athlete.

Figure 3. Shot put performance of men (upper panel) and women (lower panel) athletes in World Championships in Athletics according to shot put technique.

There were no differences in the proportion of medallists between shot put techniques, in men (24.2% for glide vs. 29.3% for rotational throwers; $p = .533$) or in women athletes (27.0% for glide vs. 21.4% for rotational throwers; $p = .414$). Finally, the proportion of fouls was similar for glide and rotational styles in men (29% fouls in glide vs. 34% in rotational; $p = .455$) and women athletes (28% fouls in glide vs. 19% in rotational; $p = .143$).

DISCUSSION

To date, elite shot putters select between the glide and rotational technique, but the most efficient style to enhance performance in elite shot putters is unknown. Thus, the aim of this study was to analyse the trend in the use of glide vs. rotational shot put technique in elite throwers and their association with throwing distance. To respond to this objective, we gathered the results of all men and women finalists in the shot put competitions in the World Championships between 2001 to 2019. In the last 10 editions of World Championships in Athletics, 56 men and 55 women throwers qualified for the final round, with 69.4% of the men using the rotational technique, while only 12.3% of the women athletes performed this spin style. Interestingly, despite this difference between sexes, there has been a progressive increase in the frequency

of elite shot putters that used the rotational technique in men and women athletes (Figure 2). However, the mean throwing distance, the proportion of medals won and the frequency of fouls in these last editions of the World Championships have remained similar between techniques in both men and women athletes. All this information, taken together, suggests a preference in the use of the rotational technique in elite shot putters, particularly in men, but this tendency is not supported by an enhanced performance or a reduction in the frequency of fouls. Further investigations should be geared to explaining the current preference for this technique, but in the light of these results, both glide and rotational techniques seem equally effective to optimise shot put performance in elite athletes.

In men, the use of the rotational technique has become more frequent in World Championships and, since Paris 2003, rotational shot putters have outnumbered gliders. In men athletes, in the first 3 World Championships in Athletics (Edmonton, Paris and Helsinki) only 48% of the throwers performed the rotational technique, while in the last 3 finals (Beijing, London and Doha), this figure rose to 91%. A similar but later shift is also present in women athletes because non finalists in the first 3 World Championships in Athletics employed the rotational technique, while 42% of women throwers used the rotational style in the last 2019 World Championship. In these championships, 9 out of 10 of the best performances were achieved with the rotational technique in men (four of them in the recent 2019 World Championship in Athletics), but 10 out of 10 of best women's performances were by glide throwers. Attending to all-time best performances, 4 out of the 6 longest throws in men have been achieved with the rotational technique (three of them in the recent 2019 World Championship in Athletics) and the world record holder is a rotational thrower. Although the second and third all-time best performances were obtained with the glide technique, these were obtained more than 30 years ago. On the other hand, in the all-time top list of women's shot put performances, the first 10 places correspond to gliders, though they were achieved in the past century. The best performances by women of the 2019 season are equally distributed between both styles (3 athletes with the rotational style and 2 athletes with the glide style out of the 5 best season performances). These data in the distribution of techniques suggest a growing preference for the rotational style over the glide in elite athletes, but the scientific grounds for this selection might not be based on enhanced throwing performance nor on more optimised biomechanics.

Previous scientific research that used kinetic and kinematic analysis has not shown any clear benefits for the rotational technique over the glide style (Čoh et al., 2008; Rodríguez et al., 2002; Schofield et al., 2019). In fact, several reports comparing glide and rotational techniques in World Championships have suggested benefits of the glide over the rotational technique, at least in some biomechanical parameters (Byun et al., 2008; Dinsdale et al., 2017a, 2017b; Gutiérrez-Davila et al., 2009; Hommel, 2009; Wilko Schaa, 2010). These investigations suggest that the glide technique permits a longer base of support in the power position. This longer support gives the movement of the shot a more ascending trajectory in the final phase, while the rotational throwers showed a flatter trajectory (Dinsdale et al., 2017b, 2017a). Nevertheless, analysing the data from Osaka 2007 (Byun et al., 2008), Berlin 2009 (Wilko Schaa, 2010) and London 2017 (IAAF, 2018), the analysis of the angle of release did not differ between rotational and glide throwers. Although the glide technique could favour a more ascending trajectory in the final phase of the shot, rotational throwers overcome this deficiency with a marked backward lean of the trunk on release to give a better angle of release at delivery (Dinsdale et al., 2017b). Thus, the potential benefits of the higher base of support in the power position with the glide technique might be easily offset by leaning the trunk at release in the rotational style.

The glide technique produces more lineal locomotion across the circle with a progressive acceleration of the shot, permitting optimal speed dynamics. Athletes using the rotational technique need to reduce the velocity of the put when they turn around their longitudinal axis, particularly when they are in opposition to the direction

of release (Dinsdale et al., 2017b). This means that rotational athletes enter the power position with slower shot velocities and then they need to apply most of final release velocity from the power position (between 80-94% of the total in rotational athletes, between 75-82% in gliders) (Dinsdale et al., 2017b, 2017a). Nevertheless, thanks to a higher separation of the hip axis from the shoulder line at the beginning of the final acceleration, rotational athletes can achieve higher angular velocities of the shoulder to overcome the previously slower velocity of the shot, (Hommel, 2009) and then, the speeds of release are similar between techniques (Byun et al., 2008; IAAF, 2018; Wilko Schaa, 2010).

The data provided by the aforementioned investigation agree with the analysis of the throwing distances in the current study. There were no statistical differences in the throwing distance obtained by gliders and rotational shot putters in the World Championships either in men or women athletes. These data clearly indicate that a similar throwing distance might be obtained with both techniques in men and women elite athletes and do not support the exclusive use of the rotational technique in the last World Championship. On the other hand, the idea that fouls are more frequent in rotational than glide throwers, is common in coaches and athletes. Nevertheless, our data suggest that the frequency of fouls was similar between rotational and glide throwers, at least in these finals of the World Championships. Probably, the evolution of the rotational technique, and the perfection of this style from a younger age, has ameliorated the proportion of fouls during competition, and it seems that both techniques are consistent to obtain optimal performance in elite athletes.

Shot put performance in the World Championships in Athletics in this century was similar between the two shot put techniques in both men and women. Shot put performance depends on velocity, angle and height of release, with velocity being the greatest factor on official shot put performance (Schofield et al., 2019). We have discussed that angle and speed of release in the analysis of several World Championships were similar for glide and rotational, and thus, the distance achieved in the shot put might not be influenced by the technique employed, at least in elite athletes that have mastered the selected style. So, the apparent fading of the glide technique is not supported by empirical data. More research is necessary to elucidate the potential advantages or disadvantages of these techniques during training or at early stages. However, it can be concluded that the glide and rotational techniques offer possibilities to achieve high performance, and the characteristics of the athlete or the coach can determine the choice.

CONCLUSION

The use of the rotational style in elite shot put has increased in men elite athletes with all finalists using this technique in the last World Championship. A clear trend towards the use of the rotational technique is also present in women shot putters although the glide style is still the most prevalent. However, there are no differences in shot put performance, or in the proportion of medallists/finalists, or in the frequency of fouls between techniques that justify the use of the rotational over the glide technique.

AUTHOR CONTRIBUTIONS

JJS: designed the study, data acquisition, draft the manuscript, review the final version. JDC: designed the study, data acquisition, review the final version.

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No funding agencies were reported by the authors.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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