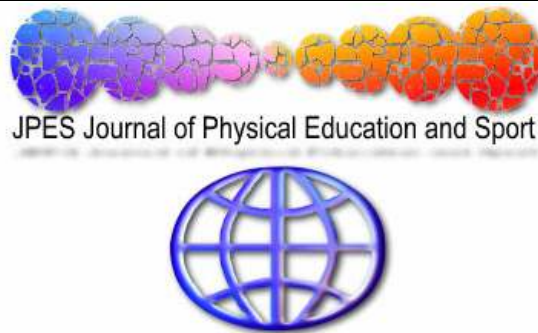




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ORIGINAL RESEARCH

SUCCESS RATES OF UNDERHAND AND OVERHAND FREE-THROWS AS NOVEL SKILLS

Dr. Robert C. Schneider¹Dr. Christopher Williams²

The College at Brockport

State University of New York

ABSTRACT

In the pursuit of scoring as many points as possible during basketball competitions, most effective free-throw shooting techniques were explored. This study sought to determine whether the underhand or overhand basketball free-throw shooting style was naturally more prone to success than the other. Total participants (N=29) were 15 male and 14 female undergraduate students, who were at least 18 years of age (average age was 23.98) with no prior basketball shooting experience. Through a counterbalanced design, each participant shot 25 underhand free-throws on one day and 25 overhand free-throws on a different day. No significant differences between the number of successful overhand and underhand shots were observed for attempts 1-13 when compared to attempts 14-25. Males averaged .57 more successful attempts overhand than underhand. Females averaged .33 less successful attempts overhand than underhand.

Overall, as a group, the performance of both underhand and overhand shooting was positively correlated (.28), representing a trend suggesting that if a participant shot well underhand they also shot well overhand, indicating that it is unlikely that either the overhand or underhand shooting style is more naturally more prone to success than the other; hence, free-throw shooting success may be more dependent on repetition than style.

Keywords: trajectory, backspin, arc, NCAA, angle of release

INTRODUCTION AND REVIEW OF LITERATURE

The overhand free-throw shooting style, historically, has been the predominant basketball free-throw shooting style of choice. Nearly unheard of today is an alternative approach to overhand free-throw shooting – the underhand style – which may have been used most frequently in the 1950s when it was believed that as many as 10% of basketball players used it (Modesti, 1997).

Few measures in sport have remained as consistent over the years as the success percentages of men's and women's free-throw shooting (Branch, 2009). Since the 1960s the success rates of National Collegiate Athletic Association (NCAA) Division I men's free-throw shooting has remained remarkably consistent, hovering around 69.0%, never dropping below 67.0%, and never rising above 70.0% (Branch, 2009; National Collegiate Athletic Association, 2010a). Women's Division I free-throw averages have also been consistent since record keeping began in 1981, ranging from 67.2% to 70.5% over 29 seasons through 2010 (National Collegiate Athletic Association [NCAA] 2010b). More recently, over the past 10 years women's Division I success rates have been extremely consistent ranging from a low of 68.49% to 69.04% (NCAA, 2010b).

From an individual standpoint the best free-throw shooters succeed at rates surpassing 90%. At the top of the all time NCAA free-throw leaders list is former Missouri State player Blake Ahearn who, during the 2003-04 season, made 117 of 120 free-throws for a 97.5% success rate ("Single Season Leaders," 2010).

Free-throw shooters are expected to succeed, in general because the free-throw is considered to be a “simple” shot (Edwards, 2009). Making it one of the easiest shots in basketball is the absence of a defender when the free-throw shot is taken (Okubo & Hubbard, 2006). The absence of a defender allows the free-throw shooter time to relax and concentrate before shooting (Brancazio, 1981). Reilly (2006) acknowledged the perceived simplicity of free-throw shooting by expressing his disbelief at athletes who cannot make free-throws.

Despite the perceived simplicity of the free-throw, not all players are effective free-throw shooters. Syracuse University’s Arinze-Onuaku stands out as one of the worst with his 37 successes out of 124 shots for 29.8% during the 2008-09 season (Young, 2010).

Regardless of the acknowledgement that making free-throws is often the critical difference in a game (Roth, 2007), examples of players, at any level, attempting to improve their free-throw shooting by switching from the overhand to underhand style are scarce. In fact, no examples were found in which college level players consistently used the underhand style.

While playing in the National Basketball Association’s (NBA’s) professional league, however, Rick Barry achieved a 90% free-throw success rate, while shooting underhand, over the course of his career (Rosen, 2009). Barry led the NBA in free-throw percentage during the 1977-1978, 1978-1979, and 1979-1980 seasons (Regular Season Records, 2010). Interestingly, though, few players have chosen to adopt the underhand style that proved to be extraordinarily successful for Barry.

A literature search revealed the perceived benefits of the underhand free-throw style and reasons why players most often elect not to use the underhand style but rather prefer the traditional overhand style. Skills necessary for effective free-throw shooting, regardless of style, are included. And, the following techniques specific for successful use of the underhand free-throw shooting style are discussed: arc, velocity, backspin, and balanced and angle of release.

Support for the Underhand Style

Despite the near dearth of basketball players using the underhand free-throw shooting style, Edwards (2009) claimed that its positive results are undeniable. By switching to the underhand free-throw, according to Rosen (2009), poor free-throw shooters could improve by 20% in a week. Further support for the underhand free-throw came from Brancazio (as cited in Rist, 2008) who asserted that from a physics (i.e., biomechanics) standpoint, if all players used the underhand style there would be a dramatic increase in success rates.

Masculinity and Unwillingness to Change

Players, in general, are unwilling to change their free-throw shooting style (from overhand to underhand), which Modesti (1997) refers to as “unfortunate.” The less than masculine stigma associated with the underhand style is a reason why even the poorest free-throw shooters are unwilling to switch over to the underhand style (Modesti, 1997; Reilly, 2006; Rosen, 2009). Modesti (1997) interviewed several prominent players and coaches from various levels of men’s basketball, all affirming that the less than masculine stigma associated with the underhand free-throw is an impediment to its progress. Reinforcing the non-masculine stigma associated with the underhand style is the ego of players and the ribbing taken from others directed at those who might be considering using it (Edwards, 2009).

On the other hand, Rosen (2009) suggested that poor free-throw shooters in the NBA try using the underhand style, as it could not be any more embarrassing than the dismal percentages they currently shoot using the overhand style. Rosen also pointed out that if the underhand free-throw was good enough for Rick Barry, it should be good enough for players who shoot dismal percentages.

A rare exception to those players resisting the switch from overhand to underhand was former NBA great Wilt Chamberlin, who in his best year only shot 61% and in his worst shot a meager 42% (Libby, 1977). Through Chamberlin’s self-analysis, the one handed (overhand) style caused him to shoot too flat and too hard (Libby, 1977). After switching to the underhand style, Chamberlin switched back because in his words, it made him feel like a sissy (Reilly, 2006).

Effective Free-Throw Shooting – Overhand or Underhand

Successful free-throw shooting depends on a relationship of factors that determine the ball’s path toward the rim. Height of release, angle of release, speed of release, and spin of the basketball are factors considered crucial for successful free-throws (Brancazio, 1984; Embse & Engebretsen, 1996; Okubo & Hubbard, 2006; Southard & Miracle, 1993). Furthermore, biomechanically sound techniques that are reproducible are necessary for shooting success (Hudson, 1985). Consistency of such techniques can be developed through the repetition of shooting and through drills (Branch, 2009; Tran & Silverberg, 2008). In fact, consistent release angle and backspin were found to be two important outcomes of sound shooting techniques (Brancazio, 1984; Okubo & Hubbard, 2006). A minimum release angle of between 45 to 52 degrees makes for an optimal trajectory (Brancazio, 1984). Backspin, and especially higher levels of backspin, was found to increase the

likelihood of a successful shot (Okubu & Hubbard, 2006). There is an inverse relationship between the height of the arc and backspin velocity: as arc height increases, less backspin is necessary. A back spinning basketball decreases the speed and energy of the ball after contact with the rim allowing for a “softer” shot more likely to drop in the rim (Brancazio, 1981).

Effective Free-Throw Shooting – The Underhand Style

Techniques specific to the underhand free-throw are believed to contribute to its success. According to Edwards (2009), the simplicity of the underhand free-throw and its compact nature establishes conditions for accuracy. In addition, a larger variety of release combinations characteristic of the underhand free-throw style have been reported to be an advantage (Okubu & Hubbard, 2006). Modesti (1997) cited four factors as advantageous to the underhand free-throw style: the ball goes up softer, both hands on the ball improve aim, fewer variables in the shooting motion make for consistency, and the more relaxed motion helps eliminate fatigue as a factor during both game and practice conditions. More specifically, and from a biomechanical standpoint, the literature supports the following techniques as contributors to underhand free-throw success: the high arc, i.e., “softer shot,” (Hudson, 1985), high velocity backspin, high release point, and balanced release, i.e., “more relaxed motion,” (Curtis, 2000; Tran & Silverberg, 2008).

Arc of the underhand style. A high arc of the path of the ball is necessary for successful free-throw shooting (Hudson, 1985; Rist, 2008) and can be reached when the ball is released at an angle greater than 45 degrees (Brancazio, 1984). Furthermore, free-throws are considerably less sensitive to errors (soft shot) at a 52 degree release angle (Tran & Silverberg, 2008). In other words as the release angle increases, the arc of the path of the ball also increases. As a result, two advantageous outcomes occur. First, the velocity of the ball has a greater vertical component than horizontal component as the ball falls toward the rim. The result is a ball that tends to bounce more vertically than horizontally on a missed shot that hits the rim. The potential for a successful free-throw after an initial miss that bounces up vertically from the rim gives the ball a second chance to fall through the rim on its descent.

Secondly, a higher arc with a more vertical angle of trajectory is preferable over a low arched line drive trajectory (Brancazio, 1984) and will also increase the cross-sectional target area of the rim, i.e., makes the rim bigger, (Okubu & Hubbard, 2006). As a result, the margin for error is smaller with a lower release angle than with a higher release angle. Thus, it is better to err on the side of too much arc than too little (Brancazio, 1981; Brancazio, 1984). On the other hand, as the ball travels on an increasingly horizontal trajectory, the cross-sectional area of the rim decreases. In other words, a flat shot has a lower margin for error (Brancazio, 1981). In addition moderate or minimal velocity on the point of release might best be used in combination with a high arc (Hudson, 1985).

Release angle and velocity of the underhand style. Some players are poor free-throw shooters because they release the ball at the wrong angle (Gablonsky & Lang, 2005). As a result of the motion of the body during an underhand shot, where the ball is lowered near the ground (between the legs) and lifted through a large range of motion until release, it is more likely that the shooter can release the ball with a more accurate angle and initial velocity using the underhand style (Okubu & Hubbard, 2006). The range of motion associated with the underhand style will result in a more vertical release angle, typically greater than 45 degrees.

A minimal speed angle is the best launching angle (Brancazio, 1981). The margin for error in speed is greatest when the shot is launched at a release point leading to as high an angle as possible (Brancazio, 1984). In addition, based on the impulse-momentum relationship a greater range of motion increases the time that the projecting force is applied, resulting in less force required to achieve the appropriate velocity. With less force required, the shooter’s movements can be more controlled, and more attention can be focused on accuracy (Fitts, 1954/1992).

Backspin of the underhand style. The ability of the underhand free-throw to create backspin is a contributing factor to underhand free-throw success (Curtis, 2000; Tran & Silverberg, 2008; Rist, 2008). The result of backspin is a decrease of horizontal velocity after impact with the rim, which can work with the arc of the path of the ball to create a “softer” shot. In free-throw shooting, backspin is said to “deadend” the motion of the basketball after it bounces off the rim, causing the ball to stay closer to the rim, which increases the probability of a successful shot (Brancazio, 1981). If the ball makes contact with the upper surface of the rim during a free-throw attempt, the effect of backspin will reduce the speed and energy after hitting the rim, increasing the chance that the ball will fall through the rim (Brancazio, 1981). When the spin of the ball, however, deviates from a backspin (i.e., includes some sidespin), and initially strikes the rim (as opposed to a swish shot) it is less likely to bounce through the rim as a successful shot. A ball with sideways spin that hits a surface will veer sharply to the left or right depending on the spin direction (Brancazio, 1981). Rosen (2009) used the term “soft ball” to describe the underhand style because it turns virtually every near miss into a make; and Reilly (2006) stated that the underhand free-throw is so soft that a lot more shots are successful.

Balanced release of the underhand style. A balanced release of the underhand style results in a more consistent shot. For example, the bilateral motions of the legs and hands, allow the ball to be more easily controlled during the underhand style, preventing lateral deviations (Okubu & Hubbard, 2006). So long as the elbows are kept in (balanced approach) the underhand style provides better stability than the overhand (Rist, 2008). When comparing overhand and underhand styles, Steiger (as cited in Rist, 2008) pointed out that an overall higher probability for error exists for overhand shooting, including the ball rolling off one side of the hand; whereas when shooting underhand, enhanced stability is provided because the ball is being held by both hands. An imbalance of grip strength of one hand, however, could result in a misaligned underhand release and the subsequent off-center path of trajectory of the ball toward the rim. Successful shots require trajectories that do not deviate too far to the left or right of the center of the rim (Brancazio, 1981).

The purpose of this study was to determine whether one basketball shooting style (underhand or overhand) was naturally more prone to success than the other. It was presumed that the overhand style is a one-handed shot that requires more ipsilateral (same side) movement patterns that are less balanced and requires more individual wrist strength from the shooting/dominant hand; whereas, the underhand style is one that requires more bilateral (two sided) movement patterns that are more balanced and requires less wrist strength.

METHODS

Participants

The total participants ($N=29$), consisted of 15 men and 14 women. Prior to data collection, the study was granted approval by the researchers' Institutional Review Board, ensuring for anonymity of the participants. All participants were undergraduates attending a four year college and were required to be at least 18 years of age. The study was delimited to participants with no free-throw shooting experience. In addition, all participants had less than one year of basketball experience. For descriptive purposes, information related to general fitness habits was obtained from subjects based on their responses to survey questions regarding the frequency and duration of exercise sessions per week. Prior to data collection, the study was granted approval by the researchers' Institutional Review Board.

Procedures

Data was collected using a counterbalanced design consisting of two shooting sessions per participant. Each participant shot 25 free-throws using the underhand style and 25 free-throws using the overhand style. Participant shooting sessions were each conducted on different days to help prevent fatigue from influencing the success rate of shots attempted during the second shooting session. The interval between the first and second shooting session was at least 24 hours. Men used an NCAA regulation men's basketball (circumference of 29.5 to 30 inches) and women used an NCAA regulation women's basketball (circumference of 28.5 to 29 inches).

Prior to shooting, measures of strength and fitness were obtained from each participant. A hand held dynamometer (Jamar/model 5030J1) was used to measure grip strength (kg). Measurements were obtained as each participant held the dynamometer with the arm fully extended and the shoulder at approximately 45 degrees of abduction. Grip strength was measured for the dominant and non-dominant hands. Participants were instructed to squeeze the dynamometer with a maximal effort.

A shooting script describing proper shooting techniques to be used for both the overhand and underhand style was read to each participant prior to his/her shooting trial. The underhand style shooting script included the following shooting techniques:

Position your feet comfortably, shoulder width apart.

Grip the ball with your hands placed evenly on the sides of the basketball.

Bend your knees and lower the ball between your knees.

Elevate your body and shoot the ball, while following through.

The overhand style shooting script included the following shooting techniques:

Position your feet comfortably, shoulder width apart.

Place your shooting hand underneath the ball with your guide hand on or near the side of the ball.

Bend your knees, lowering your body.

Elevate your body and release the ball with your shooting hand while following through.

RESULTS

Participants' average age was 23.98 years ($SD=6.75$). The average age of the males was 24.5 years ($n=14$, $SD=6.92$). Females' average age was 23.4 years ($n=15$, $SD=6.77$). Participants averaged 4.27 exercise sessions per week. Of the 29 participants, 28 exercised 31 minutes or more per week, and were considered active. Furthermore, 11 participants exercised 60 or more minutes per week, and one exercised less than 15 minutes per week.

No significant differences were found between dominant ($M=41.12$, $SD=10.92$) and non dominant ($M=40.47$, $SD=11.89$) grip strength across males and across females. Similarly, no significant differences were found between dominant ($M=49.64$, $SD=7.87$) and non dominant ($M=49.57$, $SD=9.87$) grip strength of males, nor between dominant ($M=33.54$, $SD=6.43$) and non dominant ($M=32.18$, $SD=5.80$) grip strength of females. In fact, significant correlations were found between dominant and non dominant grip strength among males ($r=.87$, $p=.000$) and among females ($r=.95$, $p=.000$). Significant differences were found between the dominant hand grip strength of males ($M=49.64$, $SD=7.87$) and females ($M=33.17$, $SD=6.36$); ($F=38.71$, $p=.000$). Significant differences also were found between the non dominant hand grip strength of males ($M=49.57$, $SD=9.87$) and females ($M=31.97$, $SD=5.65$); ($F=35.40$, $p=.000$).

To examine the relationship between grip strength and shooting success, Pearson correlation was used. No significant correlation was found between grip strength of the dominant hand and underhand performance ($r=.03$) nor overhand performance ($r=.06$). Similarly, no significant correlation was found between grip strength of the non dominant hand and underhand performance ($r=-.01$) nor overhand performance ($r=.04$).

Regardless of gender, no significant differences were found between the number of successful shots using underhand ($M=6.24$, $SD= 3.28$) and overhand ($M=6.34$, $SD=2.97$) styles. Similarly, no significant differences were found for shooting success of males between the underhand ($M=6.50$, $SD= 3.82$) and overhand ($M=7.07$, $SD=2.95$) styles; nor for shooting success of females between the underhand ($M=6.0$, $SD= 2.80$) and overhand ($M=5.67$, $SD=2.92$) styles. In addition, no significant correlation between grip strength of the dominant hand and the underhand performance ($r=.02$) or the overhand performance ($r=.06$) was found.

Finally, there was no significant difference across males and females between the number of successful underhand shots for attempts 1-13 ($M=3.41$, $SD=1.78$) when compared to the number of successful underhand shots for attempts 14-25 ($M=3.15$, $SD=1.70$). Similarly, there was no significant difference between the number of successful overhand shots for attempts 1-13 ($M=3.31$, $SD=1.85$) when compared to the numbers of successful overhand shots for attempts 14-25 ($M=3.10$, $SD=1.68$). And similarly, when comparing successful shots between attempts 1-13 and 14-25 among males and females separately, no significant differences were found.

DISCUSSION

Overhand/Underhand Success

As an overall group, regardless of gender, no significant differences were found between underhand and overhand shooting performance. Also as a group, the performance of both underhand and overhand styles were positively correlated ($r=.28$). This trend suggests that if a participant shot well underhand they also shot well overhand, indicating that it is likely that neither the overhand or underhand shooting style is naturally more prone to success than the other.

Strength. Regarding dominant and non dominant grip strength, no statistical differences were observed among all participants, regardless of gender; nor were statistical differences observed between dominant and non-dominant grip strength among men or among women. The active participation in exercise sessions among all but one participant may explain the aforementioned finding. Yet, as would generally be expected, grip strength of both the dominant and non dominant hands of males was observed to be greater than for females' dominant and non-dominant hands. This greater grip strength of males, suggests that males would have a greater success rate than females when shooting overhand, which, in fact was found to be the case in this study but not to any degree of significance.

However, by virtue of the fact that all participants' shots reached the rim during the shooting trials it is likely that the grip strength of participants was great enough to support the minimum velocity and shooting angle necessary to not only travel the 15' distance to the rim but do so with a velocity and angle allowing for the maximum potential for success. The amount of force needed to launch the 15-foot free-throw at a 54 degree angle is only 2% greater than the minimum force (at 49 degrees) needed to cover the 15-foot distance (Brancazio, 1984).

Therefore, males' greater dominant and non-dominant hand grip strengths, when compared to females' dominant and non-dominant grip strength, may not be a factor leading to greater successes by males. In fact, the means and standard deviations of shooting success show no significant differences between the underhand and overhand performance, regardless of gender.

Distance. Coppedge (1967) also found that at the free-throw shooting distance of 15 feet, greater grip strength was not an indicator of success. However, at a shooting distance of 25 feet it was found that participants with greater grip strength experienced greater shooting success (Coppedge, 1967). Thus, as the distance is increased beyond 15 or 20 feet, significant differences in performance may be found between successes of participants with greater grip strength when compared to those with lesser grip strength. If the distance is increased beyond 15 or 20 feet, then the underhand style may be more successful then the overhand style for those with lesser grip strength. However, the underhand style's apparent effectiveness for distances beyond 15

feet is generally impractical because most any shot beyond 15 feet would be considered a jump shot, which is attempted during live game situations, making it virtually impossible to release without being blocked by a defender.

Balance of strength. The magnitude of grip strength, at least beyond a minimum threshold, may not be as much of a contributing factor for underhand free-throw shooting success as is the balance of grip strength between the dominant and non dominant hand. The underhand shooting style requires each hand to be placed on a side of the basketball prior to a simultaneous two hand release. An imbalance of strength, favoring either hand, could potentially cause the ball to drift off center from the rim, creating a misalignment between the path of the ball and the rim, or cause sidespin, decreasing the likelihood of success. Furthermore, a sidespin might result from an imbalance of dominant and non dominant hand grip strength, causing, according to Brancazio, (1981), the ball to veer sharply to the left or right after it hits the rim, contributing to a missed shot. In this study, regarding the underhand style, an “on-center” straight forward path of the ball traveling toward the rim was supported because an imbalance of strength was not found to exist, as no significant differences in grip strength were found when comparing dominant and non-dominant hands of participants.

Repetition. Repetition may contribute more to free-throw shooting success than the style of shooting. Given that neither the underhand or overhand free-throw shooting style was shown to be more naturally prone to success, success may be more dependent on repetition than style. The importance of emphasizing repetition is consistent with the views of Branch (2009), and Tran and Silverberg (2008) who pointed out that consistent development of sound shooting techniques are developed through repetition. Aspiring basketball players should select one of the styles and commit to it by striving to achieve shooting success through multiple practice repetitions. However, athletes with lesser grip strength, i.e., youth, may experience success more quickly with the underhand style.

Fatigue/Learning Effect

In this study, no significant differences between the number of successful overhand and underhand shots were observed for attempts 1-13 when compared to attempts 14-25, which may indicate that acute muscle fatigue did not have an effect on successful attempts. The aforementioned findings are consistent with the findings in a study by Looney, Spray and Castelli (1996) in which split shooting trial procedures were also used. Looney et al. (1996) also found that learning or fatigue did not severely affect free-throw shooting accuracy. One might have hypothesized that novice shooters would have improved during the second half of the shooting sequence (attempts 13-25); however, the data in this study did not indicate that fatigue or learning affected the number of successful shots. On the other hand, although beyond the scope of our study, it is possible that a learning effect could have been attenuated by fatigue, or that a learning effect may have required more than the 25 shots recorded in our experiment.

Among men and among women, differences between underhand and overhand shooting success existed but were not significantly different. It was observed that males averaged .57 more successful attempts overhand than underhand; whereas, females averaged .33 less successful attempts overhand than underhand. When comparing the success rates of the men's and women's overhand shots, a trend for higher success rates for men (3.6%) was found. If extrapolated to larger numbers of shots, the number of overhand success by the men becomes apparent when compared to females. If males and females were to attempt 1000 overhand shots, males would make approximately 36 more shots than females.

Furthermore, if fatigue increases with attempts or in the later stages of games, differences in overhand success rates could be exacerbated. The effects could have real ramifications in game situations because it was found by Kozar, Vaughn, Whitfield, Lord, and Dye (1994) that during the last five minutes of basketball games, free-throws constitute 35% of the points scored. The trend of slightly higher success rates of the men's overhand style when compared to women's overhand style may, again, be attributed to greater grip strengths of the male dominant hand when compared to the females' dominant hand. Thus it might be suggested that an underhand free-throw style by females could make up for the slightly greater success rates achieved by the men when using the overhand style.

INSIGHTS AND RECOMMENDATIONS

Although each free-throw shooting style is learned at approximately the same rate, a trend in this study suggests that males might be more apt to succeed when using the overhand style and females might be more apt to succeed when using the underhand style.

Beyond a minimum level, additional upper body strength is unnecessary to achieve success using either free-throw shooting style. Players with low levels of physical strength, however, are more apt to experience success using the underhand style. Whereas, a balance of upper body strength appears to be preferable for players using the underhand style, those with an imbalance of upper body strength may experience more success with the overhand style.

A coach's primary challenge might not be the instruction of the underhand free-throw but rather his/her ability to persuade a player to switch over from the traditional overhand style. Additional challenges might lie in the fact that there is a lack of experts who can teach the underhand free-throw shooting skill from an experience standpoint.

Moreover, the general perception of the underhand free-throw is that it is an unacceptable form of free-throw shooting, which could lead to hypercriticism unless the success rate is well beyond success rate averages of the overhand style.

Players should continue with the style they have been using unless their success rate is abysmal. The definition of abysmal may vary, but anyone whose overhand success rate is less than 50% should consider switching to the underhand style. In the final analysis, players will be best served by selecting either style, and practice it through multiple repetitions.

FURTHER RESEARCH

Despite the fact that a correlation between grip strength and successful free-throw shooting was not revealed in novices, further research might be conducted to determine a minimal grip strength threshold necessary to achieve successful free-throw shooting. Studying a youth population would likely result in lower grip strength recordings than in our young adult population. Lower (youth) grip strength recordings might show a significant drop in successful free-throw shooting when compared to higher (young adult) grip strength recordings. The same research design should be implemented while increasing the number of shot attempts per participant from 25 to upwards to 1000. Finally, similar studies should be conducted with skilled players at various levels (e.g., youth, high school, etc.).

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