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A Quantitative Analysis of Squash Shot Accuracy

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Abstract – The purpose of this analysis was to determine the validity of the Hunt Squash Accuracy Test to predict the success of certain game types. The exact matching of such shot during tournament match-play was contrasted with the precision of the corresponding shot form in the HSAT. The average HSAT value association was substantially high (0.95), the total precision of the shot (0.90), the average consistency of the backhand percentage (0.94) and the total association of the forehand percentage (0.77). The only unique HSAT shooting forms with a substantially high connexon were: straight drive BH (0.92) and straight volleyball BH (0.97). The majority of the styles of shot; boasts, rises and declines both displayed major similarities both on the BH and on the FH line.

Key Words – Validity, Quantitative Analysis, Technique.

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INTRODUCTION

In squash, the ball is moved through a given four-walled area in which all players engage. Unlike other sports. It enables the ball to be struck off each of the four walls so long as it meets the front wall before bouncing in the specified area. Points may be earned by correctly approaching a strategically favorable point at the court, thereby eliminating an opponent or ensuring that he cannot effectively move the ball (Lees, 2003)[1]. Squash is a highly technological and tactical game (Vučković, Perš, James & Hughes, 2009)[2]. However, while numerous studies have been performed evaluating the tactical aspects of squash (Pereira, Wells & Hughes, 2001; Vučković et al., 2009)[3], relatively few studies analyze the technological component of squash performance or even less validated tests are used to evaluate and monitor technological squash output.

Improved success in sport can partially be due to an improvement in the standard of preparation as measured in a sport-specific testing (Müller, Benko, Raschner & Schwameder, 2000)[4]. The creation of athlete powers and vulnerabilities that may be ignored by fewer precise studies, accurate reproducible experiments are therefore a must (Wilkinson, Leedale-Brown & Winter, 2009a)[5]. Some coaches use the Hunt Squash Accuracy Measure (HSAT) to determine one of the technical dimensions of shot accuracy. It assesses the hitting precision of a competitor over 13 separate styles of squash strokes on both the back and the forehands. In contrast with tournament and seasoned coach rankings (Williams, Chase, Graham-Smith, & Bourdon, 2014)[6], the HSAT was previously demonstrated to be a credible and accurate test6. However, no determination was made as to whether the score of as given HSAT shot is compatible with a successful result of the same shot in a match. The goal of this analysis is to determine the relation between the HSAT scores and the corresponding exactness of the shots played during the tournament match.

SQUASH GAME

Squash is a racket and ball competition performed by two teams with a tiny hollow rubber ball at a four-walled courtyard. The players alternate as they hit the ball with their racquets on the playing surfaces of the four courtyard walls. The goal of the game is to strike the ball such that the offender cannot play a fair return. There are about 20 million people who regularly play squash in more than 185 countries worldwide. The governing body of Squash, the WSF, was recognized by the IOC, but amid a range of applications the sport is not part of the Olympic Games. Fans want to campaign for its inclusion in the potential Olympic program.

EQUIPMENTS

Racket

The squash rackets are 686 mm (27.0 in) in length and 215 mm (8.5 in) in width, with a gross region of 500 cm (77.5 sq. in.). The maximum weight approved is 255 grammes, but the weight is normally from 90 to 150 grammes (3-5,3 oz).

Ball

They are composed of two parts of rubber-compound, which are gathered together to create a hollow sphere with a matte finish.[6] The squash balls are between 39.5 and 40.5 mm in diameter and weigh between 23 and 25 grammes. Different balls are given for different climates, ambient environments and play standards: more advanced players use fewer bounty than fewer skilled balls (slower balls prefer to 'die' in short corners than to 'stand up' to make easier shots). Squash balls can be struck tens of times at the beginning of a session to warm it up; cold squash balls have very little bounce. Tiny colored dots suggest the ball's responsive level (bouncy). The "double yellow dot" mark, which was launched in 2000, replaces the old "yellow dot" mark. A "silver mark" ball is also available for use at high altitudes. The colors remembered are:

Colour	Speed (of Play)	Bounce	Player Level
Double yellow	Extra Slow	Very low	Experienced
Yellow	Slow	Low	Advanced
Red	Medium	High	Medium
Blue	Fast	Very high	Beginner/Junior

Some ball makers, such as Dunlop, use an expert methodology to identify balls. You always have the same dot ranking, but are called to help you pick a ball that is ideal for your degree of expertise. Four styles of balls are: Intro (blue dot, 140% Pro bounce), Improvement (red dot, 120% Pro bounce), Rivalry (single yellow dot, 110% Pro bounce) and Pro (double yellow dot).

Many shoes with a non-marking tread and eye safety involve the use of shoes. Some organizations mandate both junior and double players to wear eye safety. The National Health Institutes consider utilizing polycarbonate goggles.

Court

The courtyard is a playing space enclosed by four partitions. On the courtyard, the front and rear of the court line are divided from the left and right side of the court rear and three 'boxes' are created: the front half, the left back, and the right backside. The two rear boxes have smaller support boxes.

The four walls of the court are separated into a front wall, two side walls and a rear wall. An "outline" sits around the top of the front wall and descends to the rear wall along the side walls. The tip of the 'tin' is indicated by the bottom of the front wall, half a meter high. The service line is the center line of the front wall. The scale of the court is:

Dimensions	Distance	+/-
Length	9750mm	10mm
Width	6400mm	10mm
Height	5640mm	
Diagonals	11665mm	25mm

Double courts are bigger than single courts in North America, because of the hard ball and a much quicker speed. The double court would be substantially greater than the single court with double the number of matches. The twin court shall have a range of 25 feet by 45 feet and a height of at least 24 feet but probably 26 feet.

MANNER OF PLAY

Service

A racket is turned by the players to determine who serves first. This player begins the first rally by deciding to serve either from the left or right box. For a legal operation, one of the feet of the server must be in the service box, and would not strike a portion, because the athlete hits the ball. After the racket reaches the ball would reach the front wall above the service line and below the outline and at the opposite side of the lane. The receiver may opt to volley a service as it reaches the front wall. When the server gains the round, the two players turn to the next round. If the server loses the position, then the adversary serves and may serve from either place.

Play

After the service, players switch to the front wall, over the tin and below the outline. The ball will at any point strike the side and back walls as long as it reaches beneath the outline. It shall not touch the floor until the racket is touch and the front wall is reached. A ball on either the outer line or the line at the top of the tin is known as down. If the ball has reached the front wall, the attacker must come back while on the floor (and on a variety of occasions opposite the side and back walls). Plays will travel across the court anytime, however the unintentional or intentional blockage of the moves of the other player is prohibited. After a goal, players usually return to the middle of the floor.

Strategy and Tactics

One main strategic aspect of squash is called "Dominating T" (the crossroads of the red lines close to the middle of the court, like a letter "T," where the player is in the strongest place to pick up the next shot of the opponent). Experienced players return a goal, and switch back to the "T" until they take the next goal. The player will easily reach either section of the court from that location to get the next shot of the opposing party with minimal movement and likely

optimize the movement the opponent is needed to react to the returned shot.

A typical strategy is to strike the ball directly to the rear corners of the side walls; this is the key squash shot recognized as a "rail," straight, wall or "broad." After making the ball, the player travels to the middle of the court near the "T" to search the return of the competitor. Attacking the front corners with soft and "tiny shots" (referred to as "drop shots") allows the competitor to cover the court further, and may contribute to a definite winner. Boasts or angle shots have been purposely striking one side of the walls until the ball hits the front. They are used to dissatisfaction once again to allow the adversary to fill the court further. The back-wall shots move straight or diagonally to the center, pulling the enemy to the front. Advantageous tactical shots may be taken in reaction to the opponent's poor answer, if prolonged, the bulk of the court being free of charge.

Rallies between seasoned players can require 30 or more shots and endurance, both aerobic and anaerobic, thus, has a very strong premium. As the players are better prepared and particularly able to hit targets, points are always turned into a war of attrition. The fitter player has a big benefit on higher stages of the game.

The opportunity at the last moment to adjust the trajectory of the ball is often a strategy used to imbalance the player. Expert players can foresee a few tenths of a second shot of the opponent before the average player and offer them an opportunity to respond faster.

Depending on play style, squash players are generally referred to as

- Power players: effective shots to steal the opponent's time away. John White, Omar Mosaad, Mohammed Sadiq, for example.
- Shotmakers: quick attempts to drive the adversary time down. Jonathon Power, Ramy Ashour, Amr Shabana, James Willstrop, for example.
- Retrievers: great recovery to counteract strength and precision and to quicker return attempts, to take the opponent's time away. Peter Nicol, Grégory Gaultier, Mohamed El Shorbagy, for example.
- Attritional players: a continuously high-range game from shot pace and running pace for the rival to break down over time. David Palmer, Nick Matthew, Jansher Khan, Jahangir Khan.

INTERFERENCE AND OBSTRUCTION

Interference and disruption are an inherent part of the squash, since two teams are enclosed in a common area. The rules usually encourage players to link directly to the ball, provide the space for a fair swing and have an unchecked shot on either front wall. In cases where there is intervention, a player may ask for a "send" and the player interprets the nature of the intervention (or the players themselves if there is no official). The referee could make a let and the players replay the point or grant the player a "stroke," based upon the degree of intervention, whether the player interfered with the move made an appropriate attempt to prevent intervention and if the player interfered with the ultimate shot hit the goal. An exception happens where the intervening player is immediately in the direction of the swing of the other player, stopping the swing efficiently and often providing the opponent a move.

When it is felt that little or no intervention has happened, the Regulations provide that no allowance may be allowed in the interests of consistency and the discouragement of false appeals. Since it is difficult to perceive the type and extent of intervention, it is also problematic to give (or withhold) letters and strokes.

Interference frequently happens where an attacker is fired until he reaches the front wall. If the ball was heading to the side wall when the attacker struck the ball or if it had already reached the side wall and was moving directly to the front wall, it is typically a message. It is therefore a stroke to the player who struck the ball, whether the game was heading right to the front wall when the game struck the adversary without first touching the side wall. In general, once the team has been struck by the shot, all players remain still. If the team who strikes the ball stands immediately behind the player, they lose their stroke. If the person who strikes the ball is perceived to be intentionally attempting to strike his rival, he may lose the stroke. An exception happens where the person who hits the ball "turns" i.e. the ball reaches them, but then strikes the ball on the other hand like it came off the back wall. In both situations, the stroke is aimed at the individual struck by the ball.

AIMS OF THE STUDY

1. To the sudden of the accuracy test.
2. To review success of the game.
3. Find the HSAT score and the overall precision of the percentage.

METHODOLOGY

Participants: Eight male junior squash players from the National Sports Academy willingly engaged in the

sample (15.5 ± 1,8 years; 168.3 ± 10.8 m, body mass 61.9 ± 14.6 kg). Educated consent was sought for each player and at the point of training both patients were exempt from injury. All players understood the HSAT and had already completed the task at least three times (average 8.1 ± 4.4).

Equipment set-up: All the experiments were carried out on regular glass squash courts in an indoor squash training facility (ASB Squash Courts, Czech Republic). For both the HSAT and the competition, teams used their own racket. Two video cameras were fitted on tripods 1.4 m from the field and 7.0 m from the middle of a squash courtyard (HDR-XR260VE, Sony Company, Japan). They were built such that the field of vision was opposite to the back of the bottle. Every camera was zoomed in such that the edges of the court filled the view to increase every court's field of view. Every match was high definition shot at 25 Hz.

HSAT: The HSAT consists of 375 shots of 13 separate styles of FH and BH squash strokes. Included are: swings, volleys, boasts and shots. Each shot had a goal area in which the ball had to land to be effective. The players consistently targeted the ball for both drive and volley attempts and scored dependent on the number of targets in the goal area (not even the first shot). The claims and drop-shots of an accomplished trainer were struck by a fed ball with 3-5 s between feeds. Between each separate stroke examination, the players had around 30 s. The average score was the number of good shots in the target area.

Tournament: The players competed in a round-robin competition, in which both players played a best-of-5 match against each other. Both matches were played in compliance with international single rules of the World Squash Federation and were refereed by a professional instructor. Before any match the players practiced a regular pre-game warm-up. The match order was random.

Data analysis: The HSAT scores were translated by the formula: number of shots at the goal area / total number of shots. A cumulative outcome was determined using the sum and percentage of all individual shot results. With both BH shots and FH shots, the cumulative sum was also determined separately (BH-HSAT and FH-HSAT). A rating of the tournament (TR) was derived from the tournament performance. Each shot in the squash matches played during the tournament was labelled with the following Dartfish TeamPro (Dartfish TeamPro version: 7.0) output analysis descriptors;

- Shot side: FH; BH;
- Shot type: drive; volley; boast; volley-drop; drop; lob; serve
- Shot direction: straight; cross-court;
- Outcome: rally continues; winner; unforced error, forced error.

A winner was described as a shot the opponent did not hit before the second bounce. An unforced mistake was perceived to be the player's mistake in a shot that was usually recovered. A forced error was attributed to a shot by an enemy that contributed to a challenging shot, resulting in a mistake. Each shot category was translated into a% by using the formula: total number of shots – unforced errors / total number of shots, to provide the approximate percentage per each category of shot.

Matching HSAT shoot forms and performance analysis data (10 separate shots) as well as performance analysis data and TR were then evaluated with a Pearson coefficient of commodity moment similarity after testing the distribution normality of each component. Importance has been set at $p < 0.05$. The sizes have been found to be tiny (±0.1-±0.29), medium (±0.3-±0.49), and massive (±0.5-±1.0) (Cohen, 1988).

RESULTS

The r values of Pearson for all the equivalent shots played from the BH, FH and cumulative shots as well as the overall tournament classification in comparison to the respective HSAT result are displayed in Table 1.

Table 1
Correlations between Total HSAT Score, % Accuracy for Combined Shots and TR

	% Accuracy			TR
	BH	FH	Total	
HSAT: Pearson's r	0.937*	0.767*	0.902*	0.954*

* = $p < 0.05$

Table 2 indicates the total number of shots per match (Mean # Shots PP) (± SD) over the whole tournament and r values of Pearson for each percentage precision of the same shot form along with the corresponding HSAT and TR results.

Table 2
Correlations between % Accuracy for Specific Shot Types, HSAT Shot Scores and TR

% Accuracy	Drive		Boast		Volley		Volley-Drop		Drop	
	BH	FH	BH	FH	BH	FH	BH	FH	BH	FH
Mean # Shots PP	137±30	62±20	30±16	27±10	34±11	14±5	13±5	5±4	35±14	16±9
HSAT: Pearson's r	0.923*	0.641	0.280	0.150	0.972*	0.455	0.367	0.534	0.142	0.624
TR: Pearson's r	0.928*	0.816*	0.564	0.024	0.844*	0.294	0.263	0.570	0.052	0.824*

* = $p < 0.05$

DISCUSSION

The HSAT attempts to test one of the technological components of the squash game and the players have shot the precision. An earlier confirmation report, which also demonstrated Williams et al. (2014), has verified the substantial association between the overall HSAT score and the tournament grade (0.95). The overall HSAT scoring displayed a major association with total accuracy (0.90) inside the game. Both the BHHSAT and FH-HSAT ratings also have identified major associations with the overall BH accuracy (0,94) percentage and the overall FH accuracy (0,77). These findings compare favorably with the findings of other special validation studies

such as Wilkinson, Leedale Brown, and Winter (2009b)[7] which showed a squash-related speed test with squash player ranks that were significantly associated (0.77).

In this research, the performance appraisal variables contained 'match pressure' which were a clear indicator of player capacity to strike the ball effectively during a competitive game. The BH Drive (0.92) and the BH Volley (0.97) were the particular shots in match-plays which displayed strong significant correlations with HSAT ratings, all of which had big TR correlations (0.93 and 0.84 respectively). Compared to the other shots, the high average number of shots per person per shot on the BH drive indicates that this shot is one of the most frequently played shot during a squash match (Vučković et al. 2013). The wide association with TR (0.93) and the high shot count also indicates that this shot 's effectiveness affects the overall results in a match and tournament.

The FH Push, FH Volley-Drop and FH Decline all displayed a strong connexon (0.64, 0.53 and 0.62) between match-play and HSAT results, but not important. Maybe a bigger sample size should have been obtained. The poorer associations with other HSAT shot outcomes relative to the percentage precision may be attributed to players preferring their more precise shot styles, so as to sustain a rally. You should only play such fewer specific shots while you are compelled (due to your court positioning) or are helpful (to try to reach "a winner"). It is often probable for some of the players to take more chances than others to attempt and struck more "winners" rather than to take a more precise, less challenging shot early in the rally. This would raise the probability of unforced errors and reduce their percentage precision in contrast with the non-competitive HSAT rating.

During this analysis, some HSAT shortcomings became clear. It is very notable that the evaluation would not contain cross-court shots. 36 percent of the 10 shot styles evaluated for this analysis could not be associated with HSAT scores because they were cross-court shots (e.g. BH cross-court drives). All serving and lob shots had also to be omitted from the review as these shots are not part of the HSAT and are not equivalent for this research. The HSAT assesses a theoretical dimension of squash, the consistency in shot striking, but takes into consideration possible variations in shot stroke dynamics or racket criteria that might be of prime importance in squash (Elliott, Marshall, & Noffal, 2010)[8].

The HSAT is practiced in a comparatively regulated atmosphere, several shots are continually hit and the others are guided by a coach where the player understands where the ball will be and therefore has ample time to execute the specified stroke without any pain. The pace and trajectory of the king, the location of the body and the swing kinematics might all shift while engaging and attempting to earn a point with the same shot style under match pressure. Therefore, a more in-depth review including a cinematic examination during HSAT success and during a match is suggested to analyze the biomechanics of correct and inaccurate shots. It will therefore help to establish the causes behind any variations in shot precision and thus help to improve shot strategies and skills.

CONCLUSION

The findings of the analysis, in particular the valuable association between the total HSAT scoring and the total percentage accuracy and TR affirm HSAT, as an extremely relevant way to measure the accuracy and success of junior squash players relative to the overall tournament output. The high average shot count and the important similarities between the percentage precision of the BH drive and the HSAT performance both indicate the significance of being able to play the shot precisely and reliably. Although the only other HSAT shoot to display a meaningful connexon to the percentage accuracy of match shots was the BH Volley (which also had an essential TR link). This indicate that more HSAT confirmation could be necessary in potential inquiries utilizing greater topic numbers.

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