Original Article

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Practicing Badminton Serve with the Absence of Visual Feedback

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Authors' Contribution: A – Study Design, B – Data Collection, C – Statistical Analysis, D – Manuscript Preparation

Abstract

Introduction: The server in a badminton match is partly constrained by the accuracy of the outcome of his serves unless the opponent lets the shuttlecock impact the ground. Because the opponent hits the ball before the impact, the server has very limited feedback about the short serve accuracy. The short serve should be aimed as close as possible to the short service line. The practice can differ from the match conditions, as the serve is usually performed with various accuracy. *Aim of Study:* The aim is to find out if limiting the visual feedback affects the serve outcome in a badminton practice. *Material and Methods:* Ten competitive badminton players (29.4±5.7 years) with badminton experience of 10.4±3.9 years took part in the study. Altogether, each participant served 80 backhand short serves (20 with occlusion, 20 without occlusion, 20 without occlusion, followed by 20 with occlusion) on the court. Occlusion glasses blocked the server's vision in the moment of racket-shuttlecock impact. The shuttlecock impact on the court was recorded with the video camera and analyzed in Kinovea software. *Results:* The results showed a significant difference between the accuracy of serves without the occlusion (27.6±9.9 cm) compared to the visual occlusion (32.2±12.5 cm); $t(9)=2.43$, $p \le 0.05$, $d=0.43$. *Conclusion:* Visual feedback has a significant effect on the backhand short serve accuracy. Visual constrain of the serve outcome reduced the accuracy of the serves. In a practice match, the receiver could sometimes randomly let the shuttlecock impact the ground to provide feedback to the server.

Keywords: visual perception, occlusion, motor learning, game performance

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INTRODUCTION

Badminton rally is without the shuttlecock bounce on the court (in contrast to other sports like tennis etc.). Therefore, the player doesn't have full feedback about the shot accuracy [1]. However, the players often practice serve without an opponent and they can see serve impact. The serve initiates the rally in badminton and must be played according to the rules. This means that the serving player's racket head must face downwards when in contact with the shuttlecock and hit below the waist, an imaginary line at the level of the twelfth pair of ribs. The server executes an optimal diagonal serve which should force the opponent to hit a defensive shot such as a defensive clear shot [2]. The server can use different serve types with various shuttlecock trajectories [3], which are displayed in figure 1.

In modern professional badminton, there are on average 77 serves per match [4,5]. In male badminton and doubles, the backhand short serve is almost always used [6]. A correctly played short serve, whose shuttlecock's trajectory has the top of the curve in front of the net and just falls towards the line behind the net, makes it impossible for the opponent to react with an attacking shot and thus starts putting pressure on the serving player. The short serve should be aimed as close as possible to the short service line. Accuracy of the short serve is important, as the receiver either starts to attack if the serve has a high trajectory (flies higher above the net) or the server can make the mistake of having the serve too short (not reaching the short service line). Despite this fact to execute serve with these ideal characteristics and with no intervention of the opponent, the success of the serve meeting the criteria above are low. Additionally, in 240 attempts among eight national-level players in Australia, less than 30% of the serves were classified as correct (the trajectory peak of the curve was in front of the net), with two of these players failing to serve correctly in any of their 30 attempts [7].

Acquisition of visual information affects all aspects of movement - planning, control, and evaluation of movement [8]. Top athletes need to react quickly to the opponent's action [9-11]. As the shuttlecock doesn't bounce on the ground between the shots during the rally, it challenges receiver's visual perception system and quick decision-making, whether the short serve will land short or not.

In many fast sports games, it is a common phenomenon that the player's responding time to a stimulus is less than physiologically possible. Therefore, anticipation has been an important area of game performance [12]. Players use contextual or kinematic information to predict subsequent events associated with the ability to respond appropriately to such events [13-15]. Both of these pieces of information are further used to estimate the location of a fast-moving object and will lead to a subsequent reaction (shot) [16].

In interceptive sports such as tennis, softball, cricket, badminton, or squash, it has been proven that elite players can better anticipate the ball's flight path compared to lesser skilled players [17-19]. After the serve is executed, the receiver uses kinematic information about the shuttlecock's trajectory to anticipate its trajectory. The server usually doesn't have proper feedback about the serve accuracy, as he doesn't reach the information, where would the serve land, unless the opponent lets the shuttlecock fall on the ground. Therefore the server needs to rely only on inherent feedback [20,21].

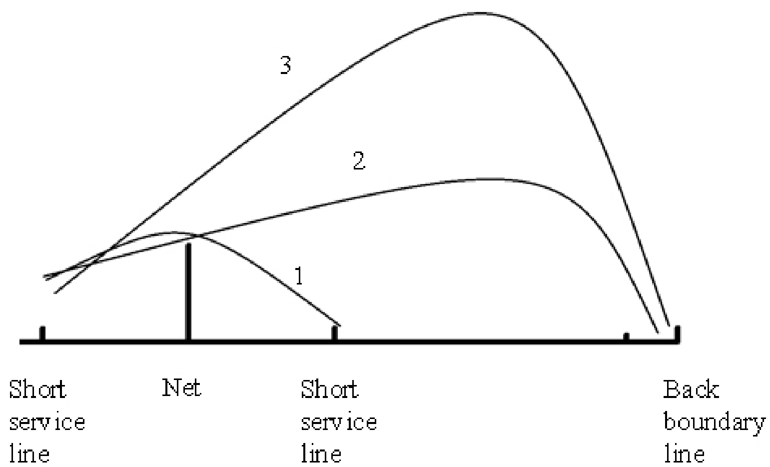

Figure 1. Badminton court profile and shuttlecock's trajectories of different serve types (1 - short serve; 2 - flick serve; 3 - forehand high serve).

Fast sports games take place under parallel constraints. For example, when serving in tennis, the receiving player must decide in a short time where to play the stroke, but at the same time must think about the exact location of the playing income at the ideal speed [16]. Badminton, unlike other interceptive sports where court-ball contact is allowed, is limited in another factor - the lack of visual feedback on the location of the shuttlecock's impact on the court, i.e. its accuracy of placement.

The presence of the opponent in most cases takes away the possibility of visual feedback on the impact of the shuttlecock because the shuttlecock is returned by the opponent. Thus, the player must rely on the imaginary point of impact of the shuttlecock observed from the trajectory and adjust the location of the strokes in case of possible inaccuracy. The player's experience is also important in this aspect, as the number of strokes is played more than two meters above the ground. He must monitor the location of the opponent when hitting the shuttlecock as well as the racket-shuttlecock impact point. The correct anticipation or feeling for the game in this regard can be one of the key factors in-game performance. The application is both in the correction of one's shots and in the estimation of the location of the opponent's shots and their eventual return or "release" on the ground [1].

In training conditions, practicing without an opponent is often used, where the server can use visual feedback on the impact of the shuttlecock on the ground to correct individual attempts. Vial et al. [7] suggested that serving training without the presence of an opponent, only concerning the impact of the shuttlecock, does not correspond to the match conditions. Where the position of the opponent not only affects the choice of service type but can also affect accuracy. The opponent, built closer to the service line, encourages shorter service, with great emphasis on the low flight height of the shuttlecock over the net. The serving player can thus gradually "test" to find out what short service the opponent will still play. However, this requires the player's maturity and excellent feeling.

The short backhand serve, which is the most common type of serve in men's badminton [6], the serving player does not receive full visual feedback on the accuracy of the service. Vial et al. [1] found, based on the computer modeling of the shuttlecock's trajectory from serves during competition matches of elite players, that even up to 33 % of short backhand serve would end too short, outside the designated serve area. However, the players often still practice the serve without an opponent. Based on mentioned above, we expect significantly better accuracy of serves without occlusion. The aim is to find out if limiting the visual feedback affects the serve outcome in badminton practice.

MATERIAL AND METHODS

Participants

The sample consisted of 10 right-handed male players playing with a right hand, aged 29.4±5.7 years, with a mean badminton experience of 10.4±3.9 years and practiced for at least 2 hours a week. The players were members of the local badminton league. The players were free of acute injuries that would affect the test in any way. This research was approved by the UK FTVS Ethics Committee. Each player voluntarily agreed to participate in this research and signed the informed consent.

Procedures

The experiment took place on a badminton court. The participants were explained details of the experiment and all of them agreed to participate voluntarily. Firstly, they had a standard badminton warm-up including stretching and hitting for about 10-15 minutes. Each participant was instructed to have four serving sessions of 20 short backhand serves from the right serving side. There was a 2-minute break between the sessions. The first and fourth sessions were under the occlusion condition. This design was selected to ensure the counterbalancing effect [22,23].

The participants wore Plato occlusion glasses (Translucent Technologies Inc., Canada), which occluded their vision at the racket-shuttlecock contact. Therefore, they did not have any visual feedback related to the flight of the shuttlecock and its impact on the ground. After the shuttlecocks impact on the ground, the shuttlecock was removed from the court and the participant could see until the next racket-shuttlecock contact. Before each serve, participants were instructed to walk a short distance (2 m) to get the next shuttlecock so that the player would have to re-prepare for the starting position. The second and third session was without any occlusion, using the same procedure.

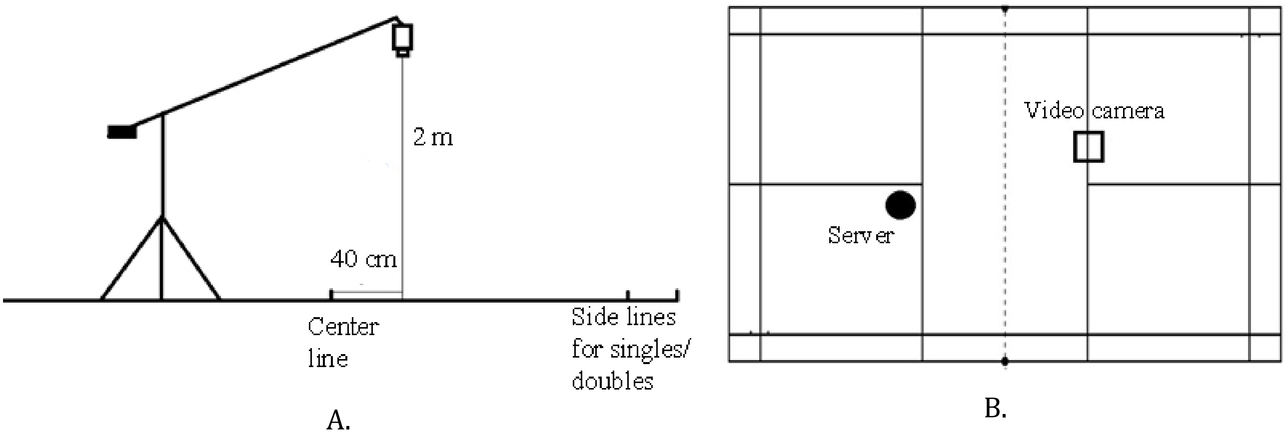

Figure 2. A. On-court video camera set-up (view from the back of the court), B. On-court video camera set-up.

All the trials were recorded with a video camera Sony HDR-CX405B. The video camera was placed on a tripod directly above the short line a height of 2 meters and 40 cm from the center line (see figures 2). Before each testing, a calibration procedure was done.

Statistical analysis

Altogether we analyzed 800 serves. Firstly, we counted all serves that were “in” and “out” (too short). Secondly, we measured the closest distance of the shuttlecock impact distance from the outer edge of the short service line (closer to the net). The data obtained from the video recordings were evaluated in the Kinovea software (version 0.9.5) and processed into SPSS 14.0 software. Descriptive characteristics (mean, standard deviation, and 95% confidence interval) were used in the analysis. Using the mean values from each participant under both conditions, we calculated paired samples t-tests and Cohen *d* [24].

RESULTS

Impact locations of all the 800 serves are displayed in figure 3. From all the serves we observed, there were 20 outs when the vision was occluded and 26 outs under normal conditions (for details of each participant see table 1). There were found no more than 4 serve errors per the condition of each participant. All other serves landed into court designated serve area.

Descriptive statistics of the serve distance under occluded and normal visual shows table 2. The participants reached better serve accuracy under normal vision. Paired sampled t-test showed significant difference between the occluded condition (32.5±23.9 cm) and normal condition 27.7±20.8 cm) $t(9)=2.4$, $p \leq 0.05$, $d=0.42$. The participants served further from the short service line under occlusion conditions.

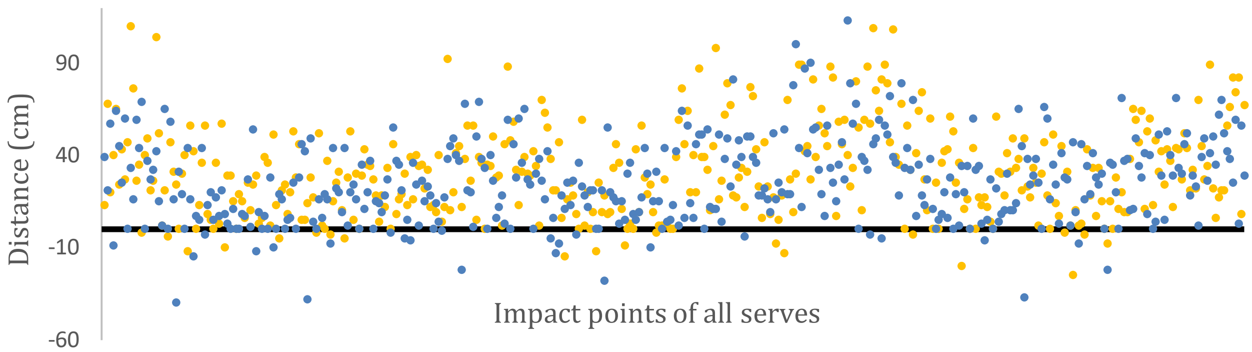

Figure 3. Impact locations of all serves (Yellow points – Occluded condition; Blue points – Normal condition). Value zero indicates the short service line (negative values mean too short serves).

Table 1. Number of serve outside the designated service area (too short serves).

Participant	Number of outs	
	Occluded vision	Normal vision
1	3	4
2	4	4
3	1	4
4	0	4
5	4	3
6	2	1
7	0	2
8	2	1
9	4	3
10	0	0
Mean	2.0	2.6
Standard deviation	1.6	1.4

Table. 2. Descriptive statistics of occluded and normal conditions.

Condition	Mean	SD	Min	Max	95% Confidence Interval	
					Lower	Upper
Occluded vision	32.5*	23.9	16.2	56.9	17.69	47.31
Normal vision	27.7	20.8	13.6	47.5	14.81	40.59

Significantly different to normal vision condition, $p \leq 0.05$.

DISCUSSION

The aim of this study was to find out if limiting the visual feedback affects the serve outcome in badminton practice. The accuracy of the serve reached significantly better results when the feedback about the shuttlecock impact was provided. This can happen only during the practice sessions or very rarely during the match. Therefore, this serving practice without the opponent doesn't correspond to the match condition [7].

At the top level of performance, it was found that the accuracy of the strokes can be affected by the presence of the opponent on the court [25] - not only by his court positioning and strategy but can also build a psychological pressure on the server as well [15]. As a general observation, the visual feedback also affected the trajectory of the serve. Although the exact data were not monitored, it was clear to the experienced observer, that the participants played the serve with a higher trajectory during the occlusion condition (this fact is supported by significantly higher mean values of distance from the short service line, which may indicate that participants tried to hit the serve „more safely“ when they did not have the feedback about serve outcome). Additionally, they did not meet the criteria of an effective serve mentioned above [7]. The shuttlecocks flew higher over the net higher compared to normal conditions. This could happen due to not using a receiver on the court in this design. Compared to research in match conditions in elite badbinton [1] where around 33 % serves that are returend by the receiver would be too short, we revealed only 10-15 % too short serves in practice condition in our experiment. This is supported by Rojas et al. [26], who found that the presence of an opponent caused a different trajectory of a basketball shot. This phenomenon could be the subject of further research in badminton.

Removing visual information about an opponent's action eliminates the possibility of anticipation and the athlete is forced to make his counter-action only on pure reaction [10,27,28]. However, removing visual information about own motor action in darts had positive effect on visual prediction outcome of dart throws of another persons [29]. The authors stated, that motor simulation during the perceptual task, which allows the motor-action to predict the landing position of a dart through activation of their own motor system. For expmle in tennis, small differences have been found when testing a ball toss during a tennis serve. The players achieved virtually identical results with their eyes closed in practice or match conditions [30,31]. However, the badminton serve shares certain features with this ball toss. Both actions take place without the server visually checking opponents' position in the phase immediately before racket-ball/shuttlecock contact. However, the tennis serve can be considered as an open skill, with the inclusion of the ball toss, which is considered as a closed skill. Despite this, the badminton short serve results to be closed skill. One of the practical recommendations could be that serve practice should include shuttlecock trajectory observation or using training methods of stretching a rope or tape over the net. The shuttlecock should fly between the rope and net and consequently land in a marked place on the court [32].

This study has some limitations. As we discussed above, we focused on the practice condition and not on match conditions where the opponent is present. Furthermore, the research design was focused only on the impact of the shuttlecock, which is only one of the factors of optimal short serve, and the trajectory characteristic such as peak height above the net was not monitored. For further research of badminton serve, we recommend linking the shuttlecock impact with the presence of the opponent to get as close as possible to the match conditions. A comprehensive view of the serve following the impact point impact of the shuttlecock as well as the trajectory could bring important results and evaluate the effectiveness of the service training in the training conditions. From a motor learning perspective, the response to alternating tests with occlusion and under normal conditions could be further examined - whether there is an improvement in performance during both forms of the tests.

CONCLUSION

This study demonstrates a significant effect of visual feedback on short backhand serve in badminton. Limiting the visual feedback at the serve location caused a significant reduction in the accuracy of the backhand short serve in practice. To deliver a practical application, we suggest, that visual feedback about the serve impact location could be sometimes provided in a practice matches to improve the accuracy of the serves. The receiver could sometimes occasionally (randomly) let the shuttlecock impact onto the court during the practice match in order to provide feedback to the server.

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