IMPLICATIONS FOR PHYSICAL PREPARATION OF CADET MALE TABLE TENNIS PLAYERS: ANALYSIS OF THE 2013 ASIAN CHAMPIONSHIP SINGLES FINAL

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The purpose of this case-study was to attain and describe data on the physical demands placed on elite Asian cadet male table tennis players in high-level competition. The 2013 Asian cadet singles final was notated live while the match was video recorded for further post-analysis. A typical point consisted of 4-5 shots with the player activated for 3.2 s, working for 3.3 s and resting for 17.8 s on average. The frequency of movement types was reported and typical footwork patterns were described for the most common movement types observed (step, linear jump, lateral jump and pivot). Typical footwork sequences were presented for the first two movements when serving and returning. This information could be used to inform a strength and conditioning programme for a developing cadet player seeking to replicate a playing style of an elite Asian cadet player.

KEY WORDS: Table tennis, Cadet, Asian, Physical preparation.

INTRODUCTION: Playing a table tennis match requires considerable physical effort (Zagatto et al., 2010). A strength and conditioning programme specific to the physical demands of the sport is therefore essential to underpin performance at a high level. Video and notational analysis can be used to inform a needs analysis for a sport (Hughes & Bartlett, 2002). In the scientific literature, notational analyses have focused on elite adult table tennis players (e.g. Zagatto et al., 2010; Malagoli Lanzoni et al., 2013). However, it is well accepted that any strength and conditioning programme should be specific to the developmental age of the player and account for distinct differences between adults and adolescents (Lloyd & Oliver, 2013). The purpose of this case-study was to gather data on the physical demands placed on elite Asian cadet male table tennis players in high-level competition. This case-study focused on the two best players who reached the singles final as they set the benchmark for physical performance required to be an elite Asian cadet male table tennis player. This information could then be used to inform a

strength and conditioning programme for a developing cadet player seeking to replicate a playing style of an elite Asian cadet player, and as a platform for future biomechanics research.

METHODS: Permission and ethical approval was granted by the organizing committee of the 2013 Asian Cadet Championships to film and analyze the final match of the male cadet singles competition. The two finalists ranked as the 9th and 12th best cadet players in the world for September 2013 by the International Table Tennis Federation. The 9th ranked player won 4-2 in sets with all six sets analysed. All results were expressed as the mean of the two players.

A Casio ZR1000 camera recording at 60Hz was fixed on a tripod directly behind the table at each end on an elevated gantry and recorded for the entire match (Fig. 1). Prior to the match starting a grid of rubber tubing (Fig. 1) was placed on the floor at each end of the table. A video image was taken at each end of the table to enable retrospective analysis of the footwork. Each square measured 0.425 m x 0.425 m, with the total area being 6.503 m^2. The video of the footwork grid was used to overlay a virtual grid on the match video (Dartfish, Fribourg, Switzerland) since the same camera with matching field of view was used. For each movement during a point, the start and end grid references (Fig. 1) were notated with letters A-D representing the linear position of the majority of the foot and the numbers 1-9 representing the lateral position of the majority of the foot. The frequency of each movement type was recorded.

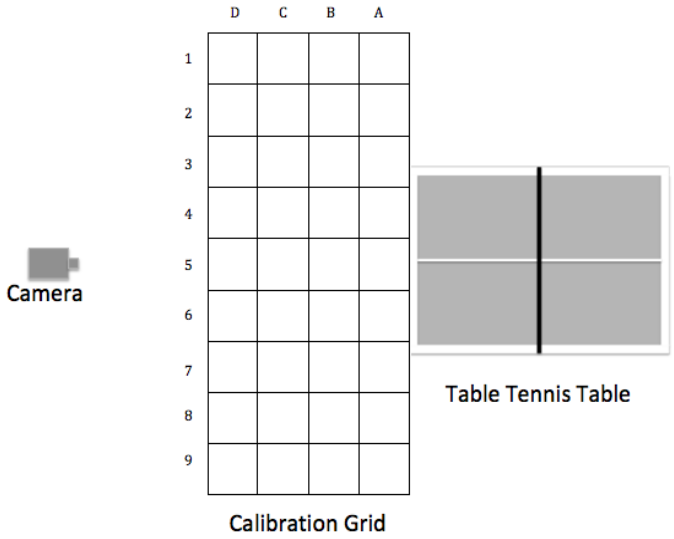

Figure 1: Schematic of camera setup, footwork grid and table

Five movement types as defined by Malagoli Lanzoni et al. (2013), being the step, chassè, slide, pivot and crossover, as well as four additional categories were included in the analysis. The pivot and jump was defined as a dynamic movement in which the body was displaced around its vertical axis in a rotational airborne manner. The lateral lunge was defined as a large step to the

side using the foot corresponding to the direction of movement with no movement of the other foot. The lateral jump was defined as a double-footed take-off and landing in which the displacement of the body was more lateral than linear. A linear jump was defined as a double-footed take off and landing in which the displacement of the body was more linear than lateral. A highly-qualified and experienced table tennis coach reviewed the video to provide insight as to when and why these movements occurred during a point.

The match was notated electronically using iCoda2 (Sportstec, Sydney, Australia) in order to calculate the duration of time spent during activation, work and rest. Activation was defined as the time spent in anticipation of the serve, starting when the returner was set in an isometric half-squat position and ending at the initiation of serve (ball leaving the hand). Duration of work was defined as the time between initiation of the serve motion and the point ending (ball bouncing on a surface having not been successfully returned to the opponent's side of the table). Rest was subsequently defined as the time between the point ending and activation commencing. If an optional time-out occurred in a set, the rest time was taken as the average of all other rest times for that set to better reflect a typical point.

RESULTS: For each point the mean and maximum (max) number of shots and times for activation, work and rest are reported in Table 1.

Table 1

Number of shots and times for activation, work and rest per point (mean and max)

	mean	max
shots (n)	4.4	21
activation (s)	3.2	10.1
work (s)	3.3	12.3
rest (s)	17.8	32.0

The mean resting time between sets was 65.2 s.

The frequency of movement types occurring in the match is reported in Figure. 2.

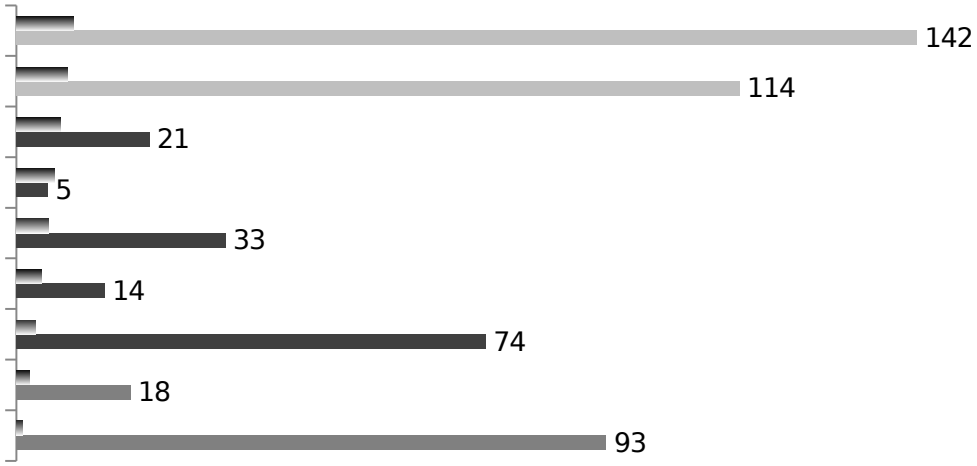

Figure 2: The frequency of movement types occurring in the match

Start and end grid references for the four most common movement types (step, linear jump, lateral jump and pivot) are reported (Table 2). The first letter and number couple corresponded to the grid reference (Figure 1) for left foot placement and the second letter and number couple corresponded to the grid reference for right foot placement.

Table 2

Typical footwork pattern for the most common movement types during a point

	start	finish
step	B1,B3	B1,A3
linear jump	C1,C3	A1,A3
lateral jump	B1,B3	B3,B5

pivot	C2,C4	A1,C2

The most common movement sequence at the start of a point for a server was a pivot (from the left corner in to the middle of the table baseline) followed by a linear jump (away from the net). This occurred sequentially in 61% of points in the match. The most common movement sequence at the start of a point for a returner was a step (towards the table) followed by a linear jump (away from the table). This occurred sequentially in 30% of points in the match.

DISCUSSION: The purpose of this case-study was to attain and describe data on the physical demands placed on elite Asian cadet male table tennis players in high-level competition. The mean number of shots per point was between 4 and 5. Each point lasted 3.3 s on average reconfirming the dynamic nature of the sport**.** These findings are similar to Drianovski and Otcheva (2002) who looked at elite senior Asian male players from 1998. The speed of the game has increased considerably over the last decade (Kondric et al., 2013) as shown by players in this case-study playing at a comparable speed to elite senior players of 15 years ago. The present case-study shows an elite Asian cadet male player must be able to sustain near maximal effort for in excess of 12 s in which time over 20 shots may occur. A player must recover sufficiently to be able to work again within 17.8 s. The resulting work:rest ratio of 1:5.5 was higher than that reported of elite senior European male players in the final of a national championship of 1:3.7 (Pradas et al., 2011). Senior players may decide to rest less between points due to superior fitness levels. However, this could also be a reflection of Asian players more attacking and physically demanding style of play described by Malagoli Lanzoni et al. (2013). In the present case-study, the activation period prior to the start of the point was calculated. A mean activation period of (3.2 s) added considerable time in which the receiver sustained effort in an isometric half-squat position in anticipation of the point starting.

Footwork analysis showed that elite cadet table tennis involved multiple linear, lateral and rotational movements for high-effort but short intensity bouts. This has clear implications for a physical conditioning programme (Lloyd & Oliver, 2013). After review of the video and input from a highly-qualified and experienced table tennis coach, footwork patterns could be explained. The linear jump was the most common movement type and was used by a player to re-set his position relative to the table in anticipation of the next shot. The step was used to return the serve or attack a subsequent shot close to the net at the start of a point as observed by Malagoli Lanzoni et al. (2013). The lateral jump was frequently used to move sideways quickly to perform a variety of offensive and defensive shots. The pivot was mainly used to perform attacking

forehand shots from the backhand corner and its frequent occurrence demonstrated the attacking nature of rallies amongst these elite Asian cadet players.

By providing the associated grid references, a coach has knowledge of the displacement changes of the feet for the common movement types and can replicate these sport and playing style-specific movements in a controlled environment. Typical sequences of movement for the serve and return are also provided to facilitate a programme focused on allowing the player to be in the most favorable position to hit the ball in a technically sound manner.

CONCLUSION: In a table tennis final match between two of the best Asian cadet male table tennis players, points typically lasted 4-5 shots and comprised linear, lateral and rotational movements each performed in less than a second. This pattern is indicative of a fast attacking style of play. The activation period of isometric contraction was considerable and should also be accounted for by the coach in a strength and conditioning programme.

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