

# Relationships between the performance of the forehand groundstroke and the one-hand or two-hand medicine ball throw.

Cyril Genevois, Thibault Pollet & Isabelle Rogowski.

University of Lyon, France.

## ABSTRACT

The goal of this research was to study the relationships between maximum ball speed post-impact in the forehand groundstroke and the performance of the one-hand and two-hand medicine ball throw. Ball speed in the forehand groundstroke significantly correlated with the values obtained for lateral one-handed throw (0,40 - 0,59), but not two-handed throw (0,01 - 0,29). These two different types of lateral throws would allow diverse training goals and should, according to the results of the present study, be used in distinct and specific moments of the training periodization.

**Key words:** Baseline, Ball speed, Physical conditioning, Correlational analysis.

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**Corresponding author:** Cyril Genevois, University of Lyon, France.

**Email:** [cyril.genevois@aol.fr](mailto:cyril.genevois@aol.fr)

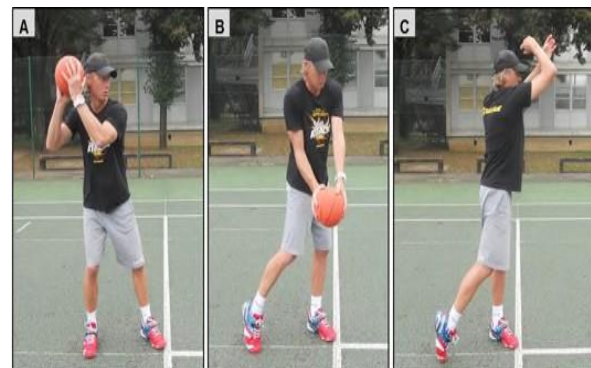
## INTRODUCTION

Based on the style and touch while played with wooden racquets, tennis has come into what Kovacs (2010) defines as the « physical era ». Generating power or high ball speeds has become a determining factor in the success of tennis at elite level (Pugh, 2003). After the serve, considered as the key of modern tennis play (Magnus, 1999), the forehand groundstroke has a predominant position in the construction of the point (Brabenec, 2000, Johnson et al, 2006). High performance tennis players use this stroke to dictate the point playing with power and precision to strategic zones of the court in order to overpower their opponents (Roetert, 2009). Players run around their backhand to hit with their “inside out” forehand, and the best ones are able to cover up to 85% of the court with their forehand groundstroke.

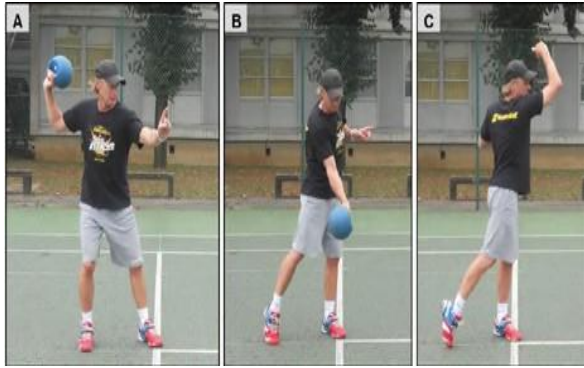
Recent studies have shown that the different rotational speeds of the hips and trunk at impact distinguish different ball speeds post- impact in the forehand groundstroke (Landlinger et al, 2010; Seeley et al, 2011). In order to improve this performance factor, Roetert et al. (2009) recommend the use of a medicine ball (MB) laterally and with two-hands (MB2) (figure 1), simulating the different positions that occur during tennis play.

These throws allow the player to improve the stroke movement while respecting the cinematic chain, especially the transfer of energy generated by the lower body towards the hitting arm.

A training regime that uses these throws has shown its efficiency in improving the batting speed in baseball (Szymanski et al, 2007). However, holding the MB with two-hands reduces the degree of freedom in the dominant arm as compared with a forehand groundstroke. Besides, to our knowledge, there has not been any research that has confirmed the benefits of these throws on the speed of the ball in the forehand groundstroke. Conversely, by using a MB with a handle, which allows the one-handed throw (figure 2), Genevois et al. (2013) have shown a significant improvement in post-impact ball speed of around 11% after a 6 week training programme.



**Figure 1. Lateral medicine ball throw with two-hands simulating a forehand groundstroke with a preparation phase (A), acceleration (B), and follow through (C).**



**Figure 2. One-handed lateral medicine ball throw simulating a forehand groundstroke with a preparation phase (A), acceleration (B), and follow through (C).**

It seems interesting to us to study the relationships between two lateral MB throwing techniques, one- and two-handed (MB2 and MB1), and the maximum ball speed post-impact in the forehand groundstroke in order to determine the pertinence of their use with the goal of improving the performance of the forehand groundstroke.

**METHOD**

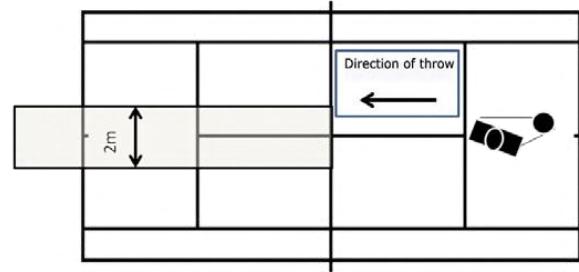
After a standardised warm up, 20 adult tennis players (age: 23.3 ± 4.2 years, height: 179.1 ± 0.07 cm, weight: 69.3 ± 7.7 kg, years of experience: 11.6 ± 5.5 years, tennis: 2.5 ± 1.04 hours, conditioning: 1.7 ± 1.3 hours, ranking between 30/4 and 2/6) performed a performance test of the forehand groundstroke and the MB1 and MB2 throws, as part of an evaluation programme of their training regime.

The performance test of the forehand groundstroke (Genevois et al., 2013) consists of measuring the ball speed post-impact of 10 crosscourt shots played at maximum speed using a radar (SR 3600; Sports-radar, Homosassa, FL, USA). The mean of the two fastest strokes played inside the court was used for the statistical analysis.

The lateral MB one and two-handed throw test was performed randomly with medicine balls of 1.5, 2, 3, 4, and 5 kg of weight. A 2 m wide target was drawn on the ground of the opposite court to direct the throw; the crosscourt positioning of the target allowed for a throwing angle close to 45° (figure 3). 3 attempts were made for each weight. The longer distance achieved within the limits for each weight of MB and for each throw type was used for the statistical analysis.

Pearson correlation coefficients (r) were calculated to determine the different relationships between maximum ball speed in the forehand groundstroke and the maximum distance achieved in the throws MB1 and MB2 for each weight. Statistical analyses were performed using the computer

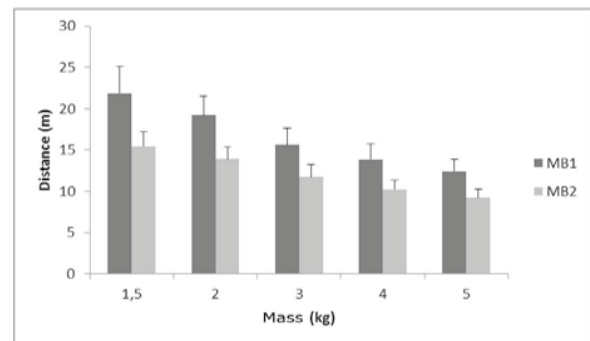
package SPSS 11.0 (SPSS, Inc., Chicago, IL, USA), and the significance value was set at p≤0.05.



**Figure 3. Experimental conditions for the medicine ball throws. Example of a two-handed throw (MB2).**

**RESULTS**

Regardless of the throwing technique, performance diminished with the increase of the mass of the MB (Figure 2). Distances achieved with MB1 were superior to those with MB2 regardless of the weight (figure 4).



**Figure 4. Mean results (± typical deviation) achieved with lateral one-handed (MB1) and two-handed (MB2) medicine ball throws with different masses.**

Correlation coefficients between maximum ball speed in the forehand groundstroke and the distances achieved for each mass of MB are shown on table 1. All the correlations were significant between the forehand groundstroke speed and the maximum distances achieved with MB1, whereas no significant correlation was observed between forehand groundstroke speed and maximum distances with MB2.

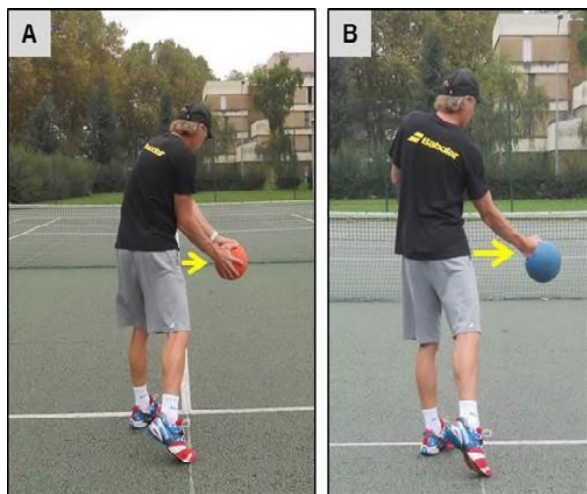
	MB1					MB2				
	1,5 kg	2 kg	3 kg	4 kg	5 kg	1, 5 kg	2 kg	3 kg	4 kg	5kg
FH	0.59**	0.43*	0.44*	0.45*	0.57**	0.24	0.23	0.01	0.29	0.16

**Table 1. Correlation coefficients between ball speed in the forehand groundstroke (FH) and distances achieved in the lateral one-handed (MB1) and two-handed (MB2) throws for each mass used with \*p≤0.05 y \*\* p≤0.01.**

## DISCUSSION

The main results of this study have shown on one-hand that, for each mass, the distances achieved with MN1 have been superior to the ones achieved with MB2 and, on the other hand that the lateral MB one-handed throws have significantly correlated with the performance of the forehand groundstroke.

The shorter distances achieved by the two-handed MB throws could be explained due to the less length of the lever on this type as compared to the one-handed throw, which would imply a shorter trajectory to accelerate the ball prior to its projection (figure 5).



**Figure 5. Length of the lever arm is reduced with two-handed throws (A) when compared to one-handed throws (B).**

Thus, the fact of holding the MB with two-hands would considerably limit the contribution of the shortening/lengthening cycle of the back muscles, and the results obtained with the two-handed throws would therefore be more representative of the speed generated by trunk rotation (Ikeda et al., 2007; Ikeda et al., 2009). In fact, in order to do this, the MB is located closer to the vertical rotational axis as compared to the one-handed throw, reducing in this way its moment of inertia and favouring a greater rotational speed for a given mass. On the other hand, the lack of a significant relationship between the results of the two-handed throws and the forehand groundstroke (Table 1) could be explained due to the limited contribution (10%) of the trunk in the generation of racquet speed in the forehand groundstroke (Elliott et al., 2009). Furthermore, at impact in the forehand groundstroke, Elliott et al., (1997) have shown that the racquet speed is generated mainly both by internal rotation (40%) as well as horizontal flexion of the arm (34%). A split of the contributions of trunk/arm could happen in the case of the one-handed MB throw. This cinematic identity could explain the significant relationships found in the results obtained among the

forehand groundstrokes and the one-handed throws (Table 1). Indeed, the way of holding the MB would allow for more freedom and movement amplitude of the arm which would be very similar to the impact of the forehand groundstroke.

As per the periodisation of training, these results allow to better define the goals of improvement related to the use of one-handed or two-handed MB throws. The two-handed throws should be used to improve the explosive rotation of the trunk. A higher trunk rotation speed contributes to an increase of the speed of the back forward and, therefore, of the racquet at impact (Seeley et al, 2011). However, the lack of direct relationships between the forehand groundstroke results and the two-handed MB throws makes it recommendable to use these drills during the general preparation phase of the player.

Indeed, the lesser degree of freedom of the dominant arm reduces the contribution of the anatomical rotations of the arm during the movement, reducing the possibilities of specific transfer to the movement of the forehand groundstroke. As per the one-handed MB throws, they allow to simulate the advantage of the coordination of the forehand groundstroke in order to transfer the improvements to the movement, this would justify the use of these drills during the specific preparation phase of the player. Besides, the one-handed MB throw could be included in the tennis specific physical tests protocols as an evaluation test representative of the performance of the forehand groundstroke.

The results of this study should be used with caution due to the characteristics of the sample, adult amateur players, and could not be generalised to the overall tennis population. It would then be needed to enlarge this research by using female tennis players, players of better level of play, and junior players of specific age groups.

## CONCLUSION

The results of the present study have shown that the ball speed post- impact in the forehand groundstroke correlates significantly with the distance achieved with the lateral one-handed medicine ball throws, and no relationships were shown with the two-handed medicine ball throws. Therefore, the two-handed medicine ball throws could be planned mainly during the general preparation phase of the player. whereas the one-handed medicine ball throws could be planned during the specific preparation phase of the player.

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