



Proposal and evaluation of a practice session including a learning tennis wall

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ABSTRACT

Tennis is a challenging sport to learn. Novice children players (5-8 years old) need a certain amount of practice to reach both consistency and mastery in their strokes. In an attempt to support the coach and help the players to remain active, ©Artengo designed an equipment consisting of increasing the hitting volume during a practice session: The Tennis Wall. The objectives of the present study were i) to propose a practice session including the use of the Tennis Wall, ii) to evaluate the influence of adding the Tennis Wall on the hitting volume in a practice session with novice children tennis players. A practice session with the Tennis Wall allowed to hit about 3 times more balls for each young tennis player compared with a traditional practice session. Although the results of this study need to be confirmed with a larger sample of participants and more training sessions, they suggest that the Tennis Wall can be an interesting support to learn tennis due to the increased repetition of strikes which contributes to skill acquisition.

Key words: Skill acquisition, constraints based approach, pedagogical equipment, exercises

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INTRODUCTION

Tennis is a challenging sport to learn due to its multidimensional nature, requiring the acquisition of complex technical and tactical skills (Kolman et al., 2019; Reid et al., 2007). Current recommendation from the International Tennis Federation for tennis coaches is to favor children novice players to perform a large volume and variety of strokes during their practice sessions (www.tennisplayandstay.com). It was demonstrated that the improvement in performance during the early learning stage is produced by repetitive practice of the tennis shots (Menayo et al., 2010). Blocked-practice sessions with repetition were shown to be effective in improving the forehand performance of younger or less skilled players, particularly in the immediate term (Farrow & Maschette, 1997; Menayo et al., 2010). The results of these studies suggest that novice players need a certain amount of repetition to reach both consistency and mastery in the task before benefitting from less predictable and more game-like practice exercises (Reid et al., 2007).

Based on the constraints-led approach of learning, three elements (task, environment and individual) can be manipulated to help the acquisition of specific skills (Newell, 1986; Regan, 2021; Renshaw & Chow, 2018). It was shown that modifying the environment (i.e. court dimensions, net height, kind of balls, racket properties or presence of an opponent) had an influence on biomechanics, game tactics and success rate of young tennis players (Buszard et al., 2016; Fadier et al., 2022; Herbaut et al., 2023; Kachel et al., 2015; Limpens et al., 2018; Larson & Guggenheimer, 2013; Shafizadeh et al., 2019;

Timmerman et al., 2015). Specific task constraints can be used to allow the learner to focus on the emergence of specific information-movement couplings and to discover new solutions to solve a problem (Reid et al., 2007). In a guided-discovery lesson, the teacher provides a temporary structure (constraint) that assists or supports the child to successfully perform the skill (Newell & Rovegno, 2021).

One solution which supports the coach to change the environment and to teach the tennis technique to novice players is the use of a rebounder net, which is usually a heavy structure put on the tennis court. In an attempt to increase the hitting volume during the tennis practice sessions and to ease the use of this kind of solutions, ©Artengo designed an equipment called: The Tennis Wall (Figure 1). It consists of an inflatable structure with stretched and inclined canvas on which the player can send the ball and see it coming back to hit it again. The claimed advantages compared to a traditional wall is that it allows the player to perform strong strikes and still have the time to place correctly for the next strike thanks to the attenuation of the impact by the canvas and the inflated tube that allows the ball to come back and bounce quite high. It is also believed that the Wall creates an environment constraint which forces the players to hit the ball on the side of the body with a proper forward swing and frame orientation at ball contact to avoid sending the ball above it, promoting both an efficient forehand technique and a more aggressive gameplay (Reid et al., 2013).



Figure 1. Player repeating forehands against the Tennis Wall

The objectives of the present study were i) to propose a practice session including the use of the Tennis Wall, ii) to evaluate the influence of adding the Tennis Wall on the hitting volume in a practice session with novice children tennis players. It was hypothesized that training with the Wall increases the hitting volume, which should support the acquisition of forehand technical skills and improve performance.

METHODS AND PROCEDURE

Participants

Twenty-four participants were involved in this study. They were distributed in 4 groups of 6 players (2 groups of red level and 2 groups of orange level). The criteria of inclusion were being aged between 5 and 8 years old, being injury-free and having less than 2 years of tennis experience. Parents were informed about the experimental procedures and the right to withdraw their child from the study during or after the experiment. They gave written consent for their child's participation and the data collection.

Procedure & Task

Children participated in two practice sessions designed by a tennis coach, one week apart in a counterbalanced order. The specific skills to work in both practice sessions were the hitting plan (forward and lateral of the body) and the frame orientation of the racket at ball contact when performing forehands. The sessions were both composed of an observational situation (PRE-Test), 3 tennis-blocks (TB#1, TB#2 & TB#3) and a final evaluation (POST-Test) (Figure 2). The experimental session consisted of a training session with the Wall. The control session consisted of exactly the same training session but the block-practice against the Wall (TB#3) was replaced by a task of forehands with balls sent by each player himself, in autonomy, to the other side of the court. Balls used during the training session and court dimensions were adapted to players' level (Red balls and 11x5.5-meters court for Red-level players, Orange balls and 18x8.2-meters court for Orange-level players).

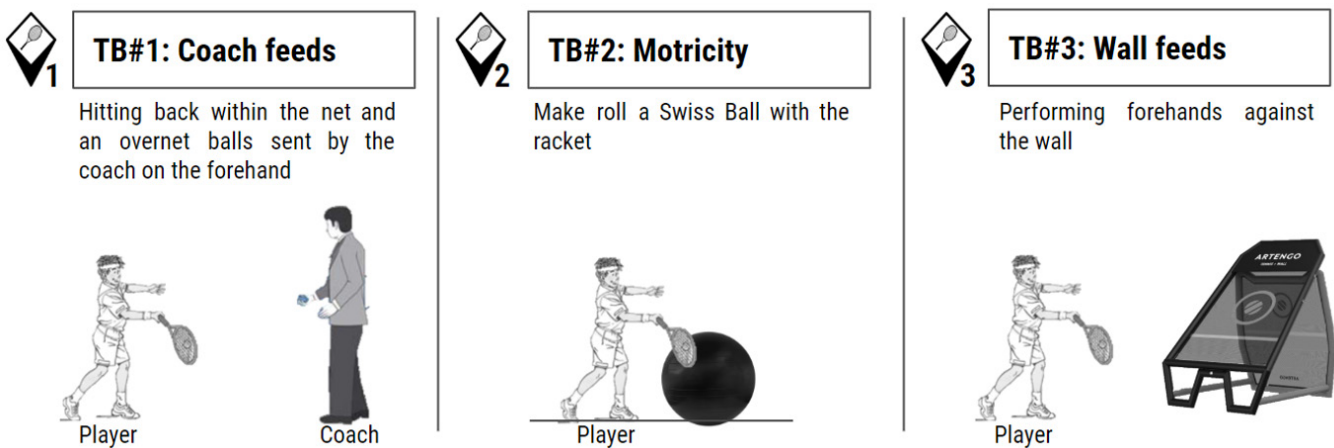


Figure 2. Tennis blocks (TB) used during the practice session with the Learning Wall.

PRE-Test (Observational situation)

- Objective: Observation of the difficulties encountered by the players and measurement of their initial performance.
- Duration: 6 minutes
- Description: The coach sends 10 balls to each player (ball color corresponding to player's level), who performs forehands with the aim to send them back to the other side of the court and within the net and an overnet placed 1 meter above the net.

Tennis Block #1: Coach feeds the ball

Same setup as the observational situation.

- Objective: Working on gesture quality.
- Duration: 12 minutes
- Description: The coach sends balls to each player, who performs forehands with the aim to send them back to the other side of the court and within the net and an overnet placed 1 meter above the net.
- Points of vigilance: Make sure that the player executes the right movements, with a proper hitting plan and with the intention to send the ball in the desired area

Tennis Block #2: Motricity

- Objective: Working on motricity and providing sensations.
- Duration: 12 minutes
- Description: The player rolls a gym ball (65 cm-diameter) forward with the racket, always keeping the gym ball forward and laterally of the body, and starting to push the gym ball from below.
- Points of vigilance: Make sure that the player keeps the contact on the gym ball with the racket from the beginning to the end of the gesture to accompany the gym ball progression.

Tennis Block #3: Wall feeds the ball

- Objective: Working on repetition to develop consistency.
- Duration: 12 minutes
- Description: The player hits forehands against the Wall, which sends the ball back to him repetitively. It is important to have a good acceleration during the forward swing and a correct frame orientation at ball contact.
- Points of vigilance: Make sure that the player keeps a sufficient distance with the Wall to favor correct placement and forward swing.

POST-Test (Final evaluation)

Same setup as the observational situation.

- Objective: Evaluate the performance evolution of the players.
- Duration: 6 minutes
- Description: The coach sends 10 balls to each player, who performs forehands with the aim to send them back to the other side of the court and within the net and an overnet placed 1 meter above the net.
- Points of vigilance: Make sure that the player executes the right movements, with a proper hitting plan and with the intention to send the ball in the desired area

Variables of interest & Data analysis

- Hitting volume: the total number of balls struck by each participant during the 1-hour practice session was recorded by the experimenters.
- Performance score progression: the score during the PRE-test (observational situation) and the POST-test (final evaluation) were measured. Out of the 10 balls fed by the coach, 1 point was granted when a ball was sent back on the other side of the court and passed within the net and the overnet. The performance score progression was computed as POST-test score minus PRE-test score.

All statistical analyses were done with XLSTAT (©Addinsoft Inc, NY, USA). Normality of data distribution was checked with a Shapiro-Wilk test. A 2x2 Repeated-measures ANOVA (repeated measure: Wall vs. No Wall, fixed factor: Red vs. Orange level) was conducted to evaluate the effectiveness of the Wall and the effect of game level on the 2 variables of interest. When a significant difference was found, t-tests with Bonferroni correction were applied. The significance threshold was set at $p < 0.05$.

RESULTS

Hitting volume

In terms of hitting volume, the repeated measures ANOVA revealed a significant main effect of players' level ($F_{1,25}=34.4$, $p < 0.001$), significant main effect of Wall condition ($F_{1,25}=68.2$, $p < 0.001$) and a significant interaction effect ($F_{1,25}=13.1$, $p < 0.001$). On average, the hitting volume increased by 289% for a practice session with the Wall compared to a practice session without the Wall ($p < 0.001$). The hitting volume increased more for Orange level players (+316%, $p < 0.001$) than for Red level players (+243%, $p = 0.025$) (Figure 3).

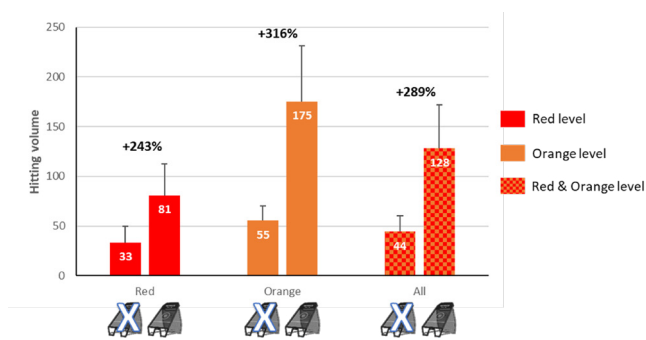


Figure 3. Hitting volume during the practice session without and with the wall (red: mean of the players with a red level, orange: mean of the players with an orange level, red/orange: mean of all the players).

Performance score progression

In terms of performance score progression, the repeated measures ANOVA showed no significant main effect of players' level ($F_{1,25}=1.1, p=0.305$), no significant main effect of Wall condition ($F_{1,25}=0.0, p=1.000$) and no significant interaction effect ($F_{1,25}=1.9, p=0.183$). The performance score between PRE-test and POST-test was not statistically significant but tended to improve both for a practice session without the Wall (+0.7 points, $p=0.054$) and with the Wall (+1.1 points, $p=0.054$) (Figure 4).

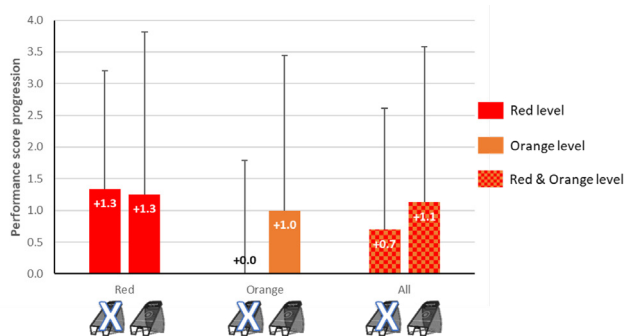


Figure 4. Performance score progression during the practice session without and with the Wall (red: mean of the players with a red level, orange: mean of the players with an orange level, red/orange: mean of all the players).

DISCUSSION

The objective of the present study was to evaluate the potential benefits for novice children tennis players to practice tennis in a training session including the use of a Tennis Wall compared to a traditional training session. The initial hypothesis that a training session with the Wall allowed increasing the hitting volume of novice children players was validated. It was observed both in red and orange level players but it seems that players with a higher level benefit even more from a practice session with the Wall, likely because they have a better capacity to make long rallies against it. Actually, increasing the number of strikes during tennis training sessions is crucial both to build the fundamental motor programs and to enhance the enjoyment of the players, which is key to keep them active and motivated to play tennis over the long-term (Anderson et al., 2009). It was shown that repeating tennis shots was effective in improving the forehand performance

of young novice tennis players (Farrow & Maschette, 1997; Menayo et al., 2010). Indeed, repeated task-specific practice generates structural and functional changes throughout the central nervous system, which is necessary to reach both consistency and mastery in the task (Leech et al., 2022; Reid et al., 2007). However, only the number of balls hit by the players was recorded but not the quality of each strike. Repeating a bad gesture multiple times could be counterproductive and may lead to learning bad habits, which can be challenging to unlearn later. It was recently evidenced in a longitudinal study that the use of a tennis racket containing visual and haptic cues helped to facilitate the acquisition of a proper technique (Herbaut et al., 2023). Further similar analyses on the Wall are needed in order to determine if using it regularly allows a larger improvement in the technique, specifically a better forward swing and a proper frame orientation at ball contact.

It made sense to observe an overall improvement trend in the performance of the players between the beginning and the end of the practice sessions. However, the absence of significant difference between a practice session with or without the Wall did not allow to conclude about the potential benefits of the Wall in terms of performance progression. As mastering complex movements such as tennis strokes requires time, it is definitely difficult to observe performance improvements in only one practice session (Reid et al., 2013). A several-weeks longitudinal study would be needed to observe more accurately the contribution of the Wall to support motor skill acquisition. Moreover, the fact that only one coach managed all the practice sessions was both a strength and a weakness of the study. It was needed to make the comparison reliable between a session with and without the Wall. Nevertheless, the outcomes in terms of hitting volume are also dependent on its teaching approach. It is likely that, with the help of the tennis coaches community, one could design new practice sessions in order to maximize the use of the Wall and optimize the learning process. It should result in even more multiplying the hitting volume during a practice and helping the acquisition of tennis-specific technical skills.

CONCLUSION

A practice session with the Tennis Wall allowed to hit about 3 times more balls for each young tennis player. Even though no better improvement in performance was observed after a practice session with the Wall compared with a practice session without the Wall, it can be assumed that the increased repetition of forehands contributes to the acquisition of a proper technical skill.

This study provides the first elements to demonstrate the interest of the Tennis Wall as a support to learn tennis, especially by the increase of repetition of the gesture (quantitative analysis). A long-term qualitative study consisting of an evaluation of the technique of each participant made by the coach during several weeks would be necessary to assess the relevance of this equipment to ease the learning of tennis technique.

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CONFLICTS OF INTEREST

AH, AV, GD and MF are employees of Decathlon which commercializes the Artengo Tennis Wall evaluated in this study.

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