Research Article

The Effect of Motor Memory Exercises on Serving and Receiving Skills among Junior Foot Tennis Players

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Abstract:

The purpose of this study was to examine the influence of motor memory exercises on developing serving and receiving skills among foot tennis players of youth age category. An experimental research design involving pretest-posttest measurements, as well as experimental and control groups was implemented in this investigation. The target group consisted of 16 youth foot tennis players aged between 13 and 15 years who were chosen from Al-Arsa Specialized Academy for Foot Tennis in Dhi Qar Province, Iraq. They were randomly allocated into two groups containing eight athletes each. The experimental group trained according to the proposed motor memory exercises schedule for six weeks, with three training sessions per week, while the other group underwent usual training program developed by the coach. Tests to measure skill performance in serving and receiving were carried out at pre- and post-intervention period. Descriptive statistics analysis, as well as paired and independent samples t-tests, were performed via SPSS. Significant differences were found in serving skill improvement, 13.25 ± 1.16 to 17.38 ± 0.51, and receiving skill, 8.63 ± 1.92 to 12.00 ± 1.07. Statistically significant differences were found in favor of the experimental group as regards serving skills ($p = 0.002$) and receiving skills ($p = 0.005$) in the post-test comparison. Thus, one can conclude that motor memory practice is highly effective in improving the quality of technical action, accuracy of movements, coordination, and stability of skills in junior foot tennis players. It is recommended to incorporate motor memory practice into the training process for young athletes, especially when performing specific skills.

Keywords: Motor memory; Motor learning; Foot tennis; Serving skill; Receiving skill; Junior athletes.

Introduction

Motor Memory and Motor Learning

It should be noted that memory is one of the basic cognitive processes that people depend on when engaging in different activities because it allows storing and retrieving past experiences and information. It is closely linked to the process of learning since people will not learn new things without using past experiences and the benefits derived from them. Therefore, in sports science, memory can be understood as the storage of information for future use and the recall of past experiences for present purposes. It plays an essential role in learning and athletic success (Saha & Saha, 2014) It is necessary to mention that motor exercises are some of the most popular ways to help young athletes learn the necessary skills. They play a crucial role in enhancing muscle strength, motor effectiveness, and coordination. In addition, the early developmental stages of a person are thought to be the best times for learning motor skills. The regular practice of motor activities leads to better improvement in the mechanical skills of movement, generation of greater forces, better coordination, and prevention of injuries sustained during sports practices. In addition, games that are fun and enjoyable motivate youth athletes and offer them safe and productive ways to learn basic skills while simultaneously improving their balance, flexibility, muscular stability, and motor perception (Radnor et al., 2020, pp. 54–56).

There are a number of physical and technical characteristics of junior tennis players that allow them to perform better athletically and successfully. Physical fitness is one of the most important parameters that determine the success in tennis since this sport requires a lot of muscular power, agility, speed, endurance, and motor skills. Technical performance in tennis also requires proper control over one's movements and quick response during competition to particular situations. It is also worth noting that the growth stage is critical for junior athletes because it determines all physiological and neurological processes that affect their technical and motor performance. Research done by other scholars shows that players who demonstrate

high speeds, agility, and muscular power perform at better athletic and technical levels and lower injury risk rates (Kramer et al., 2017, pp. 14–21).

Serving and Receiving Skills in Foot Tennis

Among the basic skills in tennis and foot tennis, the serve can be regarded as one of the most critical technical skills due to the fact that the serve is the only skill executed by the athlete on their own. The successful execution of a serve necessitates precise timing, proper coordination of the movement of the body parts, and an appropriate transfer of force from the legs to the upper part of the body. According to existing research, muscular strength, balance, and motor coordination are crucial factors in increasing serve speed and accuracy (Roetert et al., 2009, pp. 35–36).

Likewise, the reception of the serve in foot tennis can be regarded as one of the crucial defensive skills since it serves as the first point of defense in relation to the attacks of the rival party. Weaknesses in the performance of the receiving skill will likely result in lost points and will negatively affect the coordination of the offensive skill (Hamed & Khattab, 2023, p. 551).

Motor memory is regarded as one of the primary variables that significantly influence the improvement of technical performance since it helps organize, encode, and retrieve motor information when executing sport skills. Cognitive learning, mental preparation, and motor imagery contribute to the stabilization of motor performance, increasing its accuracy and effectiveness. Earlier research has shown that mental training and imagery approaches enhance technical performance in tennis through motor cognition (Turan et al., 2019, pp. 244–249).

Repetition is another variable that plays an important role in stabilizing technical performance due to its positive impact on motor learning and the encoding of skills in motor memory. Repeated and diverse practice leads to improved neural and cognitive mechanisms responsible for movement planning and execution, which contributes to decreased movement errors and higher efficiency in acquiring skills (Lage et al., 2015, pp. 132–141).

The key role of motor skill development is the participation of the central nervous system in sensory-motor integration process. The development of skilled actions occurs through the permanent cooperation of sensory and motor systems aimed at learning new actions and improving the quality of the performed movements due to constant repetition and exercise. Motor learning involves three major phases such as the cognitive phase marked by poor performance and numerous errors, the associative phase characterized by gradual improvement of movement, and the autonomous phase involving enhanced accuracy of skills (Asan et al., 2022, pp. 1–4).

The methods used in teaching and training play a crucial role in acquiring motor skills and improving athletic results. Such methods include partial one based on dividing skills into several components, whole approach, which aims at performing the action as an entity, and the part-whole approach combining both. Moreover, the use of exploratory and learner-oriented methods allows encouraging the learners' creativity and active participation thus increasing their motor development and interest in the process (Berdai et al., 2024, pp. 203–205).

The techniques involved in motor learning in contemporary times play an important role in the steady growth of technical performance since they help individuals pass through all the phases of motor learning. They make movements more coordinated and efficient, as shown in Fig (1).

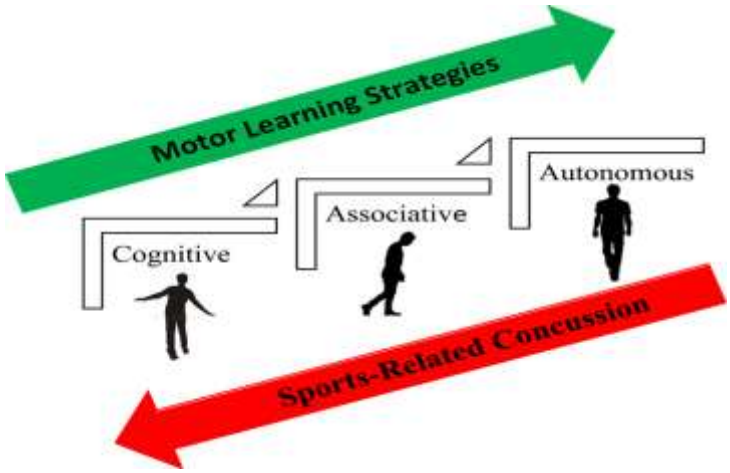

Figure . 1 Strategies for Motor Learning and Stages in Motor Skill Acquisition (Avedesian et al., 2021, pp. 2289–2300).

Fig . 1 highlights the stages involved in motor learning, i.e., cognitive, associative, and autonomous stages, that help to develop motor skill performance among athletes.

Costa et al. (2021) noted that there is a positive correlation between motor learning and technical performance in sports tasks. According to their findings, individuals who possess high motor competence learn complex skills more effectively. It was further argued that poor motor competence can affect the process of skill learning, whereas planned and repeated practice helps to facilitate motor learning and technical performance improvement, particularly skills that require coordinated movements, e.g., serve skills (Costa et al., 2021).

Athletic motor skills competencies are also regarded as important factors in achieving technical performance since they enhance balance, coordination, movement, and force production skills during sporting activities. Continuous training and correct acquisition of movement patterns play an important role in physiological and technical development, as highlighted in Fig (2).

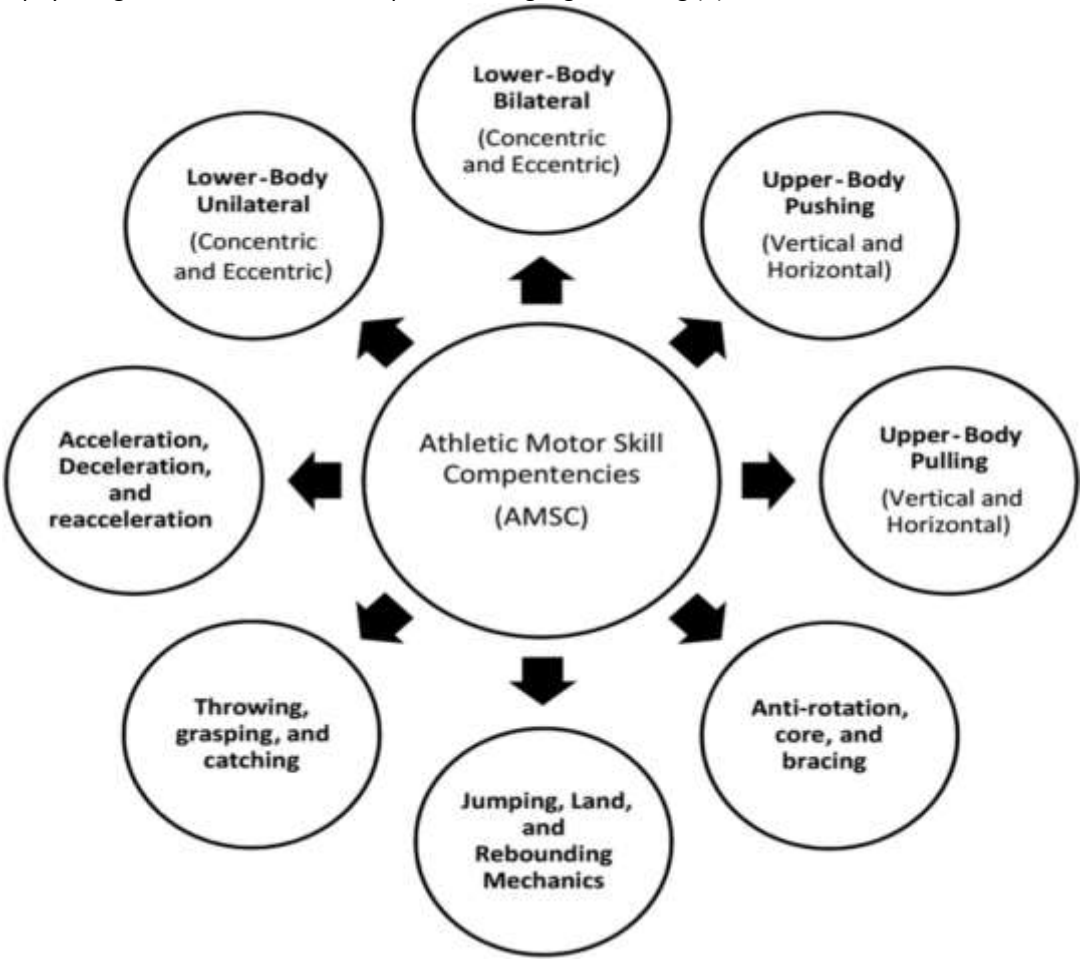

Figure . 2 Motor Skill Competencies in Athletics and Their Impact on Sports Performance (Duggan et al., 2021).

Fig (2) shows the main elements of athletic motor skill competencies such as jumping, throwing, balancing, pushing, and pulling and how they affect motor and technical performance in sports.

In order to have better understanding of the motor sequence and technical phases of serving and receiving skills, Figure (3) below shows the sequential phases of movement in instep kick skill and the angular velocity of movement produced by ball contact and follow through.

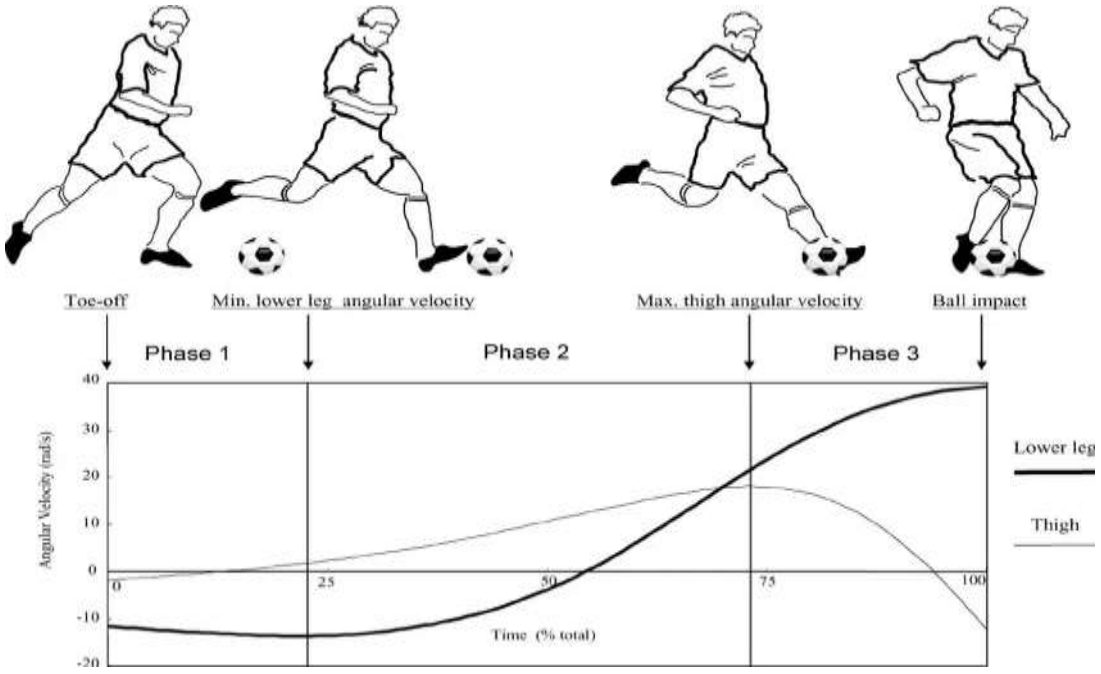

Figure . 3 Sequential Phases of Instep Serving Skill Performance and Analysis of Lower Limb Movement. (Nunome et al., 2006)

Figure 3. above clearly demonstrates the sequential movement phases that occur during instep skill performances. These include preparation, acceleration and ball contact phases. Moreover, the angular velocity of the lower limb joint angles is depicted .

Previous Studies and Research Gap

Although motor imagery, motor learning, and mental training have received considerable attention in studies of racket sports, little work has been done with regard to the impact of motor memory training on the serving and receiving abilities of foot tennis players at the junior level. Prior research in this domain has been restricted to tennis serving skills or motor learning methods without taking into account serving and receiving skills in foot tennis.

Aim and Hypotheses

Therefore, the current study tries to find out the influence of the application of motor memory exercises in order to improve the skills of serving and receiving in foot tennis game among the junior players. The study adds to the literature because of the presentation of a training program for improvement of the technical skills based on the use of motor memory techniques.

Considering the value of the motor memory and motor imagery in terms of motor learning and improvement of technical performance, the present study attempts to investigate the effect of motor memory exercises in development of serving and receiving skills among junior players of foot tennis. The assumption is made about the positive role of these exercises in improvement of technical performance and achievement of better results. Moreover, the appearance of the statistically significant differences between the experimental and control groups during the post-tests in favor of the first one is expected. This study was performed with the junior players of Al-Arsa Specialized Academy for Foot Tennis in Al-Bathaa District, Dhi Qar Governorate during the period from December 2025 to May 2026 at Jarrah Nassar Indoor Sports Hall.

Related Work

The research was conducted by Meier et al. (2020) under the title "Verbal Instructions and Motor Learning: How Analogy and Explicit Instructions Influence the Development of Mental Representations and Tennis Serve Performance." This investigation sought to evaluate the effect of analogy and explicit verbal instructions on

motor learning, mental representations, and tennis serve performance amongst junior tennis players over a span of five weeks. The experiment included 44 junior tennis players aged 11.5 years, allocated into analogy instruction, explicit instruction, and control groups. Serve performance and mental representations of the players were assessed prior to and after the experimental program and after a two-week retention period. The findings indicated an improvement in the serve velocity and accuracy of the players receiving analogy and explicit instructions. It was further evident from the investigation that both analogy and explicit instructions positively impacted functional mental representations and promoted motor learning and performance

In addition, a study was carried out by Gül et al. (2020), and it was titled "The Effect of Fun Tennis Training on Some Motoric Features and Tennis Skill in 8–10 Year Old Children." The objective of the study was to analyze the effect of fun tennis training on motor skills and tennis skills among beginners female tennis players between ages 8 to 10. The participants were 24 female players and were grouped as experimental and control groups, and the period of training was 8 weeks. The results indicated considerable improvement in motor skills, coordination, agility, and skill execution among the experimental group when compared with the control group.

Robin et al. (2022) carried out a study named "Beneficial Effects of Motor Imagery and Self-Talk on Service Performance in Skilled Tennis Players." This research was carried out with the objective of studying the impact of motor imagery and motivational self-talk on service performance in skilled tennis players. The sample included 33 participants, which were allocated into three groups – namely the control group, motor imagery group, and motor imagery and self-talk group. The subjects were administered pre-tests, training for 20 sessions, and post-tests in game-like situations. The study indicated a notable improvement in the service performance percentage of players using motor imagery and motor imagery with motivational self-talk techniques. The researchers found that the use of both motor imagery and motivational self-talk resulted in better performance efficiency than other participants. The conclusion drawn from the study is that motor imagery techniques aid in enhancing the performance in tennis service skills.

The review study, titled "Mental Imagery and Tennis: A Review, Applied Recommendations and New Research Directions," was conducted by Robin and Dominique (2022). This study was intended to determine the application of motor imagery and its impacts on the performance of tennis athletes. The review study reviewed 41 research articles obtained from scientific databases such as SCOPUS, PubMed, PsycINFO, Science Direct, and Google Scholar. The study found that motor imagery has positive impacts on motor performance, motivation, concentration, and affective responses in tennis players of all ages and skill levels. It was further noted that motor imagery is usually used together with other mental skills like positive self-talk and concentration in training sessions. The conclusion of this review study was that motor imagery needs to be included in sports training programs due to its positive impact on sports performance.

Robin et al. (2022) carried out an experiment under the title of "Tennis Service Performance in Beginners: The Effect of Instructional Self-Talk Combined With Motor Imagery." The main purpose of conducting such an investigation was to examine the role of using motor imagery along with instructional self-talk on tennis service performance among young novice tennis players. Specifically, players have been allocated to the following groups: control, motor imagery, and motor imagery combined with self-talk. Then participants have been involved in pretest, intervention period lasting for 5 days, and posttest. Consequently, significant increases in the level of service success percent and technical performance were observed among those athletes who have been practicing the use of motor imagery and motor imagery along with self-talk. Moreover, better serve speeds and technical performance scores have been noted in the latter group than in any other group.

Petancevski et al. (2022) conducted a systematic review by the title "The Effect of Augmented Feedback on the Performance and Learning of Gross Motor and Sport-Specific Skills." In their study, the researchers sought to explore the impact of augmented feedback on gross motor and sport-specific skill learning and performance among athletes. The research comprised a total of 24 studies and 895 subjects. The results showed that augmented feedback positively impacted motor learning and sport skill performance, albeit with variations in terms of the most appropriate times for intervention, frequency of administration, and time spent on feedback. It was concluded that augmented feedback has a positive effect on improving motor performance and learning of sport-specific skills.

The study by Robin et al., titled "Effects of Motor Imagery Training on Service Performance in Novice Tennis Players: The Role of Imagery Ability," examined the impact of motor imagery training on service performance of novice tennis players and established its impact on skill performance based on imagery ability. Participants of the study were categorized into poor imager, good imager, and control groups depending on their imagery ability scores. The study involved an intervention of 24 sessions where participants mentally performed service followed by the physical execution. The outcomes demonstrated that motor imagery training enhanced service success rate, velocity, and efficiency. Additionally, better progress was noted among the group with high imagery

ability scores when compared with those of low scores. Based on the study findings, it can be concluded that motor imagery training is helpful for motor skill learning and performance improvement in service.

The research was carried out by Robin et al., (2023), titled "Can We Benefit from Motor Imagery Practice When We Have Difficulty Imagining Ourselves?" The study intended to explore the impact of motor imagery practice on service learning speed among novice tennis players, as well as whether imagery ability impacts learning. During training sessions, the participants completed motor imagery tasks alongside physical training. There were improvements in serve speed, serve accuracy, and technique among those players who used motor imagery before the serve. It also came out clearly that players with poor imagery ability performed better when practicing repeatedly as compared to those with good imagery ability. In summary, the study found out that motor imagery practice is beneficial for motor learning and service performance improvement.

The research paper by Deng et al. (2024), titled "Does Motor Imagery Training Improve Service Performance in Tennis Players?," was a systematic review and meta-analysis. This study sought to evaluate the impact of motor imagery training on tennis service performance. In the analysis, the researchers considered nine experimental studies that consisted of 548 subjects. The findings revealed that motor imagery training improved service accuracy and technical service performance in tennis players, while there was no effect of motor imagery training on service speed and return accuracy. According to the study, motor imagery training may help improve tennis service performance and motor skill acquisition.

Sani et al. (2025) carried out a scoping review titled “Motor Imagery Training in Sports Psychology Enhances Tennis Serve Performance Among Competitive Young Tennis Players.” The objective of this study was to explore the effects of motor imagery training on enhancing tennis serve performance among young competitive tennis players. A total of nine studies were reviewed in the article sourced from databases like SCOPUS, PubMed, Ovid MEDLINE, and Google Scholar. Results showed that motor imagery training enhances serve accuracy, stroke speed, and tennis serve performance overall. In conclusion, motor imagery training should be integrated into training programs due to its positive impact on motor performance among young athletes.

The study undertaken by Bonnin et al. (2025) is titled “Improving Service Performance in Young Tennis Players: The Superiority of Dynamic Over Static Motor Imagery.” The main purpose of this study was to find out whether or not dynamic motor imagery in combination with physical practice would have any effect on service performance among young tennis players. The sample for this study included 12 young non-expert tennis players with an average age of 11 years. The experiment comprised three sessions in which the subjects underwent the control, static motor imagery, and dynamic motor imagery. It was found out that both motor imagery groups performed better than the control group regarding service success percentage, technical performance, and efficiency. Nevertheless, dynamic motor imagery showed better results than static motor imagery.

A research named “Dynamic Motor Imagery but not Pre-Execution Movements Enhances Serve Tennis Performance” was performed by Robin et al. (2026). This research was conducted to examine and analyze the difference between dynamic motor imagery and slight pre-execution movements in order to improve serve performance in tennis among novice young players. This experiment was carried out with the participation of 12 individuals whose mean age was 12.77 years old with 4–6 years of tennis training experience. They were asked to take part in four experimental conditions, which included control condition, dynamic motor imagery, slight movements, and slight movements with countdown task. The outcome demonstrated that dynamic motor imagery had significant impact on serve success percentage, serve velocity, technical quality, and efficiency compared to the control and slight movements groups.

According to the researcher, earlier studies have established the significance of motor imagery and motor memory training as effective methods for enhancing motor learning and performance skills, particularly serving among tennis juniors. Nevertheless, not many studies have concentrated on the importance of training foot tennis athletes and the development of serving and receiving skills among juniors. Hence, this study aims to fill the research gap by assessing the effect of motor memory exercises on the development of serving and receiving skills among junior foot tennis athletes.

Methodology

Research Design

This study involved use of an experimental design with a pretest-posttest model involving two groups (an experimental group and control group). This method was selected because it was perceived to be the most appropriate in solving the research problem by analyzing the impact of motor memory training on developing serving and receiving skills.

Research Population and Sample

The population under study included the junior players of Al-Arsa Specialized Academy for Foot Tennis in Al-Bathaa District, Dhi Qar Governorate for the 2025-2026 season of this sport. According to the rules of the Iraqi Foot Tennis Federation, the population consisted of 26 junior players aged 13-15.

The sample size was 16 players who made up 61.53% of the population. After carrying out the preliminary experiment, 10 players were excluded from the investigation. The sample was divided into two groups using random sampling as follows:

- Experimental group (n = 8)
- Control group (n = 8)

The control group was trained in accordance with the conventional coaching plan while the experimental one performed activities aimed at developing their motor memory skills.

Table . 1 Sample distribution and percentage

No.	Research Population	Number of Players	Percentage
1	Pilot Study Group	10	38.46%
2	Control Group	8	30.77%
3	Experimental Group	8	30.77%
4	Total	26	100%

Sample Homogeneity

To determine whether the sample possessed the same features of the population as well as that of a normally distributed one, the homogeneity of the morphological parameters was determined through their mean, median, standard deviation, and skewness coefficients.

Table . 2 Homogeneity of the Research Sample in Age, Height, and Weight

Variables	Unit	Mean	Median	Standard Deviation	Skewness Coefficient	Interpretation
Age	Year	14.06	14	0.85	-0.08	Homogeneous
Height	cm	157.81	158	1.97	-0.21	Homogeneous
Weight	kg	54.56	55	5.16	-0.18	Homogeneous

All skewness values ranged within ±1, indicating that the sample was homogeneous.

Equivalence of the Research Groups

To prove that there is equivalency between the control group and the experimental group, the following statistics were performed based on the results of pretest on serving and receiving skills: mean, standard deviation, independent samples t-test, and Sig. Table . 3 Equivalency Between the Experimental and Control Groups on the Research Variables

No.	Variables	Unit	Control Group Mean	Control Group SD	Experimental Group Mean	Experimental Group SD	t-value	df	Sig.	Statistical Significance
1	Serving Skill	Score	13.88	1.36	13.25	1.164	0.99	14	0.34	Non-significant
2	Receiving Skill	Score	9.00	0.75	8.63	1.92	0.51	14	0.61	Non-significant

The tabulated t-value at df = 14 and significance level 0.05 confirmed no statistically significant differences between the two groups before implementing the motor memory exercises.

Field Procedures

Identification of the Main Skills

After reviewing the literature and conducting interviews with experts and coaches of foot tennis, the most important basic skills involved in playing foot tennis were selected. The questionnaire developed on the basis of those skills was mailed to 13 experts for assessing their importance.

Table 4: Relative Importance of Basic Foot Tennis Skills

No.	Basic Skills	Number of Experts Agreeing	Importance Score (130)	Relative Importance	Number of Experts Disagreeing	Acceptance Status
1	Foot Instep Serve	12	118	90.77%	1	Accepted
2	Powerful Serve	6	58	44.62%	7	Rejected
3	High Press	7	72	55.38%	6	Rejected
4	Heel Press	3	30	23.08%	10	Rejected
5	Hook Skill	6	65	50.00%	7	Rejected
6	Foot Instep	1	18	13.85%	12	Rejected
7	Ball Cutting	2	28	21.54%	11	Rejected
8	Scissor Skill	2	25	19.23%	11	Rejected
9	Acceleration	4	40	30.77%	9	Rejected
10	Toe Skill	4	33	25.38%	9	Rejected
11	Straight Press	3	35	26.92%	10	Rejected
12	Low Heel Press	2	22	16.92%	11	Rejected
13	Sole Press	5	50	38.46%	8	Rejected
14	Hammer Skill	4	48	36.92%	9	Rejected
15	Header Skill	1	15	11.54%	12	Rejected
16	Inside Foot Preparation	8	84	64.62%	5	Rejected
17	Header Preparation	3	32	24.62%	10	Rejected
18	Foot Instep Preparation	6	56	42.08%	7	Rejected
19	Side Blocking	8	84	64.62%	5	Rejected
20	Straight Blocking	7	72	55.38%	6	Rejected
21	Jump Blocking	7	68	52.31%	6	Rejected
22	Chest Receiving	11	108	83.08%	4	Accepted
23	Inside Foot Receiving	7	77	59.23%	6	Rejected
24	Heading Receiving	5	52	40.00%	8	Rejected
25	Half Volley Field Play	6	62	47.69%	7	Rejected
26	Body Play	4	45	34.62%	9	Rejected
27	Heading Play	4	43	33.08%	9	Rejected

Maximum Total Score = 13 experts × 10 = 130

The researcher chose the skills that received an agreement percentage exceeding 75%, which are as follows:

- Foot Instep Serve
- Chest Receiving Skill

Selection of the Skill Tests

Once the main skills were established, the scientist reviewed existing scientific literature and also talked to experts in the areas of testing, evaluation, measurements, acquisition of motor skills, and foot tennis.

Table . 5 Percentage of Expert Consensus About the Selected Tests

No.	Proposed Test	Number of Experts Agreeing	Agreement Percentage	Number of Experts Rejecting	Acceptance Status
1	Mays Test for Serving Skill	13	100%	0	Accepted

2	Receiving Skill Test	11	84.6%	2	Accepted

Description of the Tests

These tests have been conducted:

1. Mays Test for Serving Skill in Foot Tennis.
2. Receiving Skill Test in Foot Tennis.

Pilot Study

The pilot study was carried out with 10 subjects taken from the entire population, but not from the sample, on Tuesday, 3 February 2026. It represents a miniature version of the experiment that was conducted under conditions similar to those of the main experiment.

Scientific Basis for the Tests

Validity

Validity is defined as the capacity of the test to measure the quality intended to be measured. Content validity was established using experts' evaluation with help from specialists in psychology, motor skill learning, teaching techniques, testing and measurement and foot tennis.

Self validity was established using the square root of coefficient of reliability.

Table . 6 Coefficients of Reliability, Validity and Objectivity of the Tests

No.	Test	Unit	Reliability Coefficient (r)	Sig.	Validity Coefficient	Objectivity Coefficient	Sig.	Statistical Significance
1	Serving Skill	Score	0.895	0.01	0.946	0.998	0.000	Significant
2	Receiving Skill	Score	0.938	0.01	0.968	0.997	0.000	Significant

The reliability of the study was conducted using the test-retest method with an interval of six days on 9 February 2026. The coefficients of reliability had values ranging from 0.89 to 0.95 indicating high reliability. The objectivity coefficients were between 0.97 and 0.98, indicating high levels of agreement among the evaluators.

Experiment

Pre-test

Pre-tests were carried out on Wednesday, 11 February 2026, at 1:00 PM in Jarrah Nassar Indoor Sports Hall, Al-Bathaa District, Dhi Qar Governorate. The steps followed by the researcher included:

1. Preparing the testing materials/equipment.
2. Recruiting the assistant team.
3. Explaining the testing procedures to the athletes.
4. Giving time for warm-up exercises.
5. Demonstrating how to carry out the test procedures.

Motor Memory Exercises Program

Once the equivalence among groups was reached, the researcher then implemented the motor memory exercises program in the experimental group on Thursday, 12 February 2026, for 6 weeks at a frequency of 3 educational sessions per week (Thursday, Friday, and Saturday).

Components of the program:

- Number of educational sessions: 18
- Duration of each session: 90 minutes
- Duration of total training: 1620 minutes
- Duration of motor memory exercises: 540 minutes
- Schedule of each session:
- Introduction: 15 minutes
- Main session: 65 minutes
- \+ Instruction session: 15 minutes
- \+ Practical session: 50 minutes
- Concluding phase: 10 minutes

Table . 7 Schedule of Educational Sessions

No.	Educational Sections	Session Duration	Number of Sessions	Total Duration	Percentage
1	Preparatory Section	15 min	18	270 min	16.67%
	General Warm-up	6 min			
	Special Warm-up	9 min			
2	Main Section	65 min	18	1170 min	72.22%
	Educational Part	15 min			
	Practical Part	50 min			
3	Final Section	10 min	18	180 min	11.11%
	Total	90 min	18	1620 min	100%

Post Test

After completion of the motor memory exercises training program for six weeks with 18 training classes, the researcher performed post-test sessions for the experimental group and the control group on Monday, 23rd March 2026 at 1 PM in conditions similar to those during pre-test.

Statistical Analysis

Statistical analysis of the data obtained was carried out using IBM SPSS Statistics 24 software. The various techniques used in statistical analysis include:

- Arithmetic mean
- Standard deviation
- Skewness coefficient
- Levene's test
- Pearson correlation coefficient
- Paired sample t-test
- Independent sample t-test

Results and Discussion

Results of Control Group

Pre-test and Post-test Results of the Control Group

Table . 8 Pre-test and Post-test Results of the Control Group

No.	Variables	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	t-value	Sig.	Statistical Significance
1	Serving Skill	13.88	1.36	15.88	1.13	-4.32	0.003	Significant
2	Receiving Skill	9.00	0.76	10.38	0.92	7.51	0.001	Significant

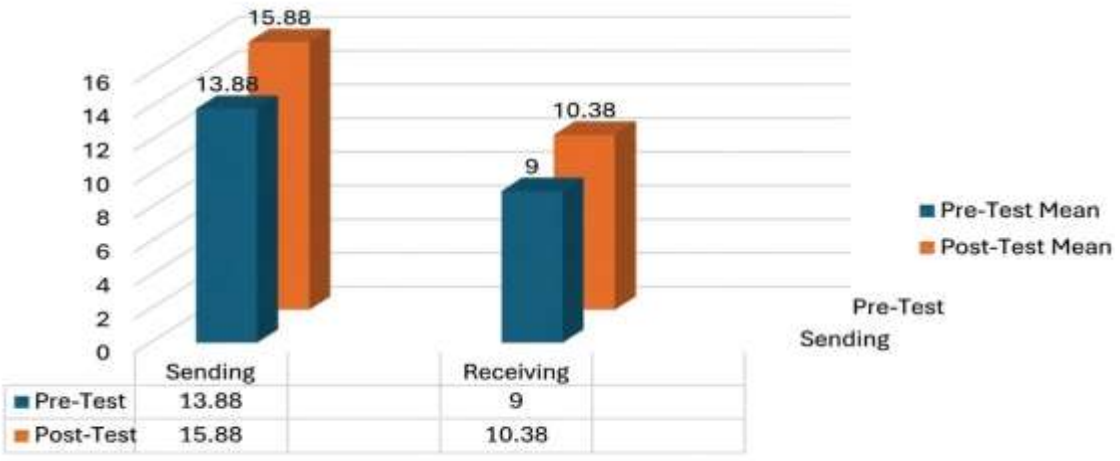

Fig . 4 Differences Between the Arithmetic Means of the Variables under Study (Serving and Receiving Skills).

Experimental Group Results

Pretest and Posttest Results of the Experimental Group

Table . 9 Pretest and Posttest Results of the Experimental Group

No.	Variables	Unit	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	t-value	Sig.	Significance
1	Serving Skill	Score	13.25	1.16	17.38	0.51	11.77	0.000	Significant
2	Receiving Skill	Score	8.63	1.92	12.00	1.07	-9.00	0.000	Significant

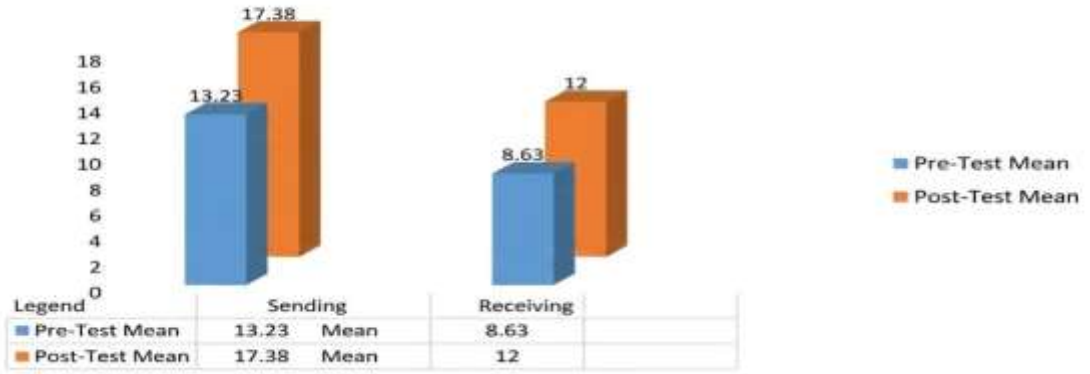

Fig . 5 Pre-Test vs. Post-Test Comparison of Experimental Group.

Comparative Study between Experimental and Control Groups

Post-Test Comparative Study between Experimental and Control Groups

Table . 10 Post-Test Comparative Study between Experimental and Control Groups

No.	Variables	Unit	Control Group Mean	Control Group SD	Experimental Group Mean	Experimental Group SD	t-value	Sig.	Significance
1	Serving Skill	Score	15.88	1.13	17.38	0.52	3.42	0.002	Significant
2	Receiving Skill	Score	10.38	0.92	12.00	1.07	3.26	0.005	Significant

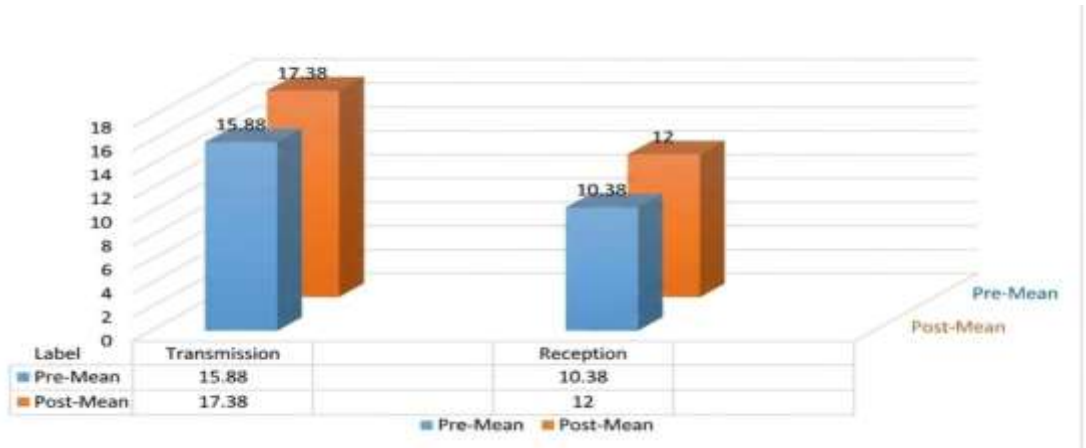

Fig . 6 Comparison Between the Experimental and Control Groups in the Post-tests.

Discussion of the Results

It is obvious that there were significant differences between the pre-test and post-test scores of the control group in both skills of serving and receiving. Such a difference can be associated with the constant training of the coach. The constant training program has played an important role in the development of the skills of the technical performance of junior foot tennis players due to the repetition of training and correction of mistakes. At the same time, the difference between the test scores in the experimental group in both serving and receiving is significantly larger compared to those in the control group. Thus, the introduction of motor memory training exercises in the experiment has proven its positive impact on the development of technical performance among junior foot tennis players. The introduction of such exercises contributes to the development of motor memory in junior foot tennis players, thus enabling them to reproduce the correct movements required for performing the skills.

As can be seen from the results of the post-test analysis comparing the experimental and control groups, there was a statistically significant difference in favor of the experimental group with respect to both serving and receiving skills. Hence, the use of motor memory exercises is indeed more efficient when combined with conventional practice in tennis. Such an outcome may be explained by the nature of motor memory exercises which involve the cognitive process of imagining the desired movement, its sequence, and its physical implementation.

In fact, the outcomes obtained in the course of this research corroborate the results of numerous studies confirming that motor imagery and motor learning techniques can be used to increase the quality of tennis serve performance. Thus, in particular, (Meier et al., 2020) , (Robin et al., 2022) , (Robin et al., 2023), (Robin et al., 2023), (Deng et al., 2024), and (Bonnin et al., 2025) proved that motor imagery training leads to improved accuracy of the service and better technical performance of tennis players in general. However, in contrast to the cited studies, this study focuses on foot tennis.

Conclusion The research results show that the proposed hypotheses are valid and that motor memory training had a positive effect on the development of service-reception skills. Significant differences were noted between the two groups tested, favoring the experimental one.

Table . 11 Comparison Between the Current Study and the Most Related Previous Studies

Study	Sample / Sport	Training Method	Main Skills	Main Results	Relation to the Current Study
Verbal Instructions and Motor Learning: How Analogy and Explicit Instructions Influence the Development of Mental Representations and Tennis Serve Performance (Meier et al., 2020)	Junior tennis players	Analogy and explicit instructions	Tennis serve	Improved serve velocity, accuracy, and mental representations	Similar in focusing on motor learning, memory, and serve performance
Beneficial Effects of Motor Imagery and Self-Talk on Service Performance in Skilled Tennis Players (Robin et al., 2022)	Skilled tennis players	Motor imagery and self-talk	Tennis service	Improved first service percentage and efficiency	Similar in using mental/motor imagery to improve service performance
Tennis Service Performance in Beginners: The Effect of Instructional Self-Talk Combined With Motor Imagery (Robin et al., 2022)	Young novice tennis players	Motor imagery with instructional self-talk	Tennis service	Improved service success, speed, and technical quality	Very close because it used young players and service skill development
Effects of Motor Imagery Training on Service Performance in Novice Tennis Players: The Role of Imagery Ability (Robin et al., 2023)	Novice tennis players	Motor imagery training	Tennis service	Improved service success, speed, and efficiency	Very close because it studied motor imagery and skill learning in beginners
Can We Benefit from Motor Imagery Practice When We Have Difficulty Imagining Ourselves? (Robin et al., 2023)	Beginner tennis players	Motor imagery with real practice	Tennis service	Improved serve speed, success percentage, and technical quality	Close because it showed repeated imagery practice improves service learning

Does Motor Imagery Training Improve Service Performance in Tennis Players? A Systematic Review and Meta-Analysis (Deng et al., 2024)	Tennis players / meta-analysis	Motor imagery training	Tennis service	Improved service accuracy and technical performance	Supports the effectiveness of motor imagery in tennis service performance
Improving Service Performance in Young Tennis Players: The Superiority of Dynamic Over Static Motor Imagery (Bonnin et al., 2025)	Young non-expert tennis players	Dynamic motor imagery with physical practice	Tennis service	Dynamic imagery produced better service success and efficiency	Very close because it used young players and dynamic motor imagery
Current Study	Junior foot tennis players	Motor memory exercises	Serving and receiving skills	Improved serving and receiving skills in favor of the experimental group	Adds a new contribution by applying motor memory exercises to foot tennis and including both serve and receive skills

In this particular study, the author strongly believes that the present study can be separated from other studies undertaken in the past, as far as the attention paid to the use of motor memory exercises in relation to foot tennis among juniors, as previous research was mostly interested in the use of motor imagery together with serving performance among the players of tennis matches. Furthermore, it needs to be mentioned that the present study was carried out on serving and receiving skills due to their significant role in foot tennis.

Limitations of the Study

- Small sample size
- Only junior athletes aged 13-15 years
- Single academy involved
- Short duration of intervention
- Results cannot be generalized to other ages and sport levels

Conclusions

- Training using exercises of motor memory assisted in the formation of the ability to serve and receive the ball in junior players of foot tennis.
- The experimental group proved to be more efficient compared to the control one in post-training tests concerning the ability to serve and receive.
- Usage of motor memory exercises brought about improvement in the accuracy of movements, coordination, technical control, and stability.

Recommendations

- Greater attention should be paid to conducting motor memory exercises by coaches within the training program of young foot tennis athletes due to their beneficial effect on technical performance.
- The mental aspects of the training process must be considered in sports training especially when preparing athletes whose performance requires high precision and coordinated movements.
- The systematic conduct of motor memory exercises along with the physical and technical training process becomes very necessary for promoting motor learning.
- The application of new methods of motor learning and mental imagery in sports training is highly encouraged.

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