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THE EFFECT OF HAND-TO-HAND EXCHANGE TRAINING ON DEVELOPING BACKHAND ACCURACY AMONG JUNIOR TABLE TENNIS PLAYERS

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Abstract.
The study aims to identify the effect of using reciprocal training on developing backhand accuracy among junior table tennis players. The importance of this study stems from the need to develop the skill performance of junior players, especially in the formative stages, as the backhand is considered one of the most important basic skills in table tennis. The researcher used the experimental method due to its suitability for the nature of the study. The sample included (20) junior players aged (12-14) years, who were randomly selected from a club in Baghdad Governorate.
The sample was divided into two equal groups: an experimental group that underwent an eight-week training program based on reciprocal training, and a control group that trained using the traditional method. A special test was used to measure backhand accuracy before and after the program was implemented, and statistical methods were used to analyze the results. The results showed statistically significant differences in favor of the experimental group, indicating the effectiveness of reciprocal training in developing backhand performance. These results provide practical evidence for coaches and those involved in youth training. They call for a review of traditional training programs and the introduction of diverse training techniques based on hand-to-hand exchanges, given their direct impact on developing technical skills. The study proposes expanding the scope of exchange training to include other skills and testing its impact on different age groups and levels.

Keywords: Exchange training, backhand, table tennis, youth, skill performance

Introduction

Table tennis is an individual sport that relies heavily on reaction speed, precise movement, and hand-eye coordination. This sport is characterized by several basic technical skills, which form an important foundation for player development. One of the most prominent of these skills is the backhand, which is frequently used during offensive and defensive exchanges in matches.

In younger age groups, particularly juniors, skill training becomes pivotal to building a player capable of performing sound technically. However, it is noted that many training programs focus on using only the dominant hand, leading to poor motor balance and limited performance accuracy, especially when executing backhands at difficult angles.

Hence, the importance of introducing modern training methods, including hand-to-hand reciprocal training, emerges. This aims to use both hands in performing exercises and skills, enhancing neuromuscular coordination, reducing motor bias toward one side, and increasing shooting accuracy.

The importance of this research stems from several aspects:

- It highlights an unconventional aspect of skill training for juniors.

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- It presents an applicable model for field use.
- It contributes to developing the technical performance of the backhand stroke, one of the fundamental skills in the game.
- It enables coaches to develop training programs based on well-studied scientific findings.

Importance of the Study

The importance of this study lies in the following points:

- It addresses the poor accuracy of backhand strokes among junior players, a common problem in the local training environment.
- It presents a field-applicable training method based on hand-to-hand exchanges, a method not widely used in table tennis training.
- Its results help improve training programs for junior players by enhancing motor balance and the use of both hands in performance.
- It provides reliable quantitative evidence that coaches can rely on when designing specific training exercises to improve accuracy.
- It contributes to enriching applied research in the field of fine motor skills in young age groups.

Study Problem

The researcher's observations and field experience in training junior players indicate a clear weakness in the accuracy of backhand strokes, especially when performed under pressure or at angles uncomfortable for the player. This is due to most players relying solely on their dominant hand to perform the skill, without developing motor coordination between the hands. Traditional training programs also do not adequately focus on developing balanced performance, which limits technical performance and impacts player effectiveness during the match.

The researcher also noted that many players struggle with changing directions or shooting from long angles due to poor use of their non-dominant hand, which reduces shooting accuracy and weakens control over the game.

Accordingly, there was a need to study the effect of an alternative training method based on hand-to-hand exchanges on developing backhand accuracy and motor balance among junior players. The main question is:

What is the effect of hand-to-hand exchange training on developing backhand accuracy among junior table tennis players?

Study Objectives

This research aims to achieve a set of objectives related to developing skill performance in junior table tennis by implementing a training program based on hand-to-hand exchanges. The objectives are as follows:

• To identify the level of backhand accuracy among junior table tennis players before implementing the training program.

• To develop a training program based on hand-to-hand exchanges to improve backhand performance.

• To measure the effect of hand-to-hand exchange training on the backhand accuracy of the experimental group.

• To compare the results of the experimental group with the control group after implementing the training program.

• To provide scientific recommendations to coaches regarding the effectiveness of using exchange training in their programs to develop junior skills..

Study Hypotheses

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Based on the research problem and objectives, the researcher formulated the following hypotheses for field testing:

- There are no statistically significant differences in the backhand accuracy test results among members of the experimental group before implementing the training program.
- There are no statistically significant differences in the backhand accuracy test results among members of the control group before and after the training program.
- There are statistically significant differences in the backhand accuracy test results in favor of the post-test among members of the experimental group.
- There are statistically significant differences in the post-test results between members of the two groups (experimental and control) in favor of the experimental group.

Study Population and Sample

The study population consists of male junior table tennis players officially registered with a club in Baghdad Governorate for the 2024-2025 sports season, ranging in age from 12 to 14 years.

The study sample was randomly selected from this population, and its number was (20) players. The sample was divided into two equal groups:

- Experimental group: 10 players who underwent a training program using hand-to-hand alternation.
- Control group: 10 players who trained using the usual method without experimental intervention.

The researcher ensured that the two groups were homogeneous in variables (age, height, weight, training duration, and skill performance level) before beginning the training program. (Nagy et al., 2017)

Definition of terms

Hand-to-hand alternation training:

It refers to performing exercises and skills using both hands alternately or sequentially, with the goal of developing motor balance, developing neuromuscular control, and reducing reliance on the dominant hand alone (Al-Sayed, 2021: 93).

Backhand strokes:

Are strokes performed from the opposite side of the dominant arm, using the palm of the hand facing away from the body. They are considered one of the most important basic skills in table tennis, especially in defensive and attacking situations (Al-Badri, 2020: 55).

Accuracy:

Refers to a player's ability to accurately and repeatedly direct the ball to a designated target. It is usually measured by the number of balls hitting target points on the table within a specified number of attempts (Abdullah, 2019: 112).

Juniors:

Are players between the ages of 12 and 14 who practice sports under the supervision of official clubs or sports federations (Youssef, 2022: 37).

Research Methodology and Field Procedures

Research Methodology

The researcher adopted the experimental approach because it suited the nature of the problem and objectives(Mohammed et al., 2025 ; H.; Y. A. Khalaf et al., 2025), particularly when seeking to measure the effect of an independent variable (hand-to-hand training) on a dependent variable (backhand accuracy).

A two-group experimental design was used: (Shvorin, 2017)

- An experimental group underwent a training program using hand-to-hand exchange.
- A control group trained using the usual method without intervention.

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The training program for the experimental group was designed based on hand-to-hand exchange during backhand strokes, by switching the racket between the right and left hands as part of structured exercises aimed at activating both upper extremities equally.
See Figure (1): Hand-to-hand exchange movements in training

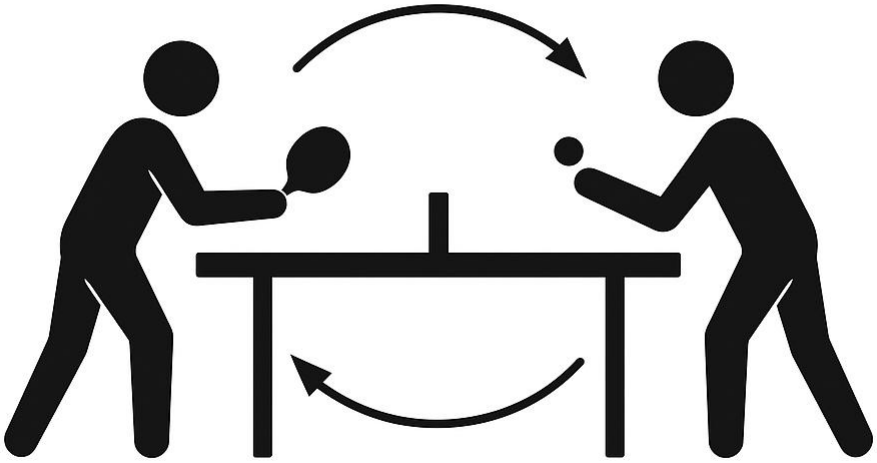

Figure (1): Hand-to-hand exchange movements during backhand training for juniors

Research Sample
The research sample was randomly selected from players from a Baghdad club in the junior category. The sample consisted of (20) players, aged between (12–14) years, and was divided into two equal groups: (Vít & Reguli, 2015)

- Experimental Group: 10 players
- Control Group: 10 players

The equivalence of the two groups was confirmed in terms of variables (age, height, weight, training duration, and skill level).
Research Equipment and Tools

- Standard table tennis tables (ITTF approved)
- DHS training balls
- Standard rackets for all players
- Measuring tools (medical scale, length gauge)
- Accuracy test form designed specifically for the research (see Appendix 1)
- Scoring form (see Appendix 2)
- Video camera to document performance
- Excel software for preliminary analysis of results

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Tests

The researcher adopted a test specifically designed to measure backhand accuracy. It was designed by placing numbered targets on the opposite half of the table, and the player was asked to execute (10) backhand hits at the targets. Points were calculated based on the number of targets hit accurately. (Levine, 2003)

See Figure (2): Backhand Accuracy Test Form

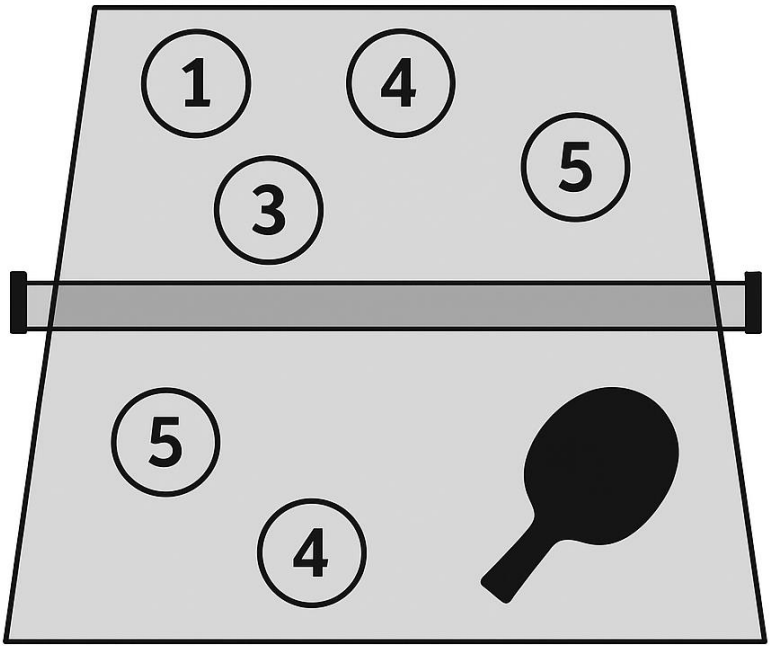

Figure (2): Table Tennis Backhand Accuracy Test Design Model

Main Experiment

The main experiment was conducted from January 15 to March 15, 2025, and included the full implementation of the training program, in addition to pre- and post-tests.

Experimental Procedures:

• Day One: The pre-test was conducted for all sample members using the same performance conditions and tools.

• Eight Weeks: The training program for the experimental group was implemented according to the hand-swap method, at a rate of 3 units per week.

• The control group: continued with regular training without any changes to its technical program.

• Last Day: The post-test was conducted using the same mechanism as the pre-test.

Experimental Control:

- All training and tests were conducted in the club's official hall.
- The same tools were used throughout the experiment.
- All sessions were documented using a video camera for accurate review.

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Exploratory Experiment

The researcher conducted an exploratory experiment on a sample of (4) players who were not part of the original sample. The experiment was conducted over two consecutive days. The aim was to:

- Verify the validity of the equipment and tools used
- Ensure the clarity of the instructions for performing the accuracy test
- Test the exercise execution time
- Determine the feasibility of implementing the training program realistically in a training environment
- Estimate the total time for the daily training session
- The experiment yielded several important observations, most notably:
- The necessity of using fixed targets to determine shooting positions
- Accurately determining the distance between the player and the table during the test
- The appropriate number of attempts (10 shots) to measure accuracy without fatigue

Some aspects of the test were modified based on these observations to ensure the accuracy and reliable reproducibility of the results.

Statistical Methods

The following statistical methods were used to process the data(Ali & Hamid, 2021; Fayyad et al., 2025; Ali et al., 2024):

- Arithmetic mean
- Standard deviation
- Two-independent sample t-test to measure differences between the two groups
- Two-paired sample t-test to measure differences before and after each group(Overman, 2002)

SPSS software was used to enter and analyze the data.

Results

Results of the experimental group (pre- and post-test)

Test Type	Highest Value	Lowest Value	Mean	Standard Deviation	t-value	Significance
Pre-test	6	2	4.10	1.20		
Post-test	9	6	7.60	1.10	8.52	Significant at 0.05

Analysis:

The results show a clear improvement in performance, with the mean increasing from 4.10 to 7.60, and the performance range narrowing from 2–6 to 6–9. The statistical difference demonstrates the effectiveness of the hand-based training program.

→ This relates to the result of the third hypothesis:

There are statistically significant differences in favor of the post-test for the experimental group.

Results of the control group (pre- and post-test)

Test Type	Highest Value	Lowest Value	Mean	Standard Deviation	t-value	Significance
Pre-test	6	2	4.20	1.30		
Post-test	7	2	4.50	1.40	1.13	Not Significant

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No clear changes were observed between the two measurements, and there was no statistically significant difference.
→ This relates to the result of the second hypothesis:
There are no statistically significant differences in the results of the control group.

Differences between the two groups in the posttest

Group	Highest Value	Lowest Value	Mean	Standard Deviation	t-value	Significance
Experimental	9	6	7.60	1.10		
Control	7	2	4.50	1.40	6.72	Significant

Analysis:
The difference is clear between the two groups in favor of the experimental group on the post-test, with an average difference of 3.10 points.
→ This relates to the result of the fourth hypothesis:
There are statistically significant differences between the two groups in favor of the experimental group.

Discussion
Discussion of the results and their connection to the research hypotheses
Discussion of the first hypothesis
Hypothesis: There are no statistically significant differences in the backhand accuracy test for the experimental group before implementing the program.
Result: The pre-test mean was (4.10) and the standard deviation was (1.20).
Interpretation: There were no training interventions at the time of the measurement, so performance remained within the normal range for juniors.
✅ The first hypothesis is correct.
Discussion of the second hypothesis
Hypothesis: There are no statistically significant differences within the control group before and after the program.
Result: The pre-test mean was (4.20) and the post-test mean was (4.50), the difference is not statistically significant.
Interpretation: The absence of directed training or systematic change led to the results remaining similar.
✅ The second hypothesis is correct.
Discussion of the Third Hypothesis
Hypothesis: There are statistically significant differences in favor of the post-test within the experimental group.
Result: The arithmetic mean increased from (4.10) to (7.60), with a significant difference at 0.05.
Scientific Interpretation: Hand-to-hand reciprocal training activates the neural coordination centers and reduces motor bias toward the dominant hand, which improves accuracy and directional ability.
✅ Hypothesis Three is correct.
Discussion of the Fourth Hypothesis
Hypothesis: There are significant differences between the two groups in the post-test in favor of the experimental group.
Result: The difference in the arithmetic mean was (3.10 points) and the value (t) = 6.72.

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Interpretation: The training program based on hand-to-hand reciprocal training was specific and focused on improving accuracy, while the regular program did not produce a clear difference.

✅ Hypothesis Four is correct.

Conclusions and Recommendations

Conclusions

Based on the analysis and discussion of the results, the researcher reached the following conclusions:

- Hand-to-hand cross-training has a clear positive effect on developing backhand accuracy among junior table tennis players.
- The experimental group who underwent the training program showed significant improvement compared to the control group who trained using the traditional method.
- Training using both hands enhances motor balance and improves neuromuscular coordination, which increases target accuracy.
- Traditional training programs, which rely solely on the dominant hand, may not be sufficient to develop full technical performance in complex skills such as the backhand.
- The age group (12–14) is a particularly responsive age group to neuroskill-based training, such as hand-to-hand cross-training.

Recommendations

Based on the results and conclusions, the researcher recommends the following:

- Adopting hand-to-hand cross-training as an essential part of junior table tennis training programs, particularly for developing backhands.
- Develop training curricula that utilize both upper extremities in performing skills, avoiding excessive emphasis on the dominant hand.
- Train coaches on how to design effective cross-training exercises suitable for different ages and levels.
- Conduct subsequent research to apply cross-training to other skills, such as the forehand or serve, and measure its impact.
- Disseminate the results of this research to youth schools and academies in various governorates to enhance technical performance in the early stages of sports development.

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Appendices

Appendix (1)

Sample Training Unit within the Proposed Training Program:

General Information	Details
Unit Title	Developing Backhand Stroke Accuracy Using Cross-Hand Training
Target Group	Junior Table Tennis Players (Ages 12–14)
Unit Duration	45 minutes
Weekly Frequency	3 units per week for 8 weeks
Venue	Official Hall – Baghdad Club

Training Unit Components:

Phase	Time (minutes)	Content
Warm-up	10	General activation drills, arm rotations, dynamic flexibility exercises

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Main	30	- Backhand stroke drills alternating between dominant and non-dominant hand
		- Target-hitting drill from right and left sides (5 attempts per side)
		- Passing drill between two players, switching hands every 3 passes
		- Training game (mini-match) switching hands each point
Cool-down	5	Relaxation exercises – muscle stretching – video error correction

Appendix (2): Backhand Stroke Accuracy Test Results Recording Form

Player No.	Attempt No.	Number of Targets Hit (out of 10)	Performance Notes
A1	1		
A1	2		
A2	1		
A2	2		
...	...		
A10	2		

Recording Instructions:

- Each player performs two attempts, each consisting of 10 backhand strokes.
- The score is calculated based on the number of balls that hit the designated targets on the table.
- Notes may include: good control, aim deviation, hesitation, good stability, etc.