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## The effectiveness of dynamic interval training to developing cardiorespiratory fitness, the ability to repeat speed and the ability to perform lay-up shooting of basketball for players under 19 years of age

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### Abstract

The purpose of the study was to determine how the dynamic lactate interval method-related workouts affected the improvement of cardiorespiratory fitness. Basketball players under the age of 19 must also be able to shoot layups with speed and endurance, and the researcher used an experimental approach with a design that included two groups (the experimental group and the control group) because it was appropriate given the nature of the study. The Imam Al-Muttaqeen Sports Club's 14 under-19 basketball players who would compete in the training season of 2022–2023 were used to determine the study community. The sample was split into two groups with seven players each (the experimental group and the control group). The experimental group completed the exercises, which included (24) training units and were implemented in the special preparation department at a pace of (3) units each week. Depending on the outcomes of the researcher's exploratory experiment, the intensity of the exercises used ranged from (50-90%). From the main section of the training unit, the workouts lasted 43 to 54 minutes. The dynamic lactate-type interval training approach was employed by the researcher. When calculating the rest intervals between repetitions and totals, the researcher counted the heartbeats and the passage of time. One of the most significant findings was that the exercises designed by the researcher using the dynamic lactate method had a positive impact on cardiorespiratory fitness as well as the ability to repeat the speed and endurance of performing the lay-up shooting skill in young basketball players.

**Keywords:** Dynamic interval training, developing cardiorespiratory fitness

### 1. Introduction

Physiology, biochemistry, biomechanics, and kinetic analysis are just a few of the closely related sciences that the science of sports training draws from for a large portion of its theories, foundations, and principles in the execution of its operations. These sciences are combined to work on developing sound scientific foundations that improve the training status of the athlete and help them achieve their best performance. Basketball is one of the team sports that require special physical preparation in order to improve the player's suitability and ability to practice it. This is because the player must move quickly across the field, jump explosively, handle the ball with accuracy and agility while shooting and handling, and speak fluidly while repeating all of these actions. The technique (lactate dynamic interval) is one of the more recent techniques that tries to increase a player's physical and tactical effectiveness throughout the game, particularly in the second half and close to the end of the game, by preserving performance and resistance to fatigue. One of the most important modern training techniques for increasing the effectiveness of both muscular and respiratory work is the alternation of periods of maximum effort and periods of rest. This technique is one of the quickest and most effective for improving cardiorespiratory fitness because it directly influences the heart muscle and blood vessels for brief periods of great high effort that are followed by rest periods. Here, it is apparent that a basketball player must possess the physical and technical ability to repeat speed, as this ability entails maintaining the execution of strong and fast movements at a high

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level of efficiency and at a maximum or submaximal level. This is necessary because one of the characteristics of the game is the variety and instability of the execution of the game's movements, as the competitor's fast movements and the strong's movements must be matched by a double move. From here, it became clear how important it was for the research to focus on creating some physiological variables by teaching coaches physical and skill exercises that would help them improve their athletes' physical and skill performance and advance to higher levels. It also showed them how to measure some physiological variables that were closely related to the athletes' physical and skill performance by creating dynamic interval lactate training and examining its impact.

### 1.1 Research problem

In order to be able to play at a high enough level throughout the entire game, especially in the second half and the final minutes, the modern game of basketball demands that the player be characterized by high physical capabilities and very high-performance endurance. The player's level of performance declines, particularly in the final period of the game, according to the researcher's observations as a former player and current coach. This is reflected in the player's ability to maintain his attack and defense speed as well as his lay-up shooting performance, which impacts the game's outcome. The majority of matches were analysed, and a conclusion was drawn. The level of performance of the players, which frequently declines, especially in the third and fourth periods, as the effectiveness of participation of players in the competition and in both defense and attack, is a result of some coaches' lack of sufficient interest in exercises related to the physiological aspect.

In order to improve the player and give him high physical and physiological capabilities that allow him to perform lay-up shooting and the majority of the offensive skills in the most effective manner throughout the match period, the researcher set out to study this problem through the application of a modern training method (dynamic lactate interval).

### 1.2 Research objective

- Preparing exercises for the dynamic lactate interval technique for basketball players under 19 years old.
- To determine how the dynamic lactate interval technique exercises affect the growth of cardiorespiratory fitness, the capacity for repetition speed, and the capacity for lay-up shooting in basketball for players under the age of 19.
- Identifying the preference of the differences between the experimental group and the control group in the development of cardiorespiratory fitness, the ability to repeat speed, and the ability to perform lay-up shooting in basketball for players under 19 years of age.

### 1.3 Research hypothesis

- The exercises of the dynamic lactate interval method have a positive effect on the development of cardiorespiratory fitness, the ability to repeat speed, and the ability to perform lay-up shooting in basketball for players under 19 years of age.

### 1.4 Research fields

**The human field:** Players of Imam Al-Muttaqeen Sports Club in basketball, under the age of 19, for the 2022/2023 training season.

**Time field:** from 10/11/2022 to 15/1/2023.

**Spatial field:** Muhammad Baqir Al-Hakim Sports Hall and the Physiology Laboratory are both located in the Kerbala Governorate's College of Physical Education and Sports Sciences, respectively.

### 1.5 Search terms

1. **Dynamic Interval Lactic:** It is a training method in which lactate production is deliberately increased by the training intensity of the exercises and then alternated with periods of low-intensity activity (active recovery). In this method, the muscle cells are trained to both use and remove the lactate produced during the low-intensity recovery period. This alternating pace and pace results in a dramatic improvement in sprinting or economic performance, VO<sub>2</sub> max, maximum oxygen consumption, and all of these variables are powerful predictors of performance (strong indicators of performance quality).
2. **Cardiorespiratory fitness:** In order for cells, particularly muscles, to produce energy, oxygen must be taken in by the heart and respiratory systems, transported via the blood, and extracted from the cells. (Aziz, Fadel Hussein, 2015, p. 25) <sup>[1]</sup>
3. **Repeated-Sprint Ability:** It is the ability to perform short-term maximum speeds repeated over a short period of time, which is characterized by the ability to maintain the performance of maximum speeds as represented by the fatigue index. (Al-Hijami, Hussein Mnaty Sachit, 2020, p. 76) <sup>[2]</sup>

## 2. Research methodology and field procedures

### 2.1. Research Methodology

Due to its applicability to the nature of the research, the experimental approach was employed in the experimental design of the two groups (experimental and control).

#### 2.1.1 Community and sample research

14 basketball players from the Imam Al-Muttaqeen Sports Club who are under the age of 19 and will participate in the training season in 2022–2023 will make up the research community. Seven players were split between the two groups (experimental and control) in the sample.

##### 2.1.1.1 Homogeneity and equivalence of the sample

The homogeneity and equivalence of the two research groups were found in the basic variables (height, mass, training and chronological age, as well as cardiorespiratory fitness, the ability to repeat the speed, and the endurance of the lay-up shooting performance in order to start from one starting line. And as shown in Table (1, 2).

**Table 1:** The homogeneity of the sample is displayed

N	Variables	Unit	Value of (Leven) test		Sig type
			Calculated	Standard error	
1	Age	Year	1.222	.397	Non
2	Training age	Year	0.565	.541	Non
3	Mass	Kg	0.198	.985	Non
4	Length	Cm	1.232	.343	Non

**Table 2:** It shows the pre-test means, standard deviations, calculated (t) values, and the significance of the differences between the control and experimental groups.

Variables	Unite	Control		Experimental		T value	Sig level	Sig type
		Mean	Std. deviation	Mean	Std. deviation			
cardiorespiratory fitness	ml/kg min	36.985	1.580	37.400	1.306	0.607	0.509	Non
The ability to repeat speed best time	Second	4.820	0.603	5.133	0.375	1.080	0.397	Non

Lay-up shooting performance	Endurance	Degree	9.547	2.998	9.012	2.772	1.563	0.232	Non
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The values of (sig) appear to be bigger than (0.05) in the preceding two tables (1, 2), which suggests that the differences are random and validates the homogeneity and equality of the two research groups in all of the tests under discussion.

## 2.2. Means, devices and tools used in the research:

### 2.2.1. Means of collecting information

- Observation.
- Tests and measurements.

### 2.2.2. Equipment and tools used in the research:

- Fitmat Pro, made in Italy.
- Ortcab bike.
- A tape measure for length.
- A medical scale to measure weight.
- A legal basketball court.
- 15 legal basketballs.
- Indicators number 10.
- Electronic stopwatches.

## 2.3. Field research procedures:

### 2.3.1. Characterization of physiological tests (cardiorespiratory fitness)

**First: Bruce Test:** (Shamkhi, Ghassan Bahri, 2012, p. 67) <sup>[3]</sup>

**The aim of the test:** is to measure the maximum oxygen consumption VO<sub>2</sub> max.

**Equipment and tools:** Fit mate Pro device using the Trad mail device.

**Performance description:** The data of the laboratory is entered, as required, into the Fit mate pro device, and then a test for the VO<sub>2</sub>max index is selected.

1. The tester performs a simple warm-up on the treadmill by controlling the speed for a period of (3-5) minutes before performing the actual test.
2. The tester climbs on the treadmill and then promises to wear the heart rate belt and the mask for the VO<sub>2</sub> max indicator of the Fit mate pro.
3. Start the treadmill and then turn on the Fit mate Pro, which was previously set to test the VO<sub>2</sub> max index.
4. Here Bruce's method begins to perform the gradual effort, as the person in charge of the test promises to increase the speed and slope of the treadmill every three minutes (increase the intensity every three minutes) according to Bruce's stress test schedule fit mate pro.

#### Register:

The result is given by the device of the relative VO<sub>2</sub>max value, measured in milliliters/kg/min.

**Second: the ability to repeat the speed test:** (Bangsbo, J., 1994, p.212) <sup>[4]</sup>

**Purpose of the test:** To measure the ability to repeat the speed.

**Required tools:** indicators - tape measure - stopwatch - flat ground.

**Performance:** The test is done by running at maximum speed (7 repetitions) for a distance of 30 meters while giving (25

seconds) a positive rest.

**Register:** The time for each iteration is recorded and calculated as follows: The best time (which is the least time achieved during the test).

**Third: Performance test, the skill of lay-up shooting in basketball:** (Hosseini Sayed Ayoub & others, 2005, p. 203) <sup>[5]</sup>

Lay-up shooting test for (45) seconds.

**The purpose of the test:** Basketball lay-up shooting performance evaluation.

**Performance:** The tester returns to take a second ball on the chair and on the free throw line to finish the lay-up shooting up to (45) seconds after performing the lay-up shooting in any direction he chooses upon hearing the whistle. The tester is standing on the free throw line with the ball in both hands.

**Register:** The number of injuries is calculated within 24 seconds.

## 2.4. Exploratory Experience

A sample of five players was subjected to the exploratory experiment on Tuesday, October 11, 2022, at 3:00 pm in the Imam Al-Muttaqeen club hall. The purpose was to determine whether the tools and equipment utilised in the research were appropriate. The length of time it took to run the tests.

## 2.5 Pre-tests

Pre-tests were conducted on Sunday 15/11/2022 at exactly three o'clock in the afternoon in the basketball hall of the Imam Al-Muttaqeen Club, and the data was emptied into a form prepared for this purpose and treated statistically.

## 2.6 Exercises for the dynamic lactate interval technique

The exercises were applied by the experimental group in the special preparation section and were as follows:

1. There were 24 training units total in the exercises, with 3 units being used each week.
2. Depending on the outcomes of the researcher's exploratory experiment, the intensity of the exercises utilised varied from (50-90%).
3. The exercise period from the main section of the training unit lasted 43 to 54 minutes.
4. The study made use of the dynamic lactate technique and interval training.
5. To calculate the rest intervals between repeats and totals, the researcher used the number of heartbeats and the passage of time.

## 2.7. The main experience

From November 20, 2022, until January 25, 2023, the researcher used the exercises created utilizing the dynamic lactate approach on the experimental research sample.

## 2.8. Post-tests

Then, on January 27, 2023, at three o'clock in the afternoon, testing and post-measurements were carried out in the stadium of Imam Al-Muttaqeen Sports Club. The provision of conditions that were comparable to the pre-tests in terms of (time, place, tools utilised, and way of performing the implementation of the tests) was taken into consideration by the researchers.

## 2.9. The statistical methods used in the research



The statistical package (SPSS) was utilised by the researchers.

### 3. Results presentation, analysis, and debate

#### 3.1 Presenting, examining, and discussing the experimental and control groups' findings with reference to the variables being examined.

#### 3.1.1 Outlining and analyzing the findings of the variations in the variables examined between the control group's pre-and post-tests

For the variables under consideration, Table 3 shows the means, standard deviations, calculated (t) values, and (sig) values between the control group's pre- and post-test findings.

**Table 3:** shows the means, standard deviations, calculated (t) values, and (sig) values between the control group's pre- and post-test findings

Variables	Unite	Pre-test		Post-test		T value	Sig level	Sig type
		Mean	Std. deviation	Mean	Std. deviation			
Cardiorespiratory fitness	ml/kg min	35.985	1.580	37.908	3.998	3.967	.023	Sig
The ability to repeat speed best time	Second	4.820	0.603	4.321	1.004	3.723	.013	Sig
Lay-up shooting performance Endurance	Degree	9.547	2.998	10.897	1.932	7.839	0.021	Sig

#### 3.1.2. Presenting and analysing the findings of the variations between the experimental group's pre-and post-tests for the studied variables.

**Table 4:** Displays the means, standard deviations, calculated (t) value, and (sig) value between the experimental group's pre-and post-test results for the variables under investigation.

Variables	Unite	Pre-test		Post-test		T value	Sig level	Sig type
		Mean	Std. deviation	Mean	Std. deviation			
cardiorespiratory fitness	ml/kg min	37.403	1.306	41.873	3.923	7.943	0.000	Sig
The ability to repeat speed best time	Second	5.133	0.375	4.231	1.032	5.231	0.000	Sig
lay-up shooting performance Endurance	Degree	9.012	2.772	11.539	1.886	13.892	0.000	Sig

#### 3.1.3 Displaying the results of the differences between the two post-tests for the control and experimental groups in the variables studied

**Table 5:** Shows the value of (t), the level of error, and the significance of the differences between the results of the post-test for the control and experimental groups in the variables studied.

Variables	Unite	Experimental		Control		T value	Sig level	Sig type
		Mean	Std. deviation	Mean	Std. deviation			
cardiorespiratory fitness	ml/kg min	41.873	3.923	37.908	3.998	11.975	.000	Sig
The ability to repeat speed best time	Second	4.231	1.032	4.321	1.004	9.423	0.000	Sig
lay-up shooting performance Endurance	Degree	11.539	1.886	10.897	1.932	7.552	0.000	Sig

Significant at the level of significance (0.05) if the error level is less than (0.05).

### 4. Discussing the results:

Table Nos. 3–4–5 showed us the test and post-measurement findings for the two groups (control – experimental). The results showed that the experimental group fared better than the control group in terms of the cardiorespiratory fitness variable. The nature of the workouts used on the research sample, according to the researcher, is what caused the experimental group to outperform the control group. The (dynamic lactate interval) exercises increased the stress on the respiratory and circulatory systems, therefore researchers looked for ways to improve their performance as well as the amount of energy stored in muscle fibres and make an effort to burn lots of calories. According to the American College of Sports Medicine (ACSM), exercising with high intensity and little rest will help you burn a lot of calories while also accelerating the growth of your heart and blood vessels. (Al-Abdullah, Jamal Sabri Faraj, 2019, pp. 98-99) [6]

There are also a number of American studies that "confirm that regular (dynamic lactate) exercises affect blood vessels, similar to the effect that is affected by drug abuse, which confirms that sport plays an important and effective role in improving the efficiency of the respiratory and circulatory systems as well as lowering blood pressure and cholesterol concentration both of which have a detrimental effect on heart health. (Barry L. Zaret, Genell J. Subak-Sharpe, 2006, p: 76) [7].

The efficiency of exercises in the dynamic lactate style, as well as their successful implementation and compatibility

with the players' abilities, are credited by the researcher for the improvement in the variable of the ability to repeat the speed and in favour of the experimental group. Due to its correct, varied, and high-stress scientific foundations, it had a positive impact on the development of the capacity to repeat speed and in delaying the onset of fatigue as well as maintaining the level of performance for as long as possible, which in turn affected the performance of other variables in the search and improved the results during the application of. The researcher also attributes this improvement as a result of the effectiveness of the exercises he performed in the high-intensity interval training method, which is commensurate with the game of basketball in terms of running at a maximum or less than maximum speed, as it had a clear role and an effective effect in improving and developing the ability to repeat the speed. Mustafa Tantawi (2015) [8] mentions that "interval training at maximum speed is one of the basic determinants that help improve the ability to repeat speed in team games, including basketball" (Tantawi, Mustafa Hassan, 2015, p. 285) [8], these results are also consistent with what Kerry McGawley and D. Taylor (2010) [9] has suggested that "interval training at maximum speed may be an effective approach to developing the ability to repeat speed in players through increases in work performed during each repetition at speed and decreases in work performed during series of repetitions performed in the test. (Kerry McGawley and D. Taylor, (2010, p. 61) [9].

The results of the post-tests between the two groups (the control and the experimental) in the lay-up shooting

endurance test were shown to significantly favour those in the experimental group, as shown in tables 3–6. The researcher attributes this to the players' careful attention to this crucial ability and their need for it, as well as their willingness to devote enough training time to it. It was crucial for the young players who made up the research sample to have a foundation in how to move inside the field, how to take advantage of open spaces, and how to get rid of the defender in order to receive the ball in a good position that enables him to score a hit through lay-up shooting, in addition to paying attention to the skill without the ball and connecting it to the offensive skills with the ball. The researcher was eager to practise and carry out them effectively, so he made all of the prepared activities stop when they were implemented with this skill. This impressive advancement resulted from the experimental study sample due to the widespread interest in the skill: "Because these exercises attempt to improve the athlete's physical capacity by utilising abilities and movement patterns comparable to the type of specialisation (Similar to the needed sport) (Al-Bashtawi, Muhannad Hassan & Al-Khawaja, Ahmed Ibrahim, 2010, p. 325) <sup>[10]</sup>.

Regular, high-intensity anaerobic training, according to the researcher, is another factor that contributes to the accumulation of significant amounts of lactic acid after training. This is because high-intensity anaerobic training increases the ability of the athlete's body's internal organs to break down a significant amount of glycogen in order to restore the compound (ATP) inside the muscle cell by anaerobic action of sugar dissolution, which results in the accumulation of lactate (Raisan Khraibet Majeed, 1999) <sup>[11]</sup> that the increase in lactic acid in the muscles and blood in many cases of fatigue is caused by the decomposition of glycogen (Majeed, Risan Khraibet, (2015,p.69) <sup>[11]</sup>. (Abu El-Ela Ahmed, 2003) <sup>[12]</sup>, he mentions the observation of physiological changes associated with adaptation to anaerobic work with the lactic acid system, which appear in the increase in the ability of fast muscle fibres in the process of breaking down glycogen to produce energy in the absence of oxygen (anaerobic glycolysis), as the maximum anaerobic energy for untrained people reaches 13 mmol/A litre of lactic acid, while well-trained athletes are 25-30 mmol/litre (Ahmed, Abu El-Ela, 2003, p. 308) <sup>[12]</sup>.

## 5. Observations and suggestions

### 5.1 Observations

1. The exercises prepared by the researcher using the dynamic lactate method had a positive effect on cardiorespiratory fitness, the ability to repeat the speed, and the ability to perform the skill of lay-up shooting in youth basketball.
2. The occurrence of physiological adaptations of the players in the variables studied, and it turned out that there is a clear improvement in the number of heart beats despite the short period of time, which is due to the effectiveness of dynamic lactate exercises.
3. The sample of the research did not pass the specific stages of the global Bruce protocol and was confined between the sixth and seventh stages of the test.

The global Bruce test is one of the appropriate tests for such a sample in terms of effort, cost and availability of tools.

### 5.2. Suggestions

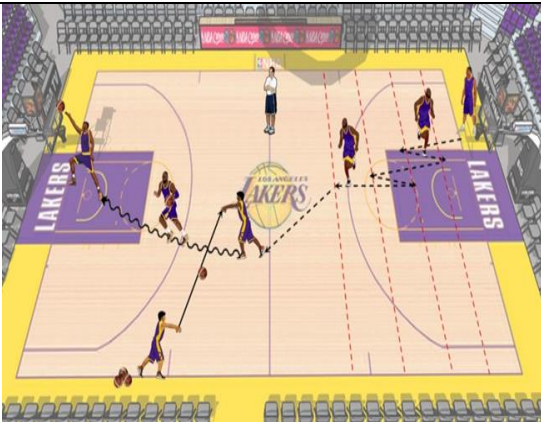



1. Adoption of the exercises prepared by the researcher in a dynamic interval lactate style within the training program for the trainer to develop the physiological variables (under study) and the performance endurance of the skill of lay-up shooting in youth basketball.
2. The need to conduct similar studies on physical and physiological variables and other samples.
3. The researcher recommends the use of dynamic interval lactate exercises for different age groups and for other games.

### 6. References

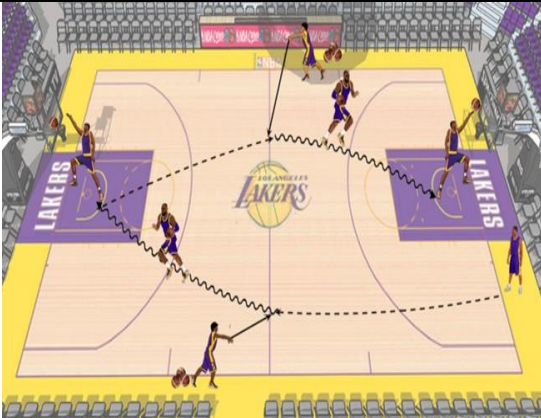
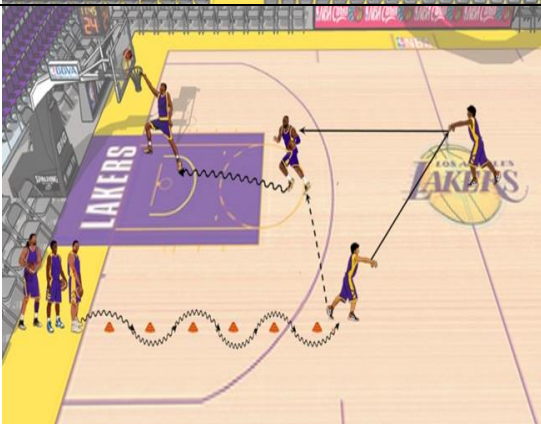
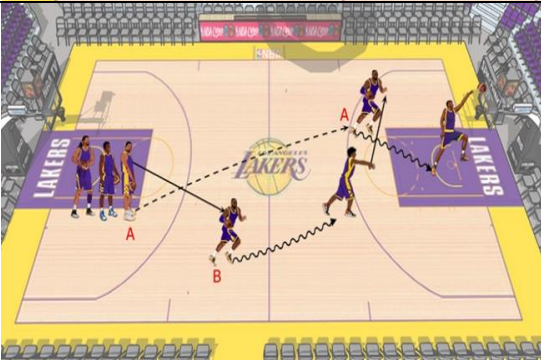
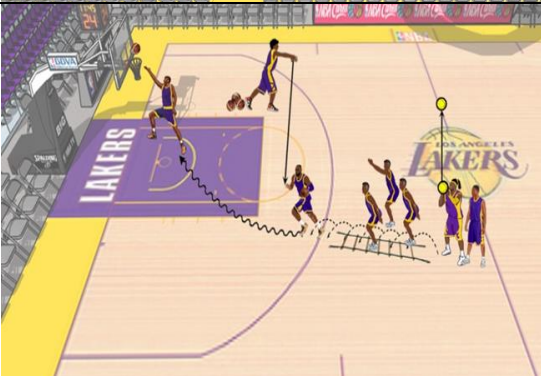
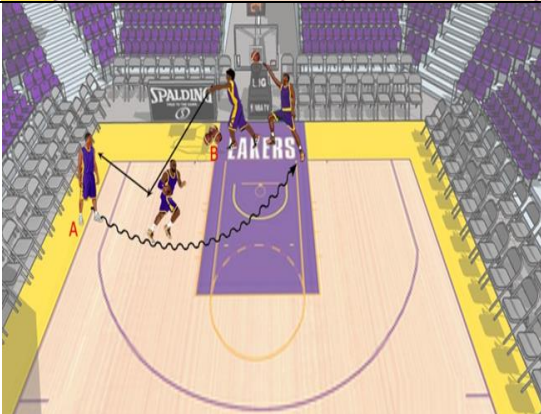
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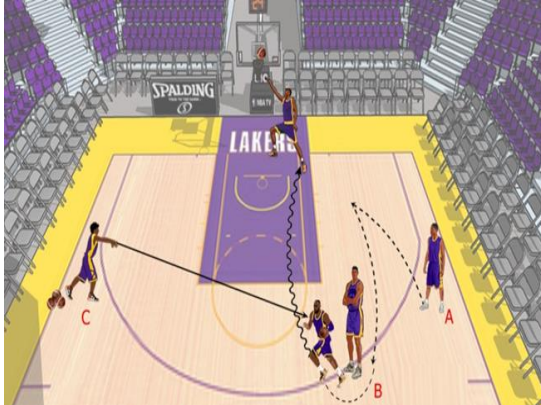

**Appendix (1)**

Exercises used in the research

N	Exercises	Forms of exercise
1	<p>The backyard of the stadium is divided into four areas, the player stands on the end line of the stadium, the exercise begins when the player quickly runs towards the first section, returns to the end line of the stadium, then to the second section, returns to the first section, then to the third section, returns to the second section, then to the fourth section and then he receives the ball from the colleague standing on the side line, performs the tapping, and then lay-up shooting</p>	
2	<p>The player stands on the end line of the field and jumps with both legs on the agility ladder, then runs quickly and receives the ball from the teammate standing on the side line of the stadium, where he performs the tapping and then lay-up shooting</p>	
3	<p>The player stands behind the end line of the court, where he runs a distance of (10 m), then jumps with both legs on the agility ladder, then performs a quick run, performs a rotation, runs in the opposite direction, jumps with both legs on the agility ladder, then receives the ball from a colleague, performs a tap and lay-up shooting</p>	
4	<p>The player stands in the middle of the field, starts by tapping the ball, then performs a lay-up shooting, then returns again by performing a tapping and lay-up shooting for (20 seconds).</p>	



<p>5</p>	<p>The player stands on the end line of the field, then starts a quick run, then receives the ball from a colleague from the middle of the field, performs tapping and shooting peacefully, then returns quickly and receives the ball from a colleague, performing tapping and lay-up shooting</p>	
<p>6</p>	<p>The player stands on the end line of the court and taps the ball between the cones at a distance of (6m), then passes the ball to the player standing in the middle of the field, who in turn returns the ball to the same player who performs the tapping and lay-up shooting</p>	
<p>7</p>	<p>The player stands behind the free throw line, where the player (A) passes the ball to the player (B) and then runs towards the basket so that the player (B) taps the ball and then passes it to the player (A) to lay-up shooting</p>	
<p>8</p>	<p>The player stands four meters after the three-point arc and works to throw the medicine ball (2 kg) to the top (3 times), then jumps with both legs over the agility ladder, then receives a handling from the fellow player, then performs the tapping and lay-up shooting.</p>	
<p>9</p>	<p>Player (A) stands to the side of the court and behind the three-point line, while player (B) stands under the basket. The exercise begins when player (B) bounces back to player (A) performs the flick and performs the lay-up shooting</p>	

10	<p>Player (A) performs a skill (V.cat), then rotates behind player (B) and receives the ball from player (C), then performs the tapping and lay-up shooting.</p>	
11	<p>The player stands at the end line of one of the sides of the court, and the coach places (5) signs, the distance between one person and another is (1.5) m. The exercise begins when the player, who is carrying the ball, starts flapping between the figures, and after completing the signs, he returns to the basket and performs the lay-up shooting.</p>	

**Appendix (2)**

Training unit sample

Week: first

Training unit: first.

Time: 43.30 min

Intensity: 50 %- 80%

Weeks	Exercises	Repetition	Repetition time	Intensity	Rest between repetitions	Groups	Rest between groups	Rest between Exercises	Total exercise time
First week	Fifth	1	45 second	85%	90 second	1	-	3 min	13.15 min
		2		50%					
		3		80%					
		4		60%					
		5		85%					
	Tenth	1	60 second	85%	120 second	1	-	4 min	17min
		2		50%					
		3		60%					
		4		80%					
		5		85%					
	Sixth	1	45 second	85%	90 second	1	-	3 min	13.15 min
		2		50%					
		3		60%					
		4		80%					
		5		85%					
Total time									43.30 min