

## **Effect of Developing Core Strength and Dynamic Flexibility on Accuracy and Velocity of Performance of some Essential Skills in Tennis**

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**Introduction and research problem:**

**Modern athletic training depends on science as a basis to obtain better results so the teacher should follow everything new in the field of training constantly to be able to present the best thing in this field and to raise the level of skill performance. Core strength exercises are considered the best training technique as many and various exercises are used that help strengthen core muscles. The core area leads to increase the ability of girls to achieve workouts very well that represent the origin of motion.**

**Nadler & Akuthota (2004)<sup>(16)</sup> stated that core muscles worked to carry the whole power resulted from the lower extremity through the trunk to the upper extremities and sometimes the tool held in the hand and consequently, the core muscles weakness would not lead to carry the dynamic power fully from the bottom to the top and the athletic performance would be worse as well as the possibility of occurring injuries. For this reason it is postulated that improving the core strength will necessarily lead to improve the athletic performance. Hence, core strength exercises are commonly used among coaches in all athletic games <sup>(16: 68)</sup>**

**Flexibility plays a great role in avoiding several injuries as it is characterized by a dynamic range in a joint different from the same in another. The ability of a muscle or a set of muscles to extend is different from another muscle or a set of muscles. It is important to develop the flexibility trait as it is different from other physical fitness components that the insufficient level of flexibility and the extent of its shortage can lead to injuries; motor performance becomes more difficult and slow down the velocity of perfection of skills.**

**Tennis is the most common sport spreading in the progressed world countries as it has enjoyment and excitement and it is suitable for all ages, moreover, attacking performances in tennis have a special nature because they depend on acts of legs and arms and coordination between them and tools used, hence, the strength of performance is associated with velocity that is different from position to another together with the agility in carrying out essential skills throughout the time of performance.**

**The researcher noticed through teaching the subject of tennis to girls at Faculty of Physical Education for Girls that the level of skill performance in tennis was low in general and the level of performance of straight forehand and backhand strokes in girls in the 1<sup>st</sup> grade in particular. The researcher noticed that faults were existed in body hardening and action was not performed freely and individual differences among girls were wide as they had no idea about tennis, moreover, the 1<sup>st</sup> grade represents the start of studying tennis that required from their performers to be free, to carry his actions, to do some velocityacts, flexibility and power exerted. The girl could not master the skill performance in case of the lack of physical abilities.**

**The abovementioned facts agreed with conclusions achieved by Marwan Ali (2003)<sup>(8)</sup> and Amr Saber (2008)<sup>(3)</sup> that training on the skill only was not enough to improve such skill and to obtain fruitful results as the improvement of the skill necessarily required improving dynamic abilities of the skill itself. Therefore, the researcher suggested conducting a workout to lay out core strength and dynamic flexibility exercises to help perform straight forehand and backhand strokes accurately and velocityin tennis.**

**Research objective:**

**To identify the effect of improving exercises of core strength and dynamic flexibility on accuracy and velocity of performance of straight forehand and backhand strokes in tennis in girls in the 1<sup>st</sup> grade.**

**Terms and concepts: Core strength exercises: Previously were used in the name of core stability exercises in the field of physiotherapy widely until sports scientists have developed them and established**

training fundamentals for such exercises and finally they have been called core strength exercises to improve and to strengthen core muscles considered the origin of motion (24:198).

**Flexibility:** The ability to perform movements to a wide range without lacerations in ligaments or muscles (9:74).

**Related studies:**

**I. Studies related to core strength**

1- Study of Justin Shinkle (2010)<sub>(22)</sub>.  
(2009)<sub>(32)</sub>

2- Study of Thomas *et al.*

3- Study of Renee Zingaro (2008)<sub>(30)</sub>  
Reabum (2004)<sub>(31)</sub>

4- Study of Stanton &

**II. Studies related to dynamic flexibility:**

5- Study of Darin Mostafa (2009)<sub>(4)</sub>  
(2004)<sub>(15)</sub>.

6- Study of Shirin Taha

7- Study of Ahmed Anwar (2003)<sub>(1)</sub>.  
(2001)<sub>(18)</sub>

8- Study of Cohen *et al.*

**Conclusions from the related studies:**

They focused on the effectiveness of core strength exercises programs and exercises for extension and flexibility and their role in improving physical and skill abilities. The researcher could outline how to make benefits from such studies to follow them in the current study.

**Research procedures:**

**Method:** The researcher used the experimental method of two groups representing the experimental and control groups and the pre and post-measurements.

**Research community:** Girls in the 1<sup>st</sup> grade at Faculty of Physical Education for Girls, Cairo, Helwan University in 2015/2016 academic year amounting to (333) girls.

**Sample:**

It was selected randomly and intentionally from girls in the 1<sup>st</sup> grade amounting to (60) girls by (18%). They were divided into two groups representing the experimental group and the control group of (30) girls each in addition to (12) girls for the pilot sample from the

same research community. The sample was selected for the reason that the researcher has been teaching such branches.

Normality of the research sample distribution: Tables (1&2) show the same after making scientific treatments on tests.

Table (1): Arithmetic mean, standard deviation and skewness coefficient of the sample in anthropometric variables. (n=60)

Variables	Measurement unit	X <sup>-</sup>	SD	Skewness coefficient
Age	Year	018.250	0.437	1.185
Height	cm	164.050	4.615	0.101
Weight	kg	58.650	5.659	-0.311

Data in Table (1) illustrate the normality of the sample distribution as the skewness coefficient ranges between(1.185 and -0.311) laying on ( $\pm 3$ ) and indicating that the research community is normal in age, height and weight variables.

Table (2): Arithmetic mean, standard deviation and skewness coefficient in physical and skill variables. (n=60)

Variables	Tests	Units	X <sup>-</sup>	SD	Skewness coefficient
Physical	Hexagonal dynamic balance test	Time	42. 163	6. 270	-0.380
	Test of the spidery feet movements	Time	41. 037	3. 788	0.533
	Test of standing bend the trunk	cm	49. 250	2. 555	-0.856
	Lying down bending knees position sitting	Number	3.0 17	0. 854	0.644
	Test of shooting at perpendicular rectangles	Score	1.5 17	1. 359	0.990
Skill	Test of velocity of forehand stroke performance	Number	1.5 33	0. 724	1.266
	Test of velocity of backhand stroke	Number	0.7 33	0. 578	0.084

performance.

The results in Table (2) indicate that the sample distribution is normal as the skewness coefficient ranges between (1.266 and 0.084) i.e. within ( $\pm 3$ ) meaning that the research sample represents a normal community in respect of the research variables.

Research sample equivalence:

After assuring of the normality of the sample distribution, the sample was randomly divided into two groups representing the experimental and the control groups of (30) girls each. The equivalence of the two groups was made as shown in Tables (3 & 4).

Table (3): Significance of differences between the experimental and the control groups in anthropometric variables.

Variables	Measuring units	Experimental group (n=30)		Control group (n=30)		Two means differences	“t” values
		X <sup>-</sup>	SD	X <sup>-</sup>	SD		
Age	Year	18.267	0.450	18.233	0.430	0.033	0.293
Height	cm	163.933	4.646	164.167	4.662	-0.233	0.194
Weight	kg	57.633	5.236	59.667	5.967	-2.033	1.403

The value of the tabulated “t” at 0.05 level of significance and 58 degree of freedom = 2.01 and the results in Table (2) show that there are no significant differences between means; hence, the two groups are equivalent.

Tables (4): Significance of differences between the pre-measurements of the experimental and control groups in physical and skill variables.

Variables	Tests	Units	Experimental group (n=30)		Control group (n=30)		Two means differences	“t” Values
			X <sup>-</sup>	SD	X <sup>-</sup>	SD		
Physical	Hexagonal dynamic balance test	Time	41.168	6.747	43.158	5.694	-1.990	1.235
	Test of the spidery feet	Time	40.2	3.67	41.8	3.78	-1.597	1.65

	movements	e	39	6	35	9		6
	Test of standing bend the trunk	cm	49.100	3.133	49.400	1.850	-0.300	0.452
	Lying down bending knees position sitting	Number	3.167	0.913	2.867	0.776	0.300	1.371
	Test of shooting at perpendicular rectangles	Score	1.800	1.518	1.233	1.135	0.567	1.638
Skill	Test of velocity of forehand stroke performance	Number	1.667	0.802	1.400	0.621	0.267	1.439
	Test of velocity of backhand stroke performance.	Number	0.833	0.592	0.633	0.556	0.200	1.349

The value of tabulated “*T*” at 0.05 level of significance and degree of freedom 58=2.01 and the results in Table (4) show that there are no significant differences; hence, the two groups are equivalent in such variables.

#### Tools of collecting data:

- 1- Reviewing the basic data: through documentary analysis of records at Dept. of Student Affairs at the Faculty.
- 2- Scientific references and related studies: The researcher used nos. (1)(8)(6)(13)(12)(7)(24)(33) to outline physical fitness components and tests to measure them and tests of the level of skill performance and also to design some exercises to develop core strength and exercises to improve dynamic flexibility.
- 3- Web sites: to help obtain exercises to develop core strength and dynamic flexibility, images and teaching videos of straight forehand and backhand strokes.
- 4- Equipment and tools used: (restameter, measuring tape, medical balance, stopwatch and lap top, chawks, Swedish bench, tennis balls).
- 5- Personal interview: to get initial information to build the questionnaire form to outline the following:

- a. Physical fitness components appendix (2) and test of their measurements appendix (3). Tests were defined as per percentages obtained appendix (4).
  - b. Tests of skill performance for the straight forehand and backhand strokes, appendix (5). Tests have been defined as per percentages obtained, appendix (6).
  - c. Contents of the proposed teaching units by using exercises to develop core strength and exercises to develop dynamic flexibility with the relevant procedures. The results have been defined, appendix (7) as per opinions of experts.
- 6- Tests: Tests of physical fitness components: they have been defined by reviewing scientific references (5), (10), (11) in addition opinions of experts and the tests were (hexagonal dynamic balance in time, the spidery feet movements in time, standing bend the trunk in cm, lying down bending knees position sitting in numbers, shooting at perpendicular rectangles in scores).

**Skill tests:** A questionnaire form has been prepared to define the suitable tests after reviewing referential survey of tests of skill performance (1), (2), (3) which were presented to experts. Tests were: (velocity of performance of forehand stroke and velocity of performance of backhand stroke).

**Validity of physical and skill tests:** by terminal comparison between the upper quartile and the lower quartile of girls in the 1<sup>st</sup> grade of (12) girls from the research community. The scores of those girls were arranged in ascending order to outline the upper quartiles of (3) girls and the lower quartiles of (3) girls. Significance of differences between them was computed as shown in Table (5).

**Table (5):** significance of differences between the upper and lower quartiles in physical and skill tests (n1=n2=3).

Variables	Tests	Units	Upper quartile		Lower quartile		2 mean s difference	“t” Values	Sig .
			X <sup>-</sup>	SD	X <sup>-</sup>	SD			

							S	*	
Physical	Hexagonal dynamic balance test	Time	34.630	0.520	48.603	0.473	13.973	34.43	0.000
	Test of the spidery feet movements	Time	37.767	1.562	45.977	2.349	8.210	5.041	0.007
	Test of standing bend the trunk	cm	54.000	1.000	43.333	2.517	10.667	6.822	0.002
	Lying down bending knees position sitting	No.	4.333	0.577	2.333	0.577	2.000	4.243	0.013
	Test of shooting at perpendicular rectangles	Score	3.667	0.577	1.333	0.577	2.333	4.950	0.008
Skill	Test of velocity of forehand stroke performance	No.	2.333	0.577	0.667	0.577	1.667	3.536	0.024
	Test of velocity of backhand stroke performance.	No.	1.667	0.577	0.333	0.577	1.333	2.828	0.047

The value of tabulated “*T*” at 0.05 level of significance and 4 degree of freedom = 2.78 and the results in Table (5) show that there are significant differences in favor of the upper quartiles and the computed “*T*” ranges between (2.828 and 34.43) i.e. more than the value of tabulated “*T*” meaning that such tests of high validity.

Stability of physical and skill tests:by test and retest method after (5) days from the end of applying the 1<sup>st</sup> application. The 2<sup>nd</sup> application was carried out on a sample of girls from the 1<sup>st</sup> grade and from the same research community and the researcher considered the same conditions of the 1<sup>st</sup> application and correlation coefficient was computed between the two applications.

Table (6): Correlation coefficients between the 1<sup>st</sup> and 2<sup>nd</sup> applications of physical and skill tests (n=12).



Variables	Tests	Units	1 <sup>st</sup> application		2 <sup>nd</sup> application		Correlation coefficient	Sig.
			X <sup>-</sup>	SD	X <sup>-</sup>	SD		
Physical	Hexagonal dynamic balance test	Time	41.888	6.166	41.321	5.823	.948*	0.000
	Test of the spidery feet movements	Time	40.802	3.704	40.385	4.140	.938*	0.000
	Test of standing bend the trunk	cm	48.750	4.634	48.333	4.228	.951*	0.000
	Lying down bending knees position sitting	No.	3.333	0.985	3.250	0.866	.959*	0.000
	Test of shooting at perpendicular rectangles	Score	3.333	0.985	3.250	0.866	.769*	0.003
Skill	Test of velocity of forehand stroke performance	No.	1.333	0.779	1.417	0.900	.951*	0.000
	Test of velocity of backhand stroke performance.	No.	1.000	0.603	0.917	0.669	.902*	0.000

The value of the tabulated “*r*” at 0.05 significance level and 24 degree of freedom = 0.576 and the results in Table (6) show that there is a significant correlation in the range between (0.769 and 0.959) i.e. more than the value of the tabulated “*r*” meaning that the tests are stable.

**Pilot study:**It was conducted on a random sample of (12) girls from the 1<sup>st</sup> grade and from the same research community from 18/10/2015 to 22/10/2015.

**Result of the pilot study:**

- a. As confirmed the tests were suitable for girls who understood the performance technique after modifying the following tests

(shooting at perpendicular rectangles. The girls stood at the distance of 4m. instead of 11.8m. from the wall. The velocity of performance of forehand stroke. The girls stood at the distance of 4m instead of 8m. from the wall. The velocity of backhand stroke. The girls stood at the distance of 3m. instead of 8m.) from the wall, Appendix (4).

- b. Scientific treatments of tests were verified. Female assistants understood the role assigned to them in measurements and recording processes.
- c. The educational unit was suitable for the sample and time allocated for each part in the unit was suitable.

**Applying the research experiment:**

**Premeasurements:** They were conducted on the experimental and control groups in variables under investigation from 27/10/2015 to 29/10/2015 in which the anthropometric measurements and physical and skill tests were carried with the same persons assigned for the measurement process and time of measurement.

**The experimental group:** The researcher applied the research experiment to the 1<sup>st</sup> grade girls in the college on 3/11/2015 to 10/12/2015 for 6 weeks by two educational units a week outside the main school schedule with total of (12) educational units for each group. The unit lapsed (45) min. and the unit time was allocated as follows:

**Table (7): Allocating time of educational units for the experimental group**

	<b>Units 1-2 to teach the forehand stroke</b>	<b>Units (3-4) to teach the backhand stroke</b>	<b>Units (5-12) to teach the forehand and backhand strokes</b>
<b>The preliminary part :</b>	<b>(10) min. administrative work (taking absence, tools preparation, warm up, physical preparation)</b>		
<b>The main part:</b>			
<b>-Core strength exercises</b>	<b>(5) min.</b>	<b>(5) min.</b>	<b>(10) min.</b>
<b>-Dynamic flexibility</b>	<b>(5) min.</b>	<b>(5) min.</b>	<b>(10) min.</b>

<b>exercises</b>			
<b>-To teach controlling the racket and ball</b>	<b>(10) min</b>	<b>(10) min.</b>	<b>(00000).</b>
<b>-Exercises for strokes as per units</b>	<b>(10) min</b>	<b>(10) min.</b>	<b>(10) min.</b>
<b>The concluding part</b>	<b>(5) min</b>	<b>(5) min.</b>	<b>(5) min.</b>

The main part includes the following:

- Core strength exercises, appendix (9). – Dynamic flexibility exercises, appendix (10).
- Exercises for controlling the racket and ball: To teach girls how to control the racket and ball and to explain the objective of the skill and how to perform it, its importance, its technical and legal aspects and performing a model of the skill and present the same on the lap top to illustrate the skill from the initial position of the movement through the video and presenting a fixed image of the skill, appendix (11) and presenting the skill once again when correcting the skill performance i.e. feedback.
- Exercises for strokes as per units: they are graduated exercises to teach and to master the skill performance. Units (1-2) are exercises for the straight forehand stroke. Units (3-4) are exercises for the straight backhand stroke and the rest of units (5-12) are exercises for the forehand and backhand strokes to improve the accuracy and velocity of performance of strokes, appendix (12).

The control group:

It was taught from 3/11/2015 to 10/12/2015 with the same educational units and times given to the experimental group. The preliminary and main parts were carried out with graduated exercises to teach and to master the skill of the straight forehand and backhand strokes but without the lap top and the concluding part to reach the required level.

**Table (8): Allocating time of educational units for the control group.**

	<b>Units 1-2 to teach the</b>	<b>Units (3-4) to teach the backhand</b>	<b>Units (5-12) to teach the forehand and backhand</b>
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	forehand stroke	stroke	strokes
The preliminary part : (10)	Administrative work (taking absence, tools preparation, warm up, physical preparation)		
The main part (30) min.	-Exercises to teach controlling the racket and ball. -Exercises for strokes as per units. -Review of performing the skill, its importance, technical and legal aspects.		
The concluding part (5) min.	Body cool down exercises, tools turning back, appendix (13) proposed units for the control group.		

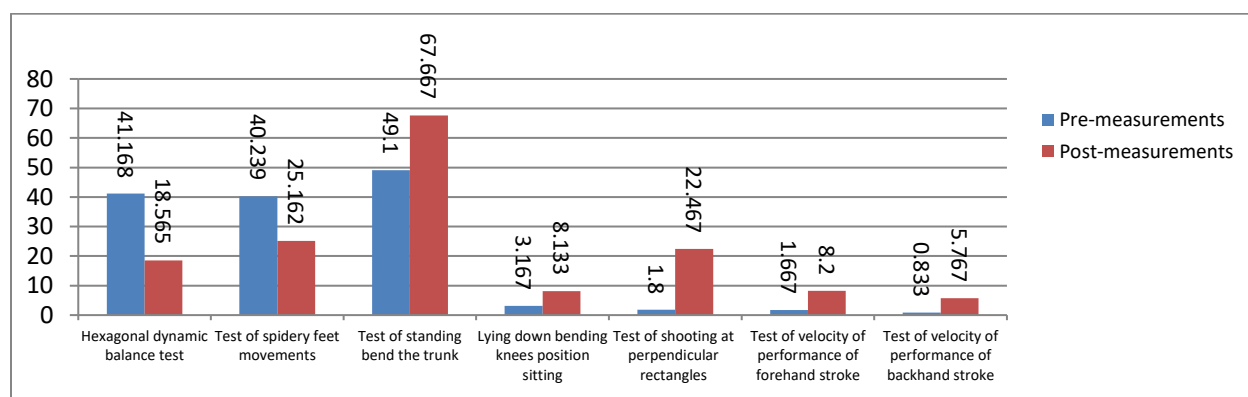
- **Post-measurements:** At the end of applying the research experiment, the post-measurements of the experimental and control groups were carried out in variables under investigation under the same conditions and order where the post-measurements have previously been taken from 15/12/2015 to 17/12/2015. After completing the post-measurements, data were tabulated and prepared for statistical analysis.

#### Presentation and discussion of results:

**Table (9): Significance of differences between the pre and post-measurements of the experimental group in physical and skill tests.**

Variables	Tests	Units	Pre-measurements (n=30)		Post-measurements		2 means differences	“t” Values	Sig .
			X <sup>-</sup>	SD	X <sup>-</sup>	SD			
Physical	Hexagonal dynamic balance test	Time	41.168	6.747	18.565	4.908	22.603	13.691*	.000
	Test of the spidery feet movements	Time	40.239	3.676	25.162	2.708	15.077	17.454*	.000
	Test of standing bend the trunk	cm	49.100	3.133	67.667	6.925	-18.56	12.553*	.000

							7		
	<b>Lying down bending knees position sitting</b>	<b>No</b>	<b>3.167</b>	<b>0.913</b>	<b>8.133</b>	<b>1.224</b>	<b>-4.967</b>	<b>24.095*</b>	<b>.000</b>
	<b>Test of shooting at perpendicular rectangles</b>	<b>Score</b>	<b>1.800</b>	<b>1.518</b>	<b>22.467</b>	<b>2.145</b>	<b>-20.667</b>	<b>43.916*</b>	<b>.000</b>
<b>Skill</b>	<b>Test of velocity of forehand stroke performance</b>	<b>No</b>	<b>1.667</b>	<b>0.802</b>	<b>8.200</b>	<b>1.126</b>	<b>-6.533</b>	<b>24.990*</b>	<b>.000</b>
	<b>Test of velocity of backhand stroke performance.</b>	<b>No</b>	<b>0.833</b>	<b>0.592</b>	<b>5.767</b>	<b>0.728</b>	<b>-4.933</b>	<b>31.118*</b>	<b>.000</b>



Data in Table (9) show that there are significant differences at (0.05) significance level and (29) degree of freedom. The researcher suggested that this progress was related to the content of the educational units of exercises of (core strength, dynamic flexibility, controlling the racket and ball and strokes as per units), appendices (9)(10)(12) and also to the use of lap top to present videos of performing the skill in the educational part of units (1-2) to teach the forehand stroke, units (3-4) to teach the backhand stroke, explaining the purpose of the skill, how to perform it, its importance and its technical and legal aspects. Added to these, the researcher stated that watching and reading the performance of exercises on the

computer helped concentrate on different parts of the exercises and in case of wrong performance, faults have been corrected instantly and the girl had to re-do the performance and the researcher reviewed the performance of the skill constantly and performed an example of exercises and continuing training and performing very well. Also repeating the performance by girls helped them do their best for accuracy and velocity of performance to show the girl's superiority over the others; hence, they performed exercises as perfect as possible that positively affected the efficiency of performance in respect of velocity and accuracy of physical and skill performance.

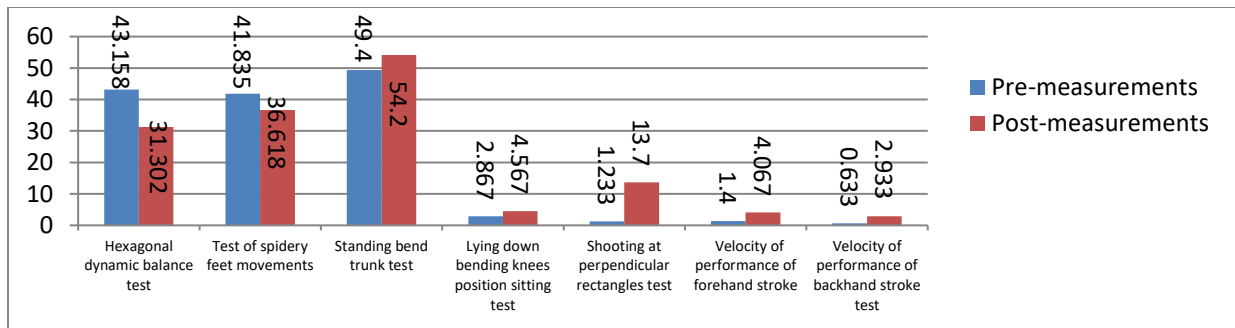
Dave Schmitz (2003) <sup>(19)</sup> indicated that the strong core muscles linked the upper and lower limbs and the exercise of core strength included multi-directional movements and when performed, concentration was on a single limb and consequently, they were considered the best exercises in improving the strength of core muscles (muscles of the body center). These results agreed with the study of Justin Shinkle (2010) <sup>(24)</sup>, Nicole Kahle (2009) <sup>(29)</sup>, Thomas, *et al.*, (2009) <sup>(33)</sup> and Lehman & Hoda (2005) <sup>(25)</sup> that exercises of core strength contributed to improve strength characterized by velocity, balance, agility and flexibility.

The proposed exercises for dynamic flexibility positively affected as they included exercises varied in intensity and repetitions suitable for different abilities of girls, individual differences and variation in training techniques that helped girls to do their best taking in their mind fundamentals of sports training in respect of graduation, adaptation to exercises such as intensity, increasing the number of performing each exercise within a specific time or with increasing time gradually, the principles of privacy and uniqueness in girls in respect of knowing distinctive and weak points in girls and how to consider the same in training and orientation, the principle of flexibility to tackle difficulties of some problems facing application, the principle of continuity in training by avoiding training interruption as training constantly would raise physical and skill levels in girls. The results achieved were in harmony with those concluded by Mohamed Al-Shinawi (2001) <sup>(10)</sup>, Ahmed Anwar (2009) <sup>(1)</sup> that improving

physical characteristics positively affected the skill performance in young ground tennis players.

Table (10): Significance of differences between the pre and post-measurements of the control group in physical and skill tests.

Variables	Tests	Units	Pre-measurements (n=30)		Post-measurements		2 means differences	“t” Values
			X̄	SD	X̄	SD		
Physical	Hexagonal dynamic balance test	Time	43.158	5.694	31.302	8.762	11.856	9.157*
	Test of the spidery feet movements	Time	41.835	3.789	36.618	4.981	5.217	6.078
	Test of standing bend the trunk	cm	49.400	1.850	54.200	3.388	-4.800	8.246*
	Lying down bending knees position sitting	No.	2.867	0.776	4.567	1.040	-1.700	7.899*
	Test of shooting at perpendicular rectangles	Score	1.233	1.135	13.700	6.829	-12.467	10.288*
Skill	Test of velocity of forehand stroke performance	No.	1.400	0.621	4.067	1.617	-2.667	8.353*
	Test of velocity of backhand stroke performance.	No.	0.633	0.556	2.933	1.230	-2.300	8.595*



Data in Table (10) illustrate that there are significant differences at (0.05) level of significance and (29) degree of freedom. The researcher suggested that this progress was due to information received by the girl during the practical performance of the skill, the illustrated explanation of the performance that has previously been given, presentation of each part of the skill separately, the repetitions of the performance of the skill, correcting faults, training and practicing and as a result the student became more efficient in the performance and helped him improve his level of performance and make the lecture pleasurable, exciting and thrilling. Also applying gradual exercises to teach and to master the skill of the straight forehand and backhand strokes from easiness to difficulty and from simplicity to complicity, repetition of application of exercise, correction of faults instantly, repetition and redoing and giving a chance for feedback to reach the level of the required perfection and consequently, a better chance to teach became available resulted from repeating and practicing, improving, developing and evaluating exercises and hence, dynamic coordination would be created and having the positive effect in the physical performance efficiency and the level of performance of the straight forehand and backhand strokes.

Table (11): Significance of differences between the post-measurements of the experimental and control groups in physical and skill tests.

Variables	Tests	Units	Experimental group	Control group (n=30)	2 means	"t" Values	Sig .
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			(n=30)				differences		
			X̄	SD	X̄	SD			
Physical	Hexagonal dynamic balance test	Time	18.565	4.908	31.302	8.762	-12.737	6.946*	.000
	Test of the spidery feet movements	Time	25.163	2.708	36.618	4.981	-11.456	11.068*	.000
	Test of standing bend the trunk	cm	67.667	6.925	54.200	3.388	13.467	9.568*	.000
	Lying down bending knees position sitting	No.	8.134	1.224	4.567	1.040	3.567	12.161*	.000
	Test of shooting at perpendicular rectangles	Score	22.467	2.145	13.700	6.829	8.767	6.708*	.000
Skill	Test of velocity of forehand stroke performance	No.	8.2000	1.127	4.0667	1.618	4.133	11.486*	.000
	Test of velocity of backhand stroke performance.	No.	5.767	0.728	2.933	1.2230	2.833	10.859*	.000

Data in Table (11) show that there are significant differences at (0.05) significance level and (58) degree of freedom. The researcher suggested that this result was due to the positive effect of the content of the proposed educational units for the experimental group as the exercises of core strength helped the girls have a stabilized vertebral column and maintain the strength resulted from pushing the legs. These results agreed with the study of Elliot *et al.*, (2003) <sup>(20)</sup>, Chow *et al.*, (2003) <sup>(17)</sup>, Stanton & Reabum (2004) <sup>(31)</sup>, Nasser Gharib (2011) <sup>(13)</sup>, Marjke *et al.*, (2004)<sup>(26)</sup> that such studies indicated to the positive effect of exercises of core strength on the skill level. Exercises of core strength helped improve nerve impulses going to muscles and as the concentration were on muscles around the vertebral column

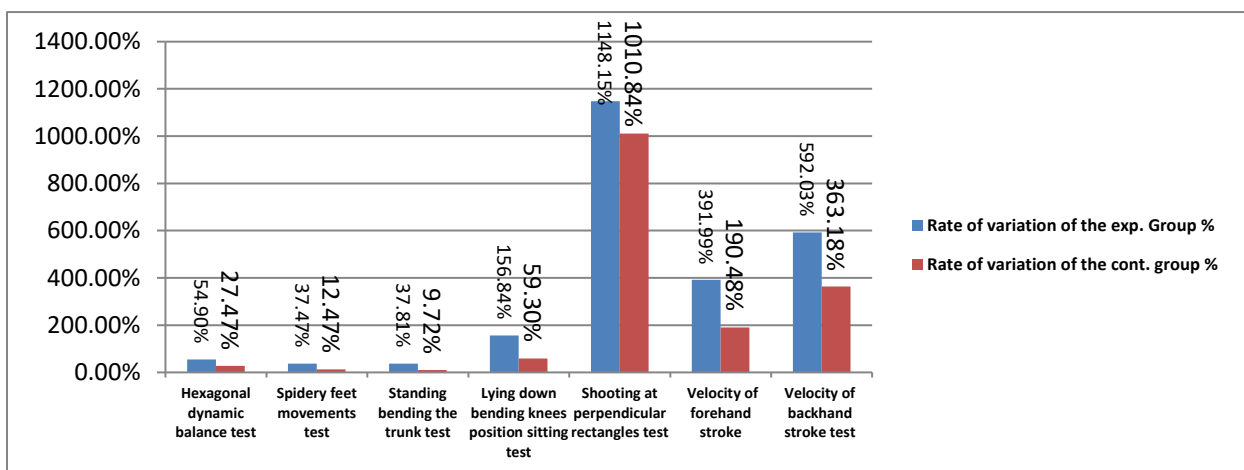
having bone marrow inside it and hence, the neuromuscular formation played an important role in how to perform movements.

The researcher suggested that dynamic flexibility exercises had positive effect on improving the level of skill performance because of the content of such exercises and their suitability for muscular groups used in the skill performance and the velocity, accuracy and strength resulted from the exercises in the skill performance. The results of this study tallied with the studies of Ali Galal Al-Din (2010) (2) and Hamdy Ahmed (2009) (6) that flexibility led to develop the motor musculature comprehensively and in a balance form and to improve the nervous coordination and it was an important factor to outline the future age of the athlete and his physical level explaining the importance of exercises of core strength and dynamic flexibility as a main requirement to develop the level of girls in tennis.

**Table (12): Rate of variation between the post-measurements and the pre-measurements in the experimental and control groups in physical and skill variables.**

Variables	Tests	Units	Experimental group (n=30)			Control group (n=30)		
			Pre-measurements $\bar{x}$	Post-measurements $\bar{x}$	Variation %	Pre-measurements $\bar{x}$	Post-measurements $\bar{x}$	Variation %
Physical	Hexagonal dynamic balance test	Time	41.168	18.565	54.90%	43.158	31.302	27.47%
	Test of the spidery feet movements	Time	40.239	25.162	37.47%	41.835	36.618	12.47%
	Test of standing bend the trunk	cm	49.100	67.667	37.81%	49.40	54.200	9.72%

	<b>Lying down bending knees position sitting</b>	<b>No .</b>	<b>3.167</b>	<b>8.133</b>	<b>156.84%</b>	<b>2.867</b>	<b>4.567</b>	<b>59.30%</b>
	<b>Test of shooting at perpendicular rectangles</b>	<b>Score</b>	<b>1.800</b>	<b>22.467</b>	<b>1148.15%</b>	<b>1.233</b>	<b>13.700</b>	<b>1010.84%</b>
<b>Skill</b>	<b>Test of velocity of forehand stroke performance</b>	<b>No .</b>	<b>1.667</b>	<b>8.200</b>	<b>391.99%</b>	<b>1.40</b>	<b>4.067</b>	<b>190.48%</b>
	<b>Test of velocity of backhand stroke performance.</b>	<b>No .</b>	<b>0.833</b>	<b>5.767</b>	<b>592.03%</b>	<b>0.63</b>	<b>2.933</b>	<b>363.18%</b>



Data in Table (12) illustrate that the percentage of improvement in the experimental group is better than that of the control group as the rate of improvement in the experimental group ranges between (37.81% and 1148.15%) whereas the rate of improvement in the control group ranges between (9.72% and 1010.84%). The researcher suggested that the rate of improvement was related to the varied exercises of the experimental group performed regularly and gradually from easiness to difficulty and from simplicity to complicity taking in consideration individual differences in each girl with the result that such exercises affected the efficiency of performance positively that the brain had its role in regulating the performance in

the light of the data received and hence, the efficiency of performance was increased in the experimental group. This agreed with that achieved by Marwan Ali (2003)<sup>(8)</sup> that training on the skill was not enough to improve such skill and obtaining fruitful results as in addition to improve the skill, it was necessary to improve dynamic abilities of the skill itself. Kamal Abdel Hamid and Sobhi Hassanein (2001) <sup>(7)</sup> stated that to perform a skill successfully, physical components contributing to perform the skill optimally had to be developed. Amr Hamza (2008) <sup>(3)</sup> showed that balance played an important role in achieving the sports achievement. These results were in conformity with studies of Shirin Taha (2004) <sup>(15)</sup>, Liang & Tian (2001) <sup>(24)</sup>, Mohsen Abu Al-Nour (2000) <sup>(12)</sup> and Sobhi Hassanein (2004) <sup>(11)</sup> that flexibility contributed to develop other numerous physical traits such as ability and muscular power.

The researcher suggested that the rate of improvement in the control group could be related to the proposed educational units by using graduated exercises to teach and to master the performance of the straight forehand and backhand strokes that led to positive effect due to the review of the performance of the skill, its importance, its technical and legal aspects, continuous training on exercises, diversity of exercises, correcting faults by the researcher instantly with the result that the positive effect on the level of physical and skill performance was occurred leading to increase the performance efficiency in the control group.

**Conclusions:** Using exercises for core strength, dynamic flexibility, controlling the racket and ball and graduated exercises to teach and to master strokes as per units for the experimental group would be better than using graduated exercises to teach and to master the performance of the straight forehand and backhand strokes for the control group that the diversity of exercises positively contributed to variables under investigation by rates of improvement in the experimental group better than the control group.

**Recommendations:** Applying exercises of core strength and dynamic flexibility to teach tennis skills in girls at Faculty of Physical Education and to teach skills of other physical activities due to their

positive effect on the level of physical and skill performance under investigation. The results of the current study should be forwarded to coaches of the sport of tennis to make use of them.

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