ISSN:2773-2851
مجلة رصين للدراسات الأنشطة الرياضية وعلوم الحركة
المجلد 03العدد: 02/ 25 ديسمبر 2022

Biomechanical analysis of (illusions)skill as a guide to specific exercises in aerobic gymnastics

التحليل البايوميكانيكي لمهارة الوشن (illusions) كتوجيه للتمرينات النوعية في الجمباز الايروبيك

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Received (date) : 14/09/2022 **Revised (date) :02/11/2022** **Accepted (date) :25/12/2022**

Abstract:
The purpose of this study was to analyze the kinematics of the movement of the movement in aerobic gymnastics as a guide to specific exercises. The sample of this study was selected as an aerobic gymnast and one of the best players in the Iranian national team for aerobic gymnastics from the holy city of Mashhad and registered with the Iranian and International Aerobic Gymnastics Federation. In light of the results obtained, a set of biomechanical indicators could be used to guide the specific training of the skill under study. The skill was divided into several stages, each with its own technical specifications that can be relied upon as indicators to guide specific training. Extracting a set of proposed specific exercises, whose biomechanical analysis results showed their similarity with the skill in question, as it leads to the dyeing of the body in the forms and directions of the correct performance of the skill, through the comprehensive and balanced development of the muscle groups involved in performance, which makes it more useful than others.
Key words: aerobic, Gymnasts, Kinematic

الملخص :
الغرض من هذه الدراسة هو تحليل كينماتيكي في حركة الوشن في الجمباز الايروبك كتوجيه للتمرينات النوعية. تم اختيار عينة هذه الدراسة لاعب جمباز ايروبيك واحد أفضل لاعب في المنتخب الإيراني للجمباز الإيروبيك من مدينة مشهد المقدسة والمسجل لدى الاتحاد الإيراني والدولي للجمباز الإيروبيك تمت معالجة تسجيل البيانات وجمعها عبر برنامج Skilspector 1.3.4 بواسطة كام يا نوع iphone11 وبسرعة 60 صورة بالثانية . في ضوء النتائج التي تم الحصول عليها أمكن الإستعانه بمجموعة من المؤشرات البيوميكانيكية لتوجيه التدريب النوعي للمهارة موضوع الدراسة. حيث تم تقسيم المهارة إلى عدة مراحل لكل منها مواصفاتها الفنية التي يمكن الاعتماد عليها كمؤشرات لتوجيه التدريب النوعي. استخلاص مجموعة من التمرينات النوعية المقترحة والتي أظهرت نتائج التحليل البيوميكانيكي تشابهها مع المهارة قيد البحث حيث تؤدى إلى صبغة الجسم بأشكال واتجاهات الأداء الصحيح للمهارة وذلك من خلال التنمية الشاملة والمتزنة للمجموعات

العضلية المشتركة في الأداء الأمر الذي يجعلها أكثر فائدة من غيرها .

الكلمات المفتاحية: ايروبيك , لاعب جمباز, كينماتيك.

1- Introduction

Gymnastics is a fertile field for biomechanical analysis, including multiple motor skills that lead to all axes and levels, which leads to the ease of analyzing its various skills. (Abdul Basir, 2007, 87). And since it is possible to analyze the movements of the human body with both offenders (kinetic - kinematics) in their general meanings, which do not go beyond the transformation of the studied phenomena into numbers and degrees or an accurate description of the phenomena in order to develop and improve the level of technical skill performance. (Shehata, 2003, 25).Aerobic gymnastics is one of the branches of gymnastics that was officially recognized by the International Federation of Gymnastics (FIG) in 1996, and the first World Aerobic Gymnastics Championships was held in Paris with the participation of 34 countries in 1997 (gymmedia,2022). Aerobic gymnastics is the latest branch of sports included in the International Gymnastics Federation, and it means the ability to perform a group of complex movements continuously using music.

The kinetic sentence exercises are characterized by strength, flexibility and continuity of performance with a rhythmic movement sequence and the use of the seven basic steps of aerobics in coordination with the movements of the arms and the elements of difficulty (FIG, 2022,9).(Vulpe Ana-Maria, 2016,62) indicates that aerobic gymnastics competitions are among the sports activities that require a high level of physical abilities such as agility, flexibility and temporal harmony of the muscles, and that is closely associated with the flow of performance.

And both (Jemni, M., Sands, Friemel, F., Stone, ., & Cooke, 2016, 26) confirm that aerobic gymnastics requires a high level of preparation, because of the importance of showing its results in competitions, so learn Motor skills and their proper performance requires adequate training to develop the functions of the muscular and nervous systems and reach a high level of strength, flexibility, muscular endurance and speed.

According to the international law of aerobic gymnastics, both male and female players, during their performance of the kinetic sentence in local and international youth competitions, are required to perform (5:8) motor skills, and in youth and

public competitions, perform (10) different skills from the four skill sets stipulated (FIG, 2022,186).

Among these motor skills in aerobic gymnastics is the skill (illusions), which falls within one of the skills of the eighth group in the international law of aerobic gymnastics figure (1), which appears mainly in all local and international competitions, as it finishes one of the compulsory skills in the junior championships and one of the optional skills in the youth and public championships.

The training process has high requirements in terms of volume, intensity and technical elements with a high level of difficulty. Aerobic gymnasts constantly perform high-intensity, complex movements that follow the patterns of music and require coordination, anaerobic endurance, strength, explosiveness, strength and flexibility. Certainly these qualities give value and excitement to the sport. However, gymnasts differ in motor abilities that reflect the quality of performance and accuracy of techniques and movements (Giugno et al., 2013, 205) (López et al., 1999, 60).

The judges assess the technical skills of all the movements in the kinetic sentence - difficulty, acrobatics, aerobic patterns, transitions, connections and many more. Perfect technique means flawless movement with high accuracy, correct posture, body alignment, and recognizable forms of the skills performed. Small, medium, large, or unacceptable errors should be identified by gymnasts and coaches who will focus on whether the error is due to a lack of concentration or an inadequate level of physical training (Mezei&Cristea,2014,367),(Prassas, 1999,1).Difficulty skills serve as a means of challenging as well as demonstrating the acquisition of target physical traits.

Despite the growing popularity of aerobic gymnastics there is still a lack of biomechanical analyzes in the literature regarding specific difficulty skill techniques (Perdomo, 2010,32). So the question arises: What resources should be used to train the typical difficulty skills of aerobic gymnastics? According to (Perdomo, 2010,32) one sport technique training resource is biomechanics "...which also allows for correcting posture axes, designing or specifying measuring instruments and techniques, increasing athletic performance, decreasing fatigue and correct posture. Biomechanical analysis is very effective in improving, describing and developing a particular technique." Moreover, it gives us the possibility to calculate different aspects of movement such as speed, acceleration, displacement and time and allows to analyze the angles of body parts relative to their frame of reference or angles with respect to different parts of the body. Understanding the patterns of movement allows

us to detect errors and find special ways to make the movement more efficient and better from the point of view. Consider the correct technique.

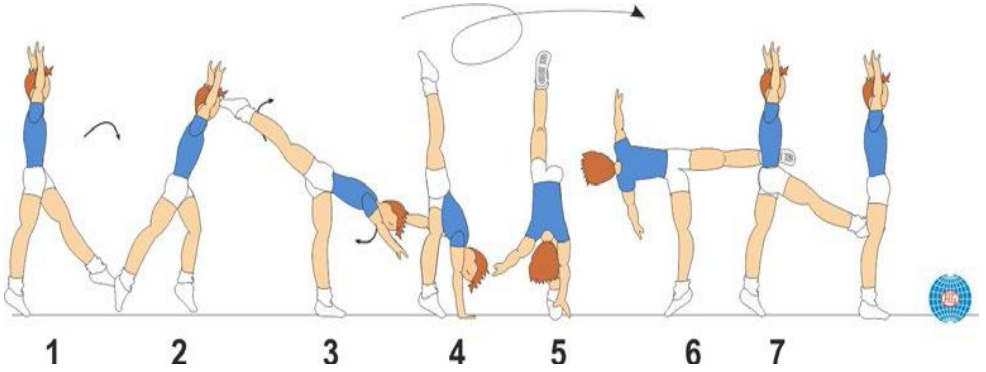


Figure (1) Illusion skill

2- Research objective

The research aims to identify the biomechanical indicators affecting the stages of technical performance as a guide for qualitative training.

3- Method

3-1 Subjects

This study was conducted on the best player in the Iranian team for aerobic gymnastics from the holy city of Mashhad in Iran, who is registered with the Iranian and International Aerobic Gymnastics Federation. He is 18 years old, 165m tall, weight 61kg and has a training age of 8 years. He has an international championship in Portugal.

3-2 Study procedures and data processing

The data recorded and collected via Skilspector 1.3.2 was processed by an iphone11 camera at a speed of 60 frames per second. After completing the video shooting, the video was transferred to the laptop and the format was converted from the mov extension to avi through the kinovea 9.5 program. Then it was called to the Skilspector program for the purpose of analysis (Fig. 3). The calibration was of 9 coordinates according to a reference frame of dimensions 2 m x 2 m. The skill

was divided into four stages (Fig. 2) for the purpose of analyzing it and developing qualitative exercises according to each stage.

Figure (2) Skill stages

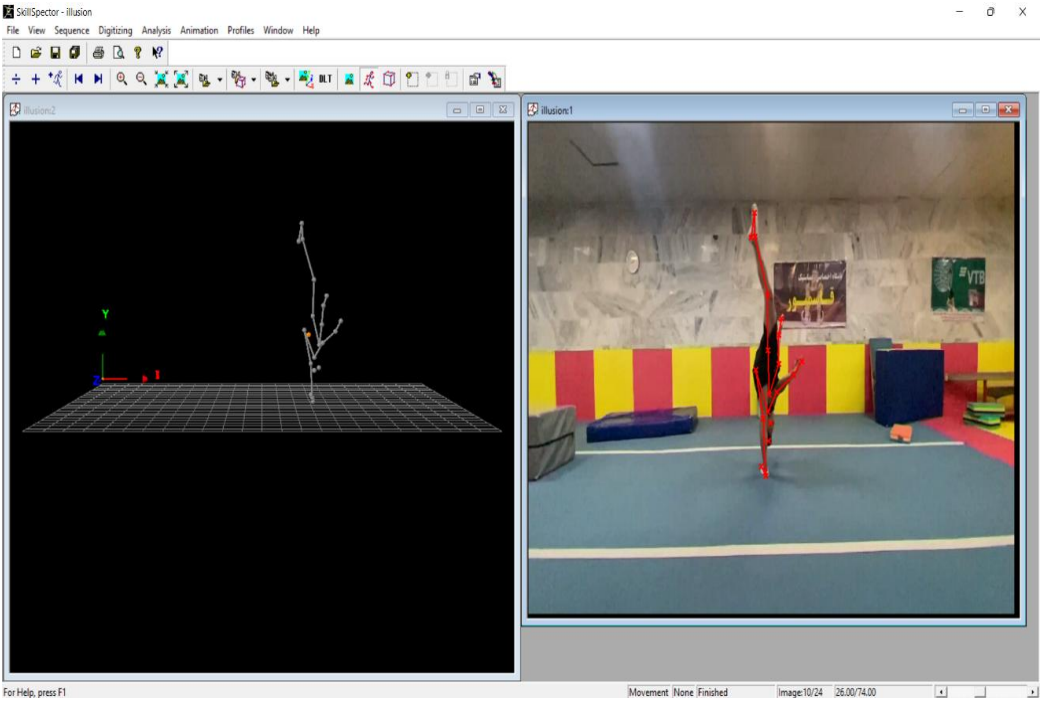


Figure (3) Movement analysis using the biomechanical program Skillspector 1.2.3

4- Results and discussion

Table (1) values of the ankle, knee and hip angles for the right and left side of the body, the right and left torso**.**

Stages	Right ankle	Right Knee	Right Hip	Left Ankle	Left Knee	Left Hip	Torso right	Torso left
Stage1	158.3	173.4	141.6	94.2	171.0	77.0	190.2	190.1
Stage2	161.4	156.9	166.8	57.9	168.9	5.9	266.3	274.5

Stage3	165.2	175.7	179.6	113.4	177.8	76.1	347.5	350.1
Stage4	121.0	176.2	164.2	120.2	179.4	174.1	437.1	442.0

Table (2) values of motion of the center of mass, angular velocity of the body, moment of inertia and angular momentum.

stages	Movement center of mass	angular velocity of the body	moment of inertia	angular momentum
stage 1	1.6	692.1	16.9	11705.8
stage 2	1.5	476.3	21.7	10356.5
stage 3	1.6	375.6	20.6	7733.3
stage 4	1.6	276.2	24.0	6618.2

Stage 1

It is clear from Table (1) (2) that at this stage I made the player take the player a step forward in order to obtain a stable footing which prompted the player to achieve the maximum load and momentum necessary for the next stage while the center of gravity of the body moved forward relative to the fulcrum.This is what (Silvia,2016,371) points out: comprehensive analysis of biomechanical data allows for more detailed conclusions to be drawn, such as those about kinematic and dynamic errors that lead to and cause other errors.

Stage 2

It is evident from Table (1)(2) that at this point it is a continuous lowering and lowering of the arm and torso forward and down while balancing the velocity of the swinging rear leg. Since angular momentum is the product of the moment of inertia and angular velocity the player can increase the angular velocity when the swinging object reaches and leg to climax and achieve rapid twisting that will release vertical momentum and open legs.This is what (Ligia,2019,37) notes that each indicator

requires individual training within the specified time to gain each stage. It is also worth noting the specificity of the exercises to train each motor variable.

Stage 3

It is clear from Table (1) (2) that at this point the momentum created by the previous actions of the participating forces has been the culmination of achieving vertical phase separation. So that the player makes an effort to separate the legs by extending the swinging leg. This coincided with the contraction of the muscle groups to overcome the mechanical action with time in contrast to the arm-thigh and leg coordinations which form a deterrent due to the small preparation step. At this point it is the preparation of the swinging foot landing which will help increase the lift of the torso which this time remains extended. The abdominal and iliac muscles play an important role in this movement phase as they provide the physical support needed to maintain the final position.This is what it indicated (Anita &Svetlana,2020,23) biomechanical considerations as reflected in correct or incorrect technique, especially in aerobic gymnastics.

stage 4

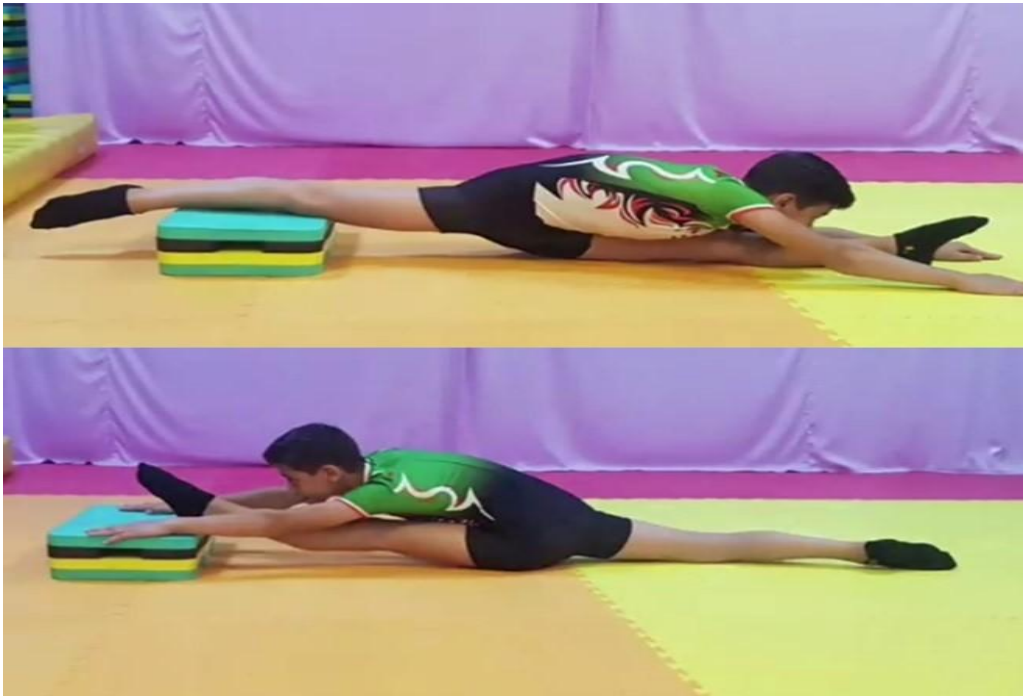
It is clear from Table (1) (2) that at this stage the foot is ready for landing and this is achieved by successive contacts of the foot with the mat while raising the torso until it reaches a standing position far in the sagittal plane.The contact of the rug is made gradually with the instep leaving the sole weight completely. These movements are involved in the exertion of the whole body, especially the bony ligaments and muscular systems.

Conclusions

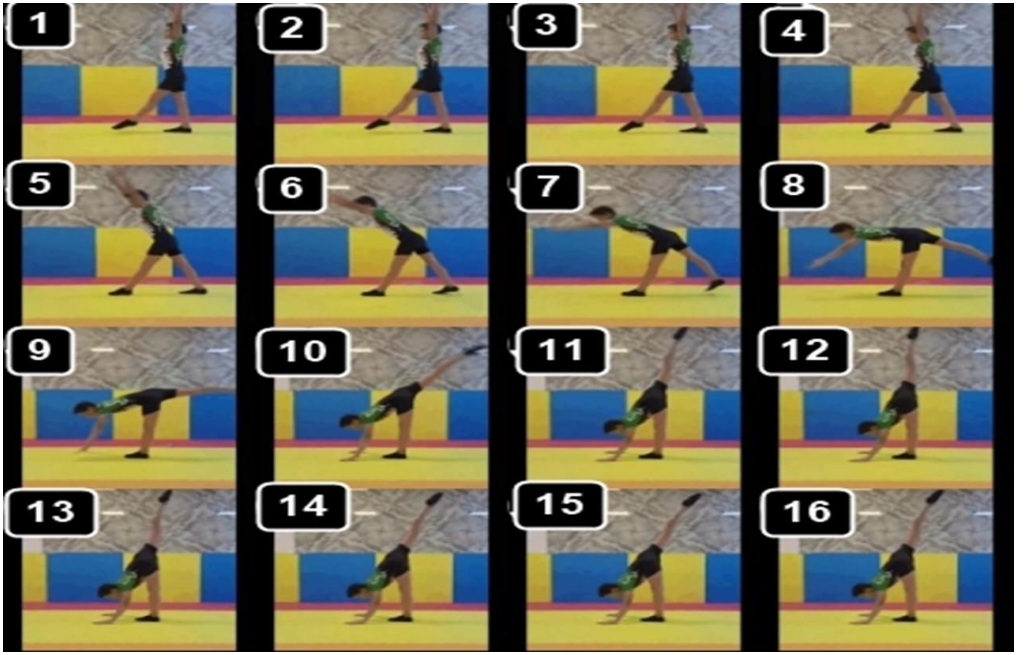
In light of the results obtained, a set of biomechanical indicators could be used to guide the specific training of the skill under study. The skill was divided into several stages, each with its own technical specifications that can be relied upon as indicators to guide specific training.

Extracting a set of proposed specific exercises, whose biomechanical analysis results showed their similarity with the skill in question, as it leads to the dyeing of the body in the forms and directions of the correct performance of the skill, through the comprehensive and balanced development of the muscle groups involved in performance, which makes it more useful than others.

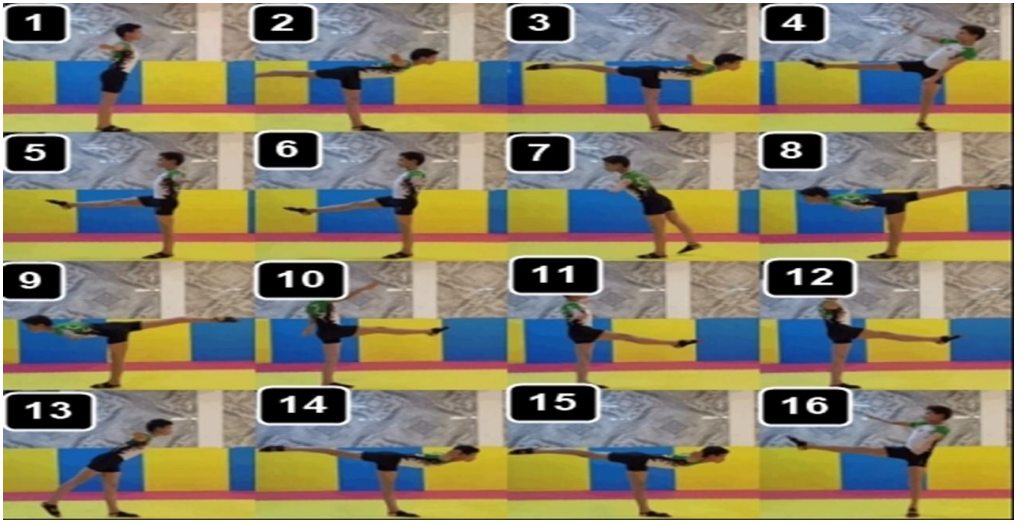
Based on the analysis, a methodology has been developed for qualitative exercises for the skill of illusions.



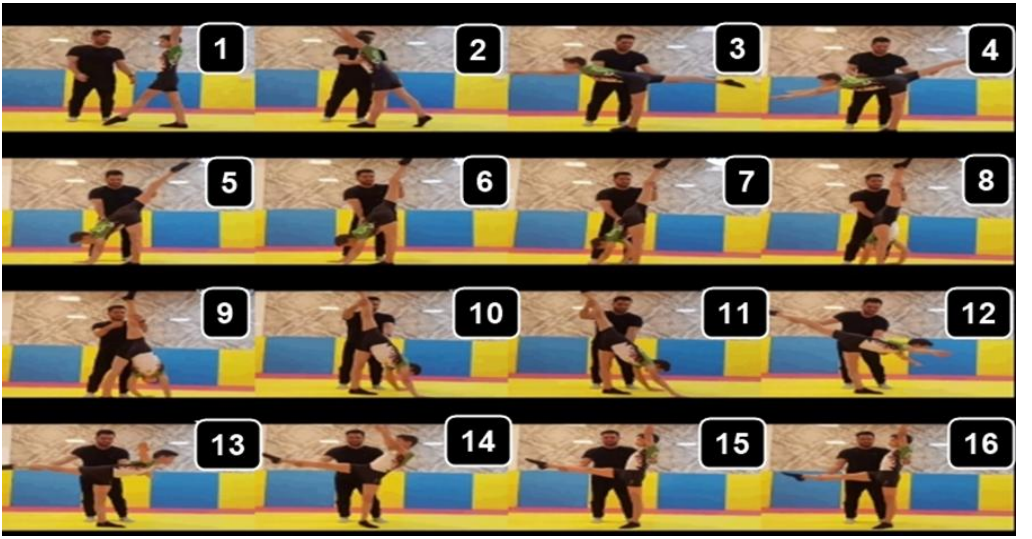
exercise 1



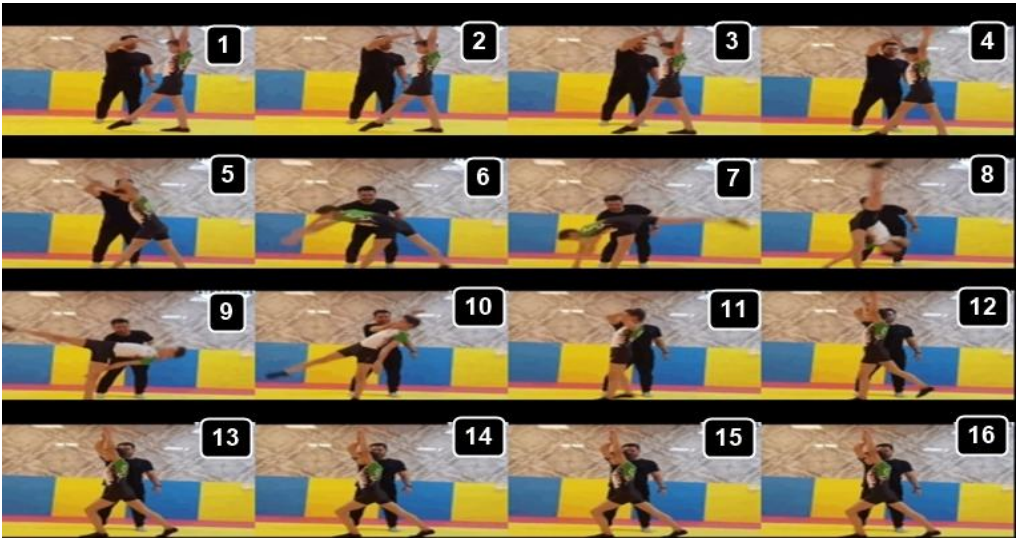
exercise 2



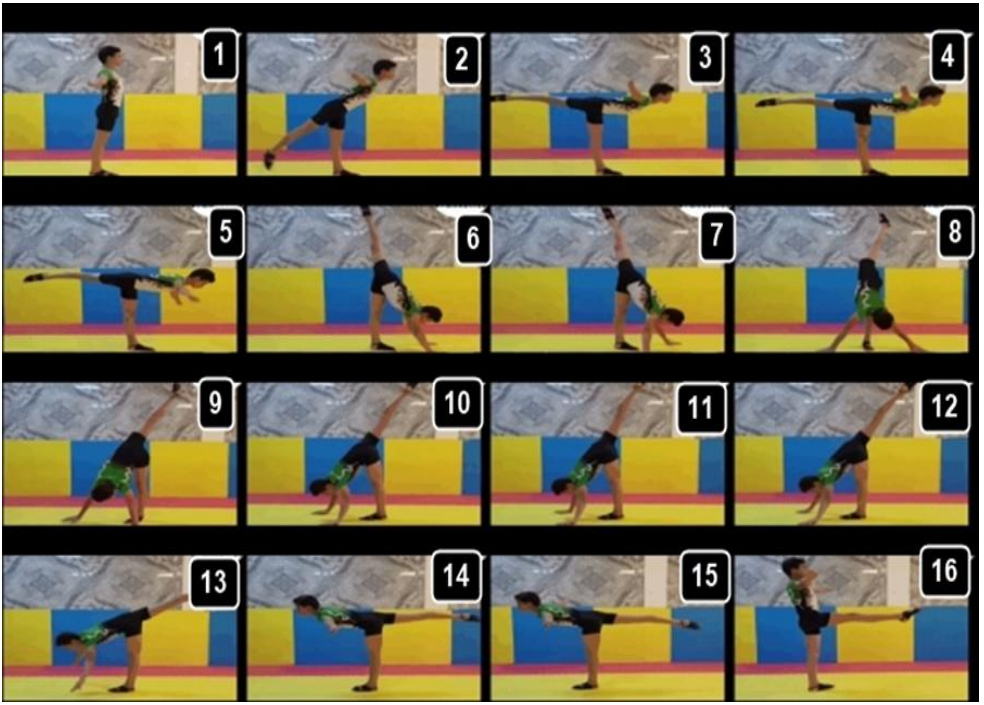
exercise 3



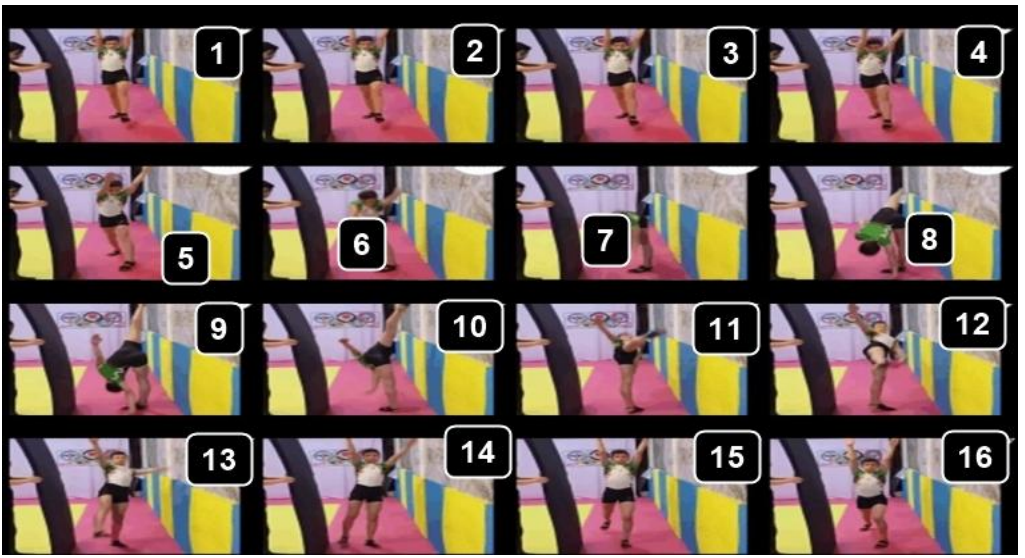
exercise 4



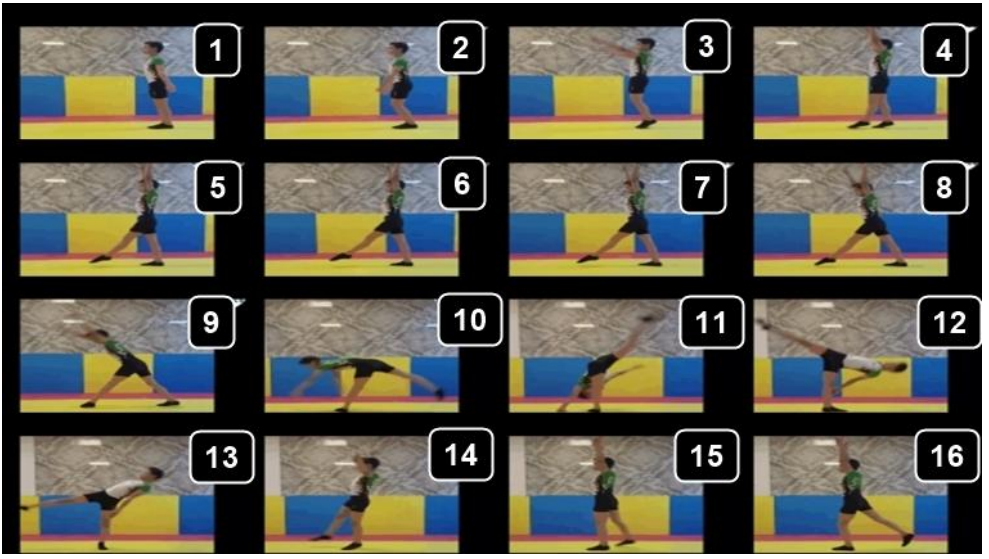
exercise 5



exercise 6



exercise 7



exercise 8

Explanation of specific exercises

1) Exercise 1: Stretching exercises. Spread the legs apart. As much as possible. Stretching exercise on a piece of the STEP Put the right leg on the STEP and bend the torso to the knee. Put the heels on the edge of the steep and bend the torso at the knee.

2) Exercise 2: Raise the leg in a split-like position in the air with one leg down. The athlete must not stand on his toes while doing this as this may cause him to lose balance and fall.

3) Exercise: 3 front balance, then kicked to swear with the raised leg, then repeat the exercise in another direction.

4) Exercise: 4 Lifting the leg in a position similar to a split in the air with one leg down, then the player rotates his body for a full cycle and ends with a position on one leg and raising the other leg. This exercise works first with the help of the coach.

5) Exercise 5: Same as exercise 4, but without the help of the trainer.

6) Exercise: 6 Do the whole lotion with the help of the coach, so that the coach grabs the player by the wrist and presses the player down, then the player rotates to make the movement.

7) Exercise: 7 Same, the fellow player puts a rug on the side perpendicularly, then the player does the work of washing so that the player does not touch the rug during the performance of the movement.

8) Exercise: 8 work to perform the movement in full after mastery.

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