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Axial Stability Exercises with Varying Back Muscle Contractions and Their Significant Impacts on Physiological Indicators due to Sports Technology and the Explosive Ability of Volleyball Players

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Abstract: The current paper aimed to prepare axial stability exercises with a variety of back muscle contractions for volleyball players, and identify their important effects on some physiological indicators according to sports technology and the explosive ability of volleyball players. The research was based on two hypotheses, both of which indicated statistically significant variations in test results. Pre and post brain signals (EEG) for the three beta brain waves in the experimental group. There are statistically significant variations between the before and post-test findings for the explosive ability of the legs in the experimental group participants. The experimental research technique was used by creating one experimental group. The research population was represented by 12 young volleyball players from Al-Kahraba Club, who were selected using a comprehensive enumeration method to represent their community of origin, with a 100% representation of their community of origin in the sample for the 2023/2024 sports season. The latest sports technologies were employed to measure brain signals (EEG) for the three beta brain waves. This method is easy to apply on the volleyball court and does not require the transportation of players to other laboratories, as is the case with the (Neurosky) device, which includes a sensitive head kit. The Sarget test is approved for the purpose of measuring the explosiveness of the legs, and the EEG is equipped with NeuroSky technology to detect nerve signals. The exercises were prepared and applied in the research experiment by applying pre-tests on 8/10/2023 and then applying axial stability exercises with varying back muscle contractions for the period from 8/13/2023 until 10/5/2023. Applying post-tests on 8/10/2023 concluded the experiment, and the SPSS system statistically processed the collected data, leading to the conclusions and applications that axial stability exercises with varying back muscle contractions enhance the level of low beta EEG signals. To improve volleyball players' explosive abilities, coaches should prioritize physiological (EEG) signals measurement in line with their sports technology. Mobile balance tools used in axial stability training should be suitable for the players' abilities and ensure their safety from sudden falls or injuries.

Keywords: axial stability exercises, back muscle contractions, physiological indicators, sports technology, explosive ability, volleyball

Introduction

The brain must effectively control and harmonize the contractile movements of volleyball players, ensuring they can effectively perform skills like massive batting, overwhelming beating, and retaining walls, to avoid technical errors and maximize the explosive power of their legs in the diverse contractile work. Sports training's vast knowledge and information is most influenced by other disciplines' ideas and foundations. Sports training is a blend of sciences. Perhaps this science attempts to improve human physical performance to compete at the greatest levels of sports (Wagdi, 2018).

Sports coaches, players, and scientists constantly look for modern methods to improve sports performance and gain a competitive advantage (Isabel Walker, 2001). Volleyball players are characterized by many jumping movements that serve the skill factor and rapid descent, as this continuous alternation between rising and falling requires maintaining the player's moving balance to preserve the body's strength from falling or stumbling.

In the case of moving balance, the electrical nerve signals for muscle contraction work to increase the body's control to maintain axial stability, given that the muscles continue to twitch for the purpose of maintaining posture without the player feeling them until he focuses on them or increases that muscle tension to confirm the brain's sensors of stability in a state of balance. To increase the athlete's ability to balance, repetition in different positions and using unstable tools and means is the best way to increase this athlete's movement ability (Bronner & Ojofeitimi, 2013).

Additionally, "axial stability training" encompasses the brain's capacity to coordinate the instructions and receptors of the nerve fibers that transmit signals to the Spiral Line muscles and to regulate these signals within the same muscles. Sports training has the potential to enhance these fundamental biochemical processes (Silva & Araujo, 2010). Moreover, nerve fiber receptors provide messages to spiral fascia muscles and control them. Fundamental biochemical processes may be improved by athletic training (Silva & Araujo, 2010).

To achieve axial stability by training the spiral line muscles of the body's axis in the trunk and limbs, it is necessary to know exactly where the resistance loads hit those muscles and how vital each muscle's work is to performance. The weight of the body part and any additional weight it receives cause a torque to occur around the joint. This torque operates oppositely to muscle contraction torque and is proportional to the vertical distance between the point of impact and the joint's axis. Resistance is also changeable, and adding these weights to impact the muscular efficiency of the muscle groups operating on these joints raises physical ability (Al-Fadhli, 2010).

To enhance balance, axial stability exercises include activities such as walking on a tightrope, standing on one foot, trembling, dynamic balancing, deep breathing, and meditation. You should ease down or stop exercising altogether if you experience any kind of discomfort or exhaustion (Azmi, 2018).

Repetition, by its nature, is a boring routine for the human soul, so we resort to using the element of suspense and its means to ensure we continue repeating this practice (Sewell & St. George, 2018). Additionally, the tools used for axial stability exercises vary regarding their material type and how they affect the body's balance. These instruments include

resilient rugs with a spongy texture that provide a tactile experience of their smooth surface, as well as rubber figurines designed for walking on. Players in this game use large air-filled Chinese rubber balls, as well as hard plastic and wooden tools that have a narrow base and a broad surface (Frizzell & Dunn, 2015).

The diversity of exercises and the inclusion of different components of physical fitness in the training program can have a more significant positive impact on the results. (Faigenbaum & Myer, 2016). The basis for excellent posture is muscular balance on both sides of the body. It also modifies the body's posture from its current position to the desired one (Mohamed, 2020).

Balance is a crucial factor in maintaining good health and physical performance. It plays a significant role in performing fundamental motor skills like standing and walking, as well as in various sports activities that involve limited movement. Furthermore, balance is essential for everyday tasks such as climbing and lifting heavy objects (Kisner & Colby, 2020).

The vestibular system monitors balance and comprises of bony tubes and chambers in "the bony labyrinth" of petrous bone, which contains membranous tubes. He termed it "the membranous labyrinth." This represents the operational element of the gadget. This gadget comprises a gelatinous area that contains a multitude of tiny calcium carbonate crystals, referred to as "balance dust". The vestibular nerve's sensory endings intertwine with the bases and ends of thousands of hair cells in the spot. Deep sensory receptors in the neck also contribute to balance. These receptors also contribute to the processing of visual information (Arthur & John, 2020).

Although neuromuscular coordination involves intricate and interrelated processes, the human brain has the ability to effortlessly combine information from sensory organs, muscles, and joints. This allows for a wide range of adaptive behaviors. It is necessary to comprehend and acknowledge the fundamental behavioral and brain factors that contribute to performance in the sphere of sports in order to enhance them (Jantzen & Kelso, 2008).

Given that the brain controls and directs all muscle contractions that produce skill performance movements in volleyball, which rely on the legs' explosive ability, it can stimulate brain waves, particularly beta waves. With higher, synchronized frequencies, these waves can simultaneously affect visual sensations. Form three types of low (beta) waves, which range from (12–15) hertz; medium (beta) waves, which range from (15–22) hertz; and high (beta) waves, which range from (22–39) hertz. The "all or none" principle applies to a single muscle fiber when it receives orders from the brain. The nerve impulse must affect the motor end plate permeability to lower the end plate voltage below the excitation threshold to cause cell movement potential. One muscle fiber might have full or no impact (Hassan, 2005).

Additionally, activating the brain will enhance the perceptions necessary for neural signals, particularly the player's perception and vision, enabling his mind to receive, store, and retrieve information." Thus, the one who organizes the training environment must find the appropriate conditions for activation to influence the sensory receptors, mainly the postural receptors related to balance (Nazer, 2010).

The brain's lower regions primarily deal with the body's automatic and instantaneous reactions to sensory stimuli. In comparison, the higher regions focus on the deliberate movements controlled by the brain's intellectual processes. In a normal human being, the activities of the various departments are balanced and coordinated. As a result of its activities, the nervous system generates motor responses at any moment, which express the intensity and direction of this result. In sports exercises, we must recognize the importance of the senses and the information they convey to the brain. We also need to consider the sensors in the skeletal muscles, such as the Golgi tendon bodies and muscle spindles, which play a protective and informative role. Additionally, the efficiency of these receptors aids in maximum joint movement. The vestibular balance system and reflexes play a crucial role in maintaining balance. These reflexes, like cross-extension, withdrawal, and flexion reflexes, reverse the muscular activity in the corresponding part. Additionally, bioelectrochemistry, which includes acetylcholine, sodium, and potassium ions, explains the mechanism of action (Aed & Ahmed, 2015).

Likewise, neurons are the basis of the brain’s working mechanism. They do not work randomly but in the form of a network, organizing themselves into groups to specialize in processing different types of information, which regulates the brain’s working mechanism and makes it more organized and accurate (Alwan, 2012).

Also, the functional anatomy of the nervous system indicates that the nervous system connects between the nerves of the brain and the spinal cord and between the rest of the sections of the central nervous system and the various parts of the body, such as the arms, hands, feet, and others (Abdel Basset, 2016).

Furthermore, we delve into the central nervous system (CNS), where the spinal cord sits at the base, containing many alpha and alpha nerves. The medulla oblongata connects it to the medulla, while the pons and the midbrain form a stalk together. The brain and cerebellum (brain stem), which are essential in the process of motor regulation during exercise, control the place and position of movement in cooperation with the brain stem. Several nerve fibers connect the two hemispheres of the brain. There is a region that connects the nerves of the cerebellum to the brain with the spinal cord's nerves, in addition to the thalamus, which is responsible for sensation, and the hypothalamus, which controls involuntary instructions (Aed & Hussein, 2016).

As the researcher focused on the physiology of volleyball training and made repeated field visits to observe young players in a group football game at the Kahraba Club, she recognized the need to enhance the players' explosive ability by implementing strategies that help them overcome technical errors in their skill performance. Aiming at muscle balance on the one hand and brain activity and activation on the other, the research problem was directed in two directions. The first was the researcher's observation that the legs were not very good at jumping. The second was trainers' need for more interest in how vital muscle tone training is for muscle synergy between the muscles of the back and legs and states of awareness. The research aims to create axial stability exercises with different back muscle contractions for volleyball players and determine how they affect physiological indicators related to sports technology and their legs' ability to jump high. The researcher believed that the pre- and post-tests of brain signals (EEG) for the three beta brain waves for

the participants in the experimental group exhibited statistically significant differences. They also thought that there were statistically significant differences between the pre- and post-tests of the players' leg explosiveness.

Methodology

In order to address the research problem, the researcher employed an experimental research approach, which involved creating a single experimental group under strict control and administering pre-and post-tests. The Al-Kahraba Club's 12 young volleyball players, who are continuing their training for the 2023-2024 sports season, represented the boundaries of the research community. All of them were deliberately selected for the current research sample (100%) from their original population using a comprehensive enumeration method to represent the experimental research group according to the determinants of the research design.

To measure the brain signals (EEG) of the three beta brain waves, we used the latest sports technology, the Neurosky device, wirelessly, from the moment of rising to the jump until the completion of the landing. This is due to the measuring device's range of up to 40 meters, which allows the user to stand at an appropriate distance from the sidelines. The Neurosky device's measurement accuracy is characterized by its ease of application on the volleyball field, eliminating the need to transport players to other laboratories. It includes (a sensitive head kit) (EEG) complete with NeuroSky technology to sense neural signals (human brain planning) and the ability to obtain via Bluetooth with any other device such as phones or controllers such as iPads and others directly on raw data, or signals related to brain signals (EEG). It is characterized by automatic wireless pairing and operates on a single (AAA) battery, with a battery operating time of (12) hours. It supports (IOS) and (Android), and its wireless range is (40) meters. Moreover, the test specifications are shown in Appendix (1).

The researcher also used the Sargent vertical jump test with a unit of measurement (cm) because the axial stability exercises with different back muscle contractions included using different moving balance tools to work on the fixed and moving muscle tension of the back muscles that support the limbs in moving balance, as well as the direction of the muscle contractions Similar to the player’s movements in the vertical jump and rapid descent phases, as shown in Appendices (2 and 3).

The researcher aimed to standardize the difficulty of the training load for axial stability exercises by varying the contractions of the back muscles with an intensity ranging from (85–95%) and adopting the high-intensity training method. The exercises for volleyball players included 5 repetitions x (3) sets, 4 repetitions x (2) sets, and 3 repetitions x (1) set. The number of heartbeats after intermittent rest reaches (120 beats) and its duration depends on the parameters of the phosphogenous energy system. It was applied during the particular preparation period and for a period of (8) consecutive training weeks at a rate of (3) training units per week. The research experiment began by applying pre-tests on (10/8/2023), then applying axial stability exercises with varying back muscle contractions for some time (13/8/2023) until (5/10/2023), and completing the experiment by implementing post-tests on (8/10/2023).

The SPSS system, version 28 (V28) was employed after collecting the data for statistical processing. Percentages, means, standard deviations, tests for variance homogeneity (Liven), and correlated samples T-tests were computed.

Result and Discussion

Table 1. The results of homogeneity of variance in the pre-tests

Indication	(Sig)	(Liven)	Standard Deviation	Arithmetic Mean	Sample Number	Tests And Units of Measuremer	
Non-indicated	0.032	0.406	0.853	12	12	Hertz	Low beta waves
Non-indicated	0.182	0.134	1.557	16.33	12	Hertz	Intermediate beta waves
Non-indicated	0.191	0.126	2.968	24.58	12	Hertz	High beta waves
Non-indicated	0.142	0.104	4.589	37.17	12	Cm	The explosive ability of the legs

Table 2. The Results of pre- and post-tests

Indication difference	(Sig)	(t)	Deviation difference	Average differences	standard deviation	Arithmetic mean	Comparison	The test
indicated	0.000	10.407	0.888	2.667	0.583	12	pre	Low beta waves
					0.651	14.67	post	
indicated	0.000	4.168	2.701	3.25	1.557	16.33	pre	Intermediate beta waves
					1.24	19.58	post	
indicated	0.000	12.688	2.73	10	2.968	24.58	pre	High beta waves
					1.24	34.58	post	
indicated	0.000	7.423	4.589	9.833	4.589	37.17	pre	The explosive ability of the legs
					1.128	47	post	

After reviewing Table (2), it is clear that there has been a clear improvement in the values of the post-test results for each of the four investigated variables among the volleyball players compared to what these results were in the pre-tests. The researcher says that these results came about because of the factor of balance and variety in working on the back muscles by investing in muscle tone to tighten and synergize the muscles to do the exercises for axial stability with the variety of back muscle contractions and because the right training tools were used for this type of training that was right for the age and level of the person. Young volleyball players are consistent with the game's specificity in directing muscle contractions like performance. Following this diversity, the players' ability to increase the brain signals (EEG) of the three (beta) brain waves (low, medium, and high) increased. This confirms that after receiving these exercises, the players were at a high level of alertness due to the diversity factor in performing these exercises. These exercises necessitated focused attention and awareness to activate the brain and a significant investment in the dynamic balance element. This compelled the players to enhance their mental alertness, aiming to regulate better the nervous signals the brain sends to control the vertical jump's motor

coordination. This positively impacted the players' physical and physiological health. The post-tests confirmed the increase in vertical jump distance, aligning with the research's intended objective.

Training muscles in both directions increases strength, and motor control improves precision and balance for artistic performance and achievement-related activities and sports motions (Seitz & Other, 2022). Also, developing the physiological condition of the muscles requires many possibilities regarding the duration, repetitions, and intensity of exercise (Issam, 2015). In sports activities, moving performance requires high motor coordination to demonstrate skills in various circumstances based on the player's previous motor experience (Abu Al-Ala, 2012).

Similarly, the progression of exercises fortifies the connection between the brain and muscles. Repetition aids in disregarding external stimuli during the movement, ultimately transforming the body's strength and athletic abilities (Lee & Brenda, 2007). Neuromuscular performance is a key goal of physical education. Every facet of life requires body component harmony, therefore motor compatibility is important beyond sports. Neuromuscular performance is the ability to smoothly and precisely integrate different body parts and motions in a single frame (Abdullah, 2006). This confirms that core stability training with varied back muscle contractions is an essential part of exercise to strengthen the core muscles and maintain straightness and balance while performing daily and sporting activities. This type of training includes many exercises that target the core muscles, such as the abdominal muscles, back, and buttocks (Huxel Bliven & Anderson, 2013).

Exercises that target the Spiral Line muscles help strengthen the torso and stretch it to suit the transfer of muscle strength to the limbs, as it is illogical to train the muscles in isolation, especially if the muscles of the most significant part of the body are the back muscles." Which requires a focus that suits the goal and direction of the exercise (McGill & Others, 2009). Additionally, appropriate repetition of exercises in various situations enhances brain signals (EEG) and raises their level, activating the brain to increase the player's sense of movement (Akuthota & Others, 2008).

Conclusion

According to the current investigation's results, the researcher draws the following conclusions:

1. In young volleyball players, axial stability exercises with varying back muscle contractions help increase the level of low, medium, and high beta EEG signals.
2. Axial stability exercises with varied back muscle contractions help develop the explosive ability of young volleyball players.
3. Volleyball coaches must focus on the physiological evaluation of EEG signals, taking into account the players' sports technology.
4. The mobile stability tools used in axial stability exercises with varying back muscle contractions must be appropriate to the level of the players and keep them safe from the risks of sports injuries or sudden falls.

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Appendix (1): The test for measuring brain signals (EEG)

- **The name of the test:** Test for measuring brain signals (EEG). (Scientific 2020)
- **The objective of the test**: Measuring the brain signals of the three beta waves.
- **The instruments and tools**: Neurosky device, chair for sitting, registration form.
- **The procedures and conditions:** The measurer stands next to the tester while sitting on a chair, facing the remote control device to change the light colors placed on a Table (1 meter away from his sight). He secures the Neurosky device to his head, and the measurer ensures the arrival of wave signals. The brain is at the interface of a portable personal calculator (laptop) screen opposite the laboratory and behind the colored light. The experimenter is then asked to pay attention and focus on the changes of light directed to his eyes during the measurement period as three radiant colors transform: blue, violet, and yellow. The remote control (Bluetooth) is used.
- **The registration:** The program interface provides the tester with one measurement position and records a reading of the three beta waves of the brain (EEG) directly on the registration form.
- **The unit of measurement:** Hertz.

Figure 1. A picture of wearing the Neurosky device

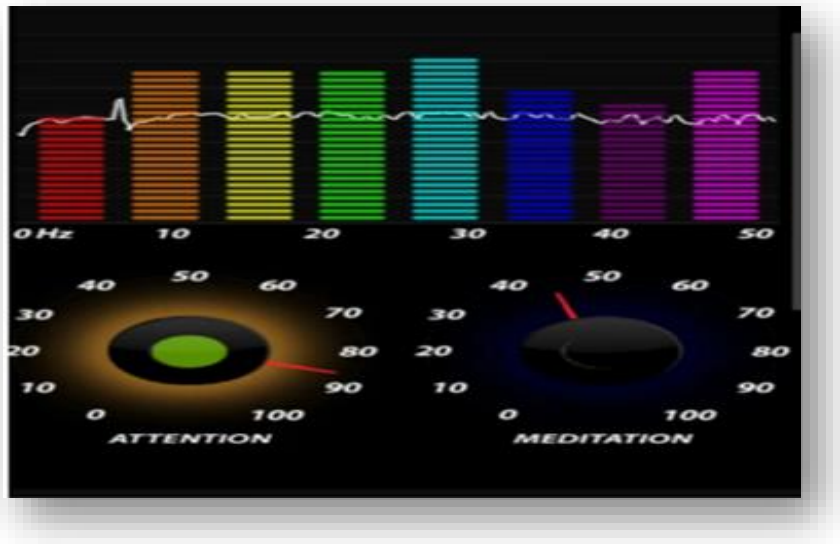

Figure 2. The interface for analyzing brain signals using the Neurosky device

Appendix (2): Instances of axial stability exercises with a variety of back muscle contractions

- **Bridge:**
  - Lay back on the floor with your knees bent and feet flat.
  - Slowly raise your position until the body is straight from head to knees, maintain this position for several seconds, and then slowly lower.
  - Try to tighten your back and abdominal muscles during the movement.
- **Upper abdominal exercises:**
  - Do upper abdominal exercises such as side bends, forward bends, and back bends.
  - Contraction and elongation movements of the abdominal muscles work to strengthen axial stability.
- **Side plank:**
  - Lay sideways on the floor, holding the body with the upper hand while extending the legs.
  - Straighten your body from head to feet for several seconds before switching sides.
- **Plank**:
  - Lay on the floor on the stomach, then rise on the arms and lower limbs of the body.
  - Keep your body balanced and straight from head to heels, and try to tighten your back and abdominal muscles during the movement
- **Functional exercises:**
  - You can lift relatively light weights while maintaining a straight back and practice medicine balls with varying weights.

Appendix (3): Instances of the mobile balancing methods use in axial stability exercises by varying back muscle contractions