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Effect of Rehabilitative Exercises on Posterior Ligament Rupture of the Lumbar Area for 40-to-50-Year Women

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Abstract: This study aimed to design a program of rehabilitation exercises and identify its effect on improving the efficiency of working muscles around the spinal column, to reduce lower back pain associated with the rupture of posterior ligaments of lumbar area, by using the one-group experimental approach. Participants were selected from women (age 44.78 ± 1.98 yr, height 159.11 ± 3.29 m and weight 90.78 ± 4.27 kg) volunteers to participate in this study. The sample was 6 of those who suffer from chronic low back pain associated with the rupture of posterior ligaments of vertebrae of the spinal column (lumbar area). The program consisted of 36 training units for 12 weeks. The results showed statistically significant differences between pre- and post-measurements in all study variables in favor of the post-measurement. The proposed program has a positive effect on the reduction of lower back pain associated with the rupture of posterior ligaments of the lumbar area and improvement of the skeleton case, particularly, the lumbar area in the spinal column.

Key words: Women % Lower back pain % Rehabilitation % Rupture of posterior ligaments of the spine

INTRODUCTION

The spinal column is the central pivot of the body and the common factor in all daily movements of the human being. The burden of most activities requiring flexion and rotation, or both, depends on it. One of the most vulnerable areas to stress, especially in more movements of its parts, is the lumbar area, due to its nature and anatomical and functional characteristics. This area is being more greatly exposed to injuries than the rest of the spinal column, which cause low back pain associated with many injuries and of which are the rupture of the posterior ligaments, slipped discs, fractures and bruising. The skeleton deviations have several implications to human health.

All systems of the body are affected by the situation of the skeleton in addition to feeling excruciating pain in the areas affected by chronic spinal deformities and often lower back pain [1-3]. The environment in which we live and work normally include high levels of pressure that directly affect the form of the body,leading to a high degree of injury.The factors of stress and anxiety lead to the withdrawal of energy which in turn leads to fatigue or muscular spasm. The poor environment, the inconvenience, sleep disorders as well as the normal pressure of the responsibilities and burdens of daily life are all factors that represent a significant burden on the muscles, bones and other vital systems of the body [4]. This is in addition to other factors affecting the skeleton deformations, whether congenital or acquired. That may be in the skeleton, muscular or nervous systems. That may be static or evolving, especially in the spinal column and the differences in the flexibility of ligaments and muscle tension.That begins inconvenience in the static vertebrae first and that was a result of the impact on the lumbar-sacral angle, which in turn leads to increasing front curvature (deviant) of the vertebrae, leading to deformation of the cavity lumbar increase (lordosis) which would cause lower back pain with aging or injury as a consequence of deviation from the lumbar-pelvic rhythm or as a result of abnormal stress factors on the spinal column. This unexpected stress increases the degree of

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tension around the spinal column and presses on the muscles and skeletal system, which causes the body to take the wrong skeleton postures in compensation for this abnormal tension. The major causes of lower back pain are the presence of defects and flaws in the skeleton and therefore, the injury occurs [5].

The lumbar concavity means rear edges are close to the lumbar vertebrae, which narrows the gap through which the nerves pass that causes some sort of pain due to pressure on these nerves. The pain often extends to appear in other places, which are often the two legs. Most causes of this deviation at the women are shoes with high heels, repeated pregnancy and neglect of the sport. The deviation of lumbar concavity is the most common cause of the occurrence of lower back pain. This pain occurs as a result of stress caused by the active role played by the lumbar vertebrae area. They carry the body and works as its pivot during activities' performance. The pelvis is a fixed bone block and the lumbar vertebrae with the sacral vertebrae move the pelvis, which represents a high load on the lumbar vertebrae. The mechanical pressure of this area represents a constant pressure. Hence, any sudden movement, such as flexion or quick rotation, puts the muscles in this area under sudden pressure it may not bear. That leads to rapid defensive contractions to counter this movement. This can lead to many pathological changes represented in the occurrence of spasm and rupture in the muscles, ligaments, soft tissues or cartilages in the lumbar vertebrae [3].

The good skeleton is closely linked to balancing. The goodness of the skeleton means to maintain the body in an equilibrium state between gravity and the body muscle strength. This goodness is governed by exerting energy, where the good skeleton does not need but little energy to balance. Therefore, the more energy exerted to maintain the skeleton straight, the weaker the muscles this refers to Al-Kharboutly [6] and Morgan and Keay [7]. Perhaps this quality-based musculoskeletal balance in the human body has the biggest impact in the various physiological processes. It contributes as much to delay fatigue and make less effort at the same time [8].

In the event of injury, the individual works subconsciously to alleviate the stress on this biomechanical stress occurred to the injured part and resulted from the impact of weight, moving a part of the body weight to the other extremity through the trunk leaning to this extremity. Thus, the center of whole gravity moves from the extremity to the body. One often remains in this posture until the injury is healed. The individual often gets used to this wrong skeleton posture, leading to the skeleton distortion or deviation. It is already clear the importance of the spinal column as being the main axis of the body and the most of its parts achieving the skeleton balance and the high risk that arises as a result of its exposure to injury. Many of the studies have therefore, conducted many rehabilitation programs for all spinal injuries treating the effects of the injury either by maintaining the affected muscles or giving flexibility to the spinal column to be returned to normality.

It was therefore, necessary: to introduce the exercises of balance and skeleton control on injuries' rehabilitation programs, especially the rupture of the posterior ligaments' injury of the vertebrae of the lumbar spinal area, identify the extent of the injury affected by the improvement of working muscle strength around the spinal column, on one hand and balance on the other hand, even, the skeleton interest to become the target of rehabilitation programs so that the skeleton deviations do not arise due to the injury and in different places of the body and not just the spinal column. The burdens of the poise and skeleton control lies in significant parts as knees, shoulders and the pelvis level. Especially, as indicators of skeleton measurements of angle of lumbar concavity for the research sample point that they are within those with lumbar cavity in excess of normal. Jamburtsev indicates that the average of the natural angle measurement of the lumbar concavity is (158.65±1.35) [3]. Interest in muscle balance exercises within the components of rehabilitation programs for this injury is of the most important steps of treatment and rehabilitation for the pain of the lumbar area. Many of the studies confirmed that there was tremendously a benefit from the motor therapy program. The exercise has a great role in the treatment of lower back pain if there is information on the frequency and intensity of exercise and at any motor phase this exercise must be performed [9]. The muscular rupture is a strain and abnormal elongation. It often occurs as a result of a violent and sudden contraction increasing over the ability of the muscle. It is possible that it is a simple rupture in the outer membrane of the muscle or a complete rupture in the muscle body or in its contact with the cord [10].

The rehabilitation is to return the full functionality or maintain it to the injured part in the body. It depends primarily on identifying the causes of injury, its proper maintenance and methods of treatment. The ordinary injured is rehabilitated so that he can carry out his function, burdens and the necessary daily needs without trouble easily [11]. It should not overload the injured tissues during the rehabilitation process and taking into account that the components of the program of exercises are subject to the process of continuous evaluation and modification to make sure that the injury is gradually being healed, without any increase in symptoms associated or delay the speed of healing. The program content must be different from one individual to another according to the limits of his capabilities and his own objectives after knowing the quality and function of the affected muscles. It is necessary to work on building the function again in the light of the nature of the muscle work and seek to re-development and improvement of physical fitness like muscle power and motor range through exercise. This exercise must be clear in which the injured performs in terms of how, when and the number of iterations that must be carried out. Gradation must be taken into account in the exercise program from one phase to another,which helps to accelerate return to his normal physical level and to ensure his return to the practice of his life in a normal way [12,13].

The lowest back pain associated with rupture of posterior ligaments for the lumbar area is one of the important problems that need further studies that contribute to the development of treatment of this problem and to reduce it. It also represents a malfunctioning in the spinal column which affects the general health of the individual and reduces his rates of production.Therefore, it is important to care for the therapeutic exercises that may lead to pain relief associated with the rupture of posterior ligaments for the lumbar area,which appear in the form of pain when you extend or bend the spinal column aside [14].

Study Objective: It is to design a program of motor rehabilitation exercise, identify its impact on the improvement of the efficiency of working muscles around the spinal column through the improvement of maximum static strength for the muscles stretching and bending the trunk, the motor range of the spinal column and improve the flexibility and angle of the lumbar area and improve the dynamic and static balance of the body.

Study Hypothesis: There would be statistically significant differences between the pre and post measurement for the tests of the maximum strength, dynamic range of the muscles working on the spinal column, flexibility and angle of the lumbar area and dynamic and static balance.

MATERIALS AND METHODS

It is the experimental method with one group.

Study Sample: The research sample was volunteer to participated in this study (age 44.78 ± 1.98 height 159.11 ± 3.29 weight 90.78 ± 4.27) ladies, with 6 of them who suffered from chronic low back pain associated with the rupture of posterior ligaments of vertebrae of the spinal column (lumbar area), as well as the exploratory sample three cases.

Terms of Sampling: A medical examination and diagnosis were performed to determine the injury by a specialist doctor, through the initial inspection to locate the position of injury and pain (which is usually between the vertebrae). Diagnosis with MRI was also used to make sure that injury was "the rupture of the posterior ligaments' injury of the vertebrae of the lumbar spinal area", after the completion of medical treatment (by topical injection to relieve pain and drugs, etc.).

The sample was identified in the cases of tension, spasm, fibrosis and weakness, rupture of collateral ligaments between the vertebrae, muscular weakness or atrophy in the muscles as a result of treatment negligence to the injured part.

Homogeneity among the sample members a whole in the variables under discussion was set and Table 1 illustrates that. It is clear from Table 1 the coefficients of skewness were limited between ±3, which indicates the homogeneity of the study sample.

Research Tools:

- A restameter to measure height.
- A form to measure the motor range of the spinal column, to measure the flexibility of the spinal column in different directions.
- Centimeter bar to measure the flexibility of the lumbar area in particular.
- A dynamometer to measure muscle strength (static strength of muscles stretching and bending the trunk was measured).
- Flexible metal tape to measure the angle of the lumbar area.
- Romberg's test and Babinski-Weill test.

Table 1: Mean Standard Deviation and Coefficient of Skewness of theVariables under Study (n = 9)

Variables	Measure Unit	Mean	Deviation	Skewness
Age	Year	44.78	1.98	-0.47
Height	Cm	159.11	3.29	0.55
Weight	Kgs	90.78	4.27	0.26
Strength of back muscles stretching the trunk	Kgs	24.11	1.27	0.68
Strength of back muscles bending the trunk	Kgs	14.33	1.12	0.54
Motor range of the spinal column, bending the trunk forwards	Cm	522	1.39	-0.15
Motor range of the spinal column, bending the trunk backwards	Cm	3.67	1.12	0.15
Motor range of the spinal column, bending the trunk right	Cm	13.67	1.66	0.05
Motor range of the spinal column, bending the trunk left	Cm	12.22	2.59	0.86
Flexibility of the lumbar area	Cm	3.33	1	0.11
Angle of the lumbar area	Point	153	1.41	1.02
Babinski-Weill test	Sec.	26.11	2.57	0.41
Romberg's test	Sec.	71.89	13.49	1.36

Table 2: Specifications of the Main Phases of the Proposed Rehabilitation Program

	Number of training units per week					
Program phases	Out of water	In water	Unit Length	Number of groups	Number of weeks	Loading intensity
First	2	1	50	3	3	50% -60%
Second	2	1	60	4	4	60% - 70%
Third	2	1	70	5	5	70% -80%

The Proposed Rehabilitative Program: The program consisted of 36 training units for 12 weeks with three times a week. Each units contains a set of rehabilitation exercises graduated in difficulty for the development of physical, motor and functional characteristics of the muscle groups and joints of the spinal column. Taking into account the property of the individual in carrying out the program on the injured women with a view to their return to their normal case, that is through a variety of exercises and the use of the method of interval training (repeating a series of exercises intervened by periods of rest and depending on the loading intensity). The program in its final form included three phases are shown in Table 2.

Statistical Processing: Mean, standard deviation, coefficient of Skewness, Wilcoxon W and percentages.

RESULTS AND DISCUSSION

From Table 3 it is clear there are differences between pre and post measurements of the study group to measure the strength of the working muscles on the trunk (stretching and bending) for the post-measurement. Table 4 shows that the improvement percentages ranged between 65.85% and 91% during the period the program was applied.This shows the extent to which the sample benefited from the proposed rehabilitation program that led to the improvement and increase in muscle strength of the trunk. This shows the effect of strength training that was used in water exercises (dynamic strength) or (static strength) training, which included the program out of the water, helping to improve static and dynamic muscle strength. This is consistent with Harrelson [13] and Lumpkin *et al*. [15] referred that muscle strength training and motor work training according to progressive resistances by using different amounts in terms of duration, repetition, which leads to improvement of the muscle strength.

In the opinion of Eitmer *et al*. [16] that the use of aqueous media in carrying out exercises plays an important role in the successful treatment and rehabilitation of injuries. It leads to increase the rate of metabolism, the body to produce heat, relaxation of the muscular system, alerting the blood circulation, increase of motor range of the spinal column and reduction of joints' pain, the pain of vertebral decay, cartilage discs injuries, lumbago and stiff joints. As they relieve pressure on the lumbar area. If the person stands in the water and its level is at the sternum, the loading on both feet is equivalent to one third of the body weight, helping to take advantage of the property of buoyancy and water thrust of the body and get rid of body weight and a sense of security, leading to increase of efficiency in the performance of aqueous motor exercises.

Table 3: Wilcoxon "W" For the Significance of Differences between Pre and Post Measurements of the Study Group (n = 6)

Statistical Significance	Z	Difference N	Direction	Mean Ranks	Measurement	Variables
Significant	-2.21	Zero	-	Zero	Post	Strength of back muscles stretching the trunk (kg)
		6	+	3.5	Pre	
			-	=		
Significant	-2.21	Zero	-	Zero	Post	Strength of back muscles bending the trunk (kg)
		6	+	3.5	Pre	
		-	=			
Significant	-2.21	Zero	-	Zero	Post	Motor range of the spinal column, bending the trunk forwards (Cm)
		6	+	3.5	Pre	
		-	=			
Significant	-1.6	Zero	-	Zero	Post	Motor range of the spinal column, bending the trunk backwards (Cm)
		3	+	2	Pre	
		3	=			
Significant	-2.2	-	-	Zero	Post	Motor range of the spinal column, bending the trunk right (Cm)
		6	+	3.5	Pre	
		-	=			
Significant	-2.2	-	-	Zero	Post	Motor range of the spinal column, bending the trunk left (Cm)
		6	+	3.5	Pre	
		-	=			
Significant	-1.83	Zero	-	Zero	Post	Flexibility of the lumbar area (Cm)
		4	+	2.5	Pre	
		2	=			
Significant	-1.83	Zero	-	Zero	Post	Angle of the lumbar area (degree)
		4	+	2.5	Pre	
		2	=			
Significant	-2.21	Zero	-	Zero	Post	Babinski-Weill test (sec.)
		6	+	3.5	Pre	
		-	=			
Significant	-2.2	Zero	-	Zero	Post	Romberg's test (sec.)
		6	+	3.5	Pre	
		-	=			

Tabular Z = zero at 0.05 significant level

Table 4: Percentages of improvement between pre and post measurement in the variables of the study (n = 6)

Variables	Post-measurement	Pre-measurement	Difference	Improvement Percentage%	Notes
Strength of back muscles stretching the trunk	24.5	46.83	22.33	91	For post-measurement
Strength of back muscles bending the trunk	14.67	24.33	9.66	65.85	For post-measurement
Bending trunk forwards (cm)	4.83	8.17	3.34	67.7	For post-measurement
Bending trunk backwards (cm)	3.67	5.83	2.16	57.45	For post-measurement
Bending trunk right (cm)	14	18.5	4.5	32.14	For post-measurement
Bending trunk left (cm)	13	19.3	6.3	48.46	For post-measurement
Flexibility of the lumbar area (Cm)	3.5	5.5	2	3.77	For post-measurement
Angle of the lumbar area (degree)	153.17	155	1.83	1.19	For post-measurement
Babinski-Weill test	25.83	69	43.1	167.1	For post-measurement
Romberg's test (sec.)	70.83	103.67	32.8	23.78	For post-measurement

Table 3 also shows that there are differences between pre and post tests of the study group in the measurements of motor range for the spinal column as well as flexibility of the lumbar area on bending forwards and the amount of lumber angles. The improvement was clear after carrying out the program in all tests. From Table 4 clearly, improvement percentages ranged between 1.19 and 67.7 for the post-measurement. This is due to the positive impact of the proposed program on the motor range and flexibility of the spine in the lumbar area, which positively influenced the angle of the lumbar area. It included a variety of training appropriate for the rehabilitation of the working muscles on the spinal column. It also included a variety of methods for the training of flexibility, which helped to increase the motor range of the trunk and lower limb joints, the muscles to restore full capacity to contract and expand and as a natural result of the disappearance of pain in the lower back and the positive impact of the components of the proposed program. This is consistent with what indicated by Kolt and Mockler [17] that the use of muscle elongation exercises and flexibility of the spinal column lead to improvement of the motor range increasing the efficiency of the muscles and joints. They suggested that the change in measuring the angle of the lumbar area was not an improvement, although there is a significance of it. However, it did not reach the averages of the natural measurements. This is due to that the study sample is in an age phase in which the bones are not adjusted easily, but the result of improvement in the muscles around the bone, that gives better results in the efficiency of human and his physical fitness, protecting it from injury due to an improvement in the working and opponens muscles. Therefore, it is a result of the proposed rehabilitation program that led to the improved condition of the posterior spinal column ligaments which certainly helped to give indications of better motor range. This along with muscle strength of the muscles stretching and bending the trunk and also the abdominal muscles which exercise make them automatically gain flexibility for the joints between the vertebrae and elongation and strengthen for their ligaments, especially the posterior. Accordingly, the motor improvement of the spinal column becomes imperative. The rehabilitation training using the types of workng movements (with free, double, anti-resistant assistance) by using the isometric and isotonic contraction, all improve the case of the working muscles around the joints, which preserves the flexibility of joints and increases the motion range of the organ resulting in the improvement of the lumbar angle. Therefore, the improvement in the lumbar angle is due to the use of coercive tensile strength training to the lumbar area and equivalent work of the contractions of the abdominal muscles stretching to strengthen them during skeleton moderation exercises. At this point, Cash [4] referred that this therapeutic method of the muscles and the corresponding are suitable for the compressed muscles as in cases of excessive distortions of lumbar concavity. The case of the spinal column will improve,particularly in its lumbar area.

As shown with Table 3, there are differences between pre and post measurements for the study group in the tests of static and dynamic balance. From Table 4, clearly, improvement percentages ranged between 23.78 and 167.1. This is due to the positive and appropriate impact of the rehabilitation exercise program proposed to improve the balance during the same period in which the program was applied. It also included flexibility and elongation training to improve the efficiency of working muscles on the trunk and lower limb, which contributed to the improvement of balance. The training of back muscles affected by the injury is met with a training for the abdominal muscles, which emphasizes the balanced work of muscles and gives the component of balance automatically to the research sample. The exercises also included the muscle strength training and endurance of the muscles working at the lower limbs. In this also, there is a balance between the muscle groups around the trunk and between the muscle groups working in the lower limb. This is consistent with what referred by Ronaid [18] that improving muscle strength, balance and motor range lead to improving motor efficiency.

It is natural that as a result of the excessive loading than the normal limit; injuries occur. The muscles of the spinal column always suffer from the misuse and overloading as a result of its skeleton form (as the sample has a concave lumbar angle in excess of limit). Muscle non-balance causes many skeleton problems. Continuous pressure on the parts of the spinal column, it leads to the weakening of the opponens muscles. Over time, the causes of injury arise and the most areas to be injured of the spinal column are the lumbar area because of the short muscles in this area [4, 6]. Through the presentation of results, this indicates the improvement of study sample due to the improvement of the skeleton case and balance. Since the improvement of the balance would improve the motor sense, thus that achieves a better skeleton case as well as improvement of muscle tone, in addition, the constant repetition of certain exercises improves the skeleton case of the lumbar area that will switch bad skeleton habits to good skeleton habits, protecting the study sample from loss of balance resulting from the injury and thus the research objective was realized.

CONCLUSIONS

- The proposed rehabilitation program has improved the case of the spinal column, particularly its lumber area through: Improvement of maximum static strength of the muscles stretching and bending the trunk, improvement of motor range of the spinal column, improvement of flexibility and angle of the lumber area and improvement of the static and dynamic balance.

- The proposed program has led to the reduction of lower back pain associated with rupture of posterior ligaments for the lumbar area.

RECOMMENDATIONS

- Guidance by the proposed program has to reduce lower back pain associated with rupture of posterior ligaments for the lumbar area.
- Use of study measurements as tests to assess the efficiency of the working muscles on the spinal column.

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