

THE EFFECT OF A THERAPEUTIC REHABILITATION PROGRAM ON THE DEGREE OF PAIN AND SOME PHYSICAL VARIABLES IN PATIENTS WITH A HERNIATED LUMBAR DISC

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Abstract

Aim. The back area occupies the most important area that is responsible for the efficiency of movement and activity in humans, due to the backbone which is considered the basic axis in the human body and the common factor in all its activities and nearly all the daily tasks.

The research aims to identify the effect of a therapeutic program on the degree of pain and some physical changes in patients with a herniated lumbar disc. That will be through identifying the effects of the rehabilitation on the pain degree, and some physical changes of the working muscles.

Methods. The researcher used the experimental syllabus as he used one group in the pre and post-test because it suits the nature of the research. The research sample is selected intentionally from those who have lumbar discs (a group of 80 injured). The researcher used the following equipment (A medical scale to measure weight – a Restameter device for measuring length – patient information release forms – Genometer to measure the range of motion – which measures the degree of pain). The patient's degree of pain is determined by determining the pain score from (0 to 10), then the patient is asked to look at his facial expression, and the score is given out of (10) using the numerical pain scale).

Results. The main findings indicate that : (i) The use of a rehabilitation program that included rehabilitation exercises has a clear positive effect on the research variable (the movement range – level of pain the strength of working muscles); (ii) There are statistically significant differences in the improving rate between the pre and post measurements for the experimented group through the effect of the suggested program on the movement rate for the backbone. (Bend the torso forward – torso curvature- Bend the torso right – and left – turn torso right – turn torso left) for the herniated lumbar disc. That was in favor of the averages for the pre-measurements with a percentage ranging between (14.50%-21.11%); and (iii).

Conclusions. There are statistical differences in the improving rate between the pre and post-measurement for the experimented group on the effect of the suggested rehabilitation program on the movement rate of the thigh (Bending the right hip joint – Extending the right hip – Bending the left hip joint – Extending the left hip joint) for the herniated lumbar disc which is in favor of the averages for the post measurements with the percentage ranging between (17.13% - 19.94%).

Keywords: lumbar; herniated lumbar; Pain

Introduction

The technological development and the emergence of modern machines, we find that their use has led to the occurrence of some health problems in the spine, from weak ligaments and cartilage up to a herniated disc as a result of using these devices for long periods in wrong positions, most of which are in the cervical and lumbar vertebrae, or these injuries occur as a result of excessive stress. The muscle ligaments between the vertebrae or the presence of structural weakness in the fibrous disc surrounding the gelatinous cartilaginous nucleus. This may be the result of hereditary or acquired structural deformities or structural weakness such as concavity or convexity of the natural curvatures of the spine. Several mechanical changes occur that change the conditions of the cartilage between the vertebrae and also often. A significant increase in body weight above normal causes constant pressure on the herniated discs. This leads to a large disc herniation (Al Safa et. al., 2011). The back area occupies the most important area responsible for the efficiency of movement and activity in humans due to the presence of the spine, which is the main axis of the human body and the common factor in almost all of its motor activities and daily work (Bakkry, 2005). A herniated lumbar disc is one of the most important and common injuries to the spine, whether in sports or other fields. It occurs as a result of an incorrect movement, excessive effort, or accidentally lifting a heavy object. This results in the rupture of the outer fibrous membrane of the cartilage and the release of the gelatinous substance (the nucleus) and its transformation into a solid substance that presses on the spine. The nerves in this area are most commonly affected by this type: the lumbar vertebrae. The protrusion (sliding) is often on one side of the spine, which often affects only one leg (Eliwa, 1997); (Roshdy, 1997). By informing the researcher of some studies and scientific research in the field of injuries and rehabilitation that were carried out in the Egyptian environment and within the limits of their knowledge, the researcher found that there is a scarcity of research that directly dealt with people with a herniated lumbar disc, whose cases do not require surgical intervention, and that dealt with the

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development of rehabilitation exercise programs of varying intensity. Based on the direction of sliding of the cartilage nucleus to rehabilitate such cases, the program is divided into several stages to develop muscle strength (static and motor) and increase flexibility and range of motion of the spine.

Objectives

The research aims to identify the effect of a rehabilitation program on the degree of pain and some physical variables among people with a herniated lumbar disc through:

- The effect of the rehabilitation program on the range of motion of patients with a herniated lumbar disc.
- The effect of the rehabilitation program on the degree of pain among patients with a herniated lumbar disc.
- The effect of the rehabilitation program on some physical variables of the working muscles (under research) in patients with a herniated lumbar disc.

Hypotheses:

- 1 - There are statistically significant differences between the averages of the pre-and post-measurements of the experimental group in the effect of the proposed rehabilitation program on the range of motion of people with a herniated lumbar disc, in favor of the averages of the post-measurements.
- 2 - There are statistically significant differences between the averages of the pre-and post-measurements of the experimental group in the effect of the proposed rehabilitation program on the degree of pain among people with a herniated lumbar disc, in favor of the averages of the post-measurements.
- 3 - There are statistically significant differences between the averages of the pre-and post-measurements of the experimental group in the effect of the proposed rehabilitation program on some physical variables (under investigation) among people with a herniated lumbar disc, in favor of the averages of the post-measurements.

Methods

Participants:

The research used the experimental method for one group through two measurements, the pre- and post-method, as it suits the nature of the research. The Ethics Committee of Arish University approved this study.

Study design:

The research used the experimental method for one group through two measurements, the pre- and post-method, as it suits the nature of the research.

Procedures

Aid and equipment:

- 1- medical scale to measure the weight.
- 2- Restameter device for measuring length.
- 3- Patient information release forms.
- 4- Genometer to measure a range of motion.
- 5- Measuring the degree of pain. The patient's degree of pain is determined by determining the pain score from (0-10) and then asking the patient and look at his facial expression and the score is given out of (10) using the (Numerical pain scale).
- 6- Nerve stimulation device.

Table 1. The pain degree

No pain	0
Simple pain	3, 2, 1
Moderate pain	6, 5, 4
Severe pain	10, 9, 8, 8

Survey study:

The study was done from 4/9/2021 to 9/9/2021 on a sample from the original community and out of the main one.

The suggested rehabilitation program:

The rehabilitation program was designed for the members of the sample under study as the following:

- View the specialized scientific references in the field of rehabilitation and backbone injuries, and through analyzing the rehabilitation programs used in the related reference studies and research.
- Interviews with experts.
- Thus. The rehabilitation program was made for cases of herniated discs and whose cases don't require surgical interference. (under consideration).

Objectives of the rehabilitation program:

- Finding the balance between the muscle groups working on both sides of the backbone and the thigh muscles.
- Strengthening the weak muscles group working on one side of the backbone and the hip joint in all directions.
- Reducing the severity of pain.
- Improve the range of motion.

Fundamentals of implementing the rehabilitation program:

- Pay attention to the preparation and warm-up that is appropriate to the nature and degree of the injury.
- Gradual load intensity during the implementation phase, and take into account load rationing.
- Taking into account flexibility during the application of the program and its ability to be modified without violating the general principles.
- Exercise should be done from easier to more difficult.
- Apply the program individually according to the condition of each sample member.
- The total time for each patient is 8 weeks.
- The number of times the rehabilitation program is applied per week; 3 training units, 12 training units per month for each stage.\
- Taking into account the physiological principle in implementing the training and rehabilitation unit.
- Taking into account giving appropriate rest periods between the rehabilitation periods.
- Continuity and regularity so as not to lose the effect of the exercise in the previous units.
- Refer to the treating physician and coordinate with him.
- When implementing, attention should be paid to rehabilitation of the muscle groups affected by the injury, as well as the muscle groups that contribute to the rapid return of the affected area to its normal state.

Program implementation stages:

The researcher divided the rehabilitation program into three stages which are:

- (1) The paramilitary stage (warming): It aims to :
 - Reduce pain.
 - Educate muscle contraction while stimulating blood circulation.
 - Improve motion range.
 - Improving and preparing muscle tone and preparing the injured person to perform the exercises in the next stage.
 - (2) The basic stage : (The content):
 - Increase the muscle strength for working muscles on the backbone and hip joint.
 - Gain a stranger range of motion than normal for the backbone and hip joint to achieve motion adaptation.
 - Increase the functional efficiency of the trunk and perform the movements of Bending and extending in various directions, taking into account that this should be done within the limits of each individual.
 - (3) The final stage: It aims to :
 - Reduce the severity of pain.
 - Relax and calm down.
 - Prepare the individual to practice the requirements of his daily life.
- Each rehabilitation unit included:
- Warming up: - It took 15 minutes to prepare the muscles and Respiratory circulatory system before training.
 - Main part: - it was 20 minutes and included performing the specified exercises within the suggested rehabilitation program.
 - Final part: - (calming down), it was 5 minutes, and included a group of exercises for relaxing all the muscles and physical structure to return the body to its state.
- (4) Conditions for implementing the rehabilitation program:
 - Perform the rehabilitation exercises 3 times weekly (Saturday-Monday –Wednesday) due to the sample presence 3 days a week in Zagazig stadium which is the permitted period.
 - The injured should perform exercises that are given to him in each rehabilitation session once again on the same day or the following day with the implementation of these exercises, the performance time, and the rest of each exercise.
 - Never continue performing the exercise as soon as feeling any pain.
 - The rest period is proportional to the exercise period and condition of each patient.
 - Taking into account any imbalance in the patient's health or psychological condition before implementing any rehabilitation unit.
 - Consider doing exercises for the rest of the body.

Results

It has been done from 6/11/2021 to 11/11/2021 on some variables of the previous one.

Table 2. The significant difference between the pre-and post-measurement in the averages of the motion range of the backbone.

<i>Suckles group</i>	<i>Pre</i>		<i>post</i>		<i>Value</i>	<i>%</i>
	M.	S.	M.	S.		
Bend the torso forward	104.9	9.61	122.7	7.59	6.45	14.50
Torso curvature back	49.5	7.04	62.9	5.59	2.23	21.3
Bend torso right	37.1	4.28	45.1	5.40	4.3	17.18
Bend torso left	35.5	3.63	45.00	4.11	4.7	21.11
Turn torso right	33.1	4.77	39.8	5.88	3.4	16.88
Turn torso left	31.9	3.63	39.5	5.08	3.3	16.27

Table 3. The significant difference between the pre-and the post-measurement in the variable motion range of the thigh.

<i>Suckles group</i>	<i>Pre</i>		<i>post</i>		<i>Value</i>	<i>%</i>
	M.	S.	M.	S.		
Bend the right hip joint to be close to the body	82.1	12.3	100.9	13.4	4.56	18.63
Stretch the right hip joint and keep it away from the body.	35.3	6.98	43.9	6.66	3.4	19.6
Bend the left hip joint and keep it close to the body.	80.3	8.92	97.6	8.99	4.7	17.73
Bend the left hip joint and keep a way out of the body.	34.5	4.31	43.1	5.04	4.3	19.94

Table 4. The significant difference between the pre-and the post-measurements in pain degree

<i>Suckles group</i>	<i>Pre</i>		<i>post</i>		<i>Value</i>	<i>%</i>
	M.	S.	M.	S.		
The degree of pain resulting from a herniated lumbar disc	62.3	10.31	23.7	8.68	9.51	64.95

Table 5. The significant difference between the pre-and post-variable measurement of the muscles strength of the torso.

<i>Suckles group</i>	<i>Pre</i>		<i>post</i>		<i>Value</i>	<i>%</i>
	M.	S.	M.	S.		
Bend the torso forward	18.59	1.85	23.46	2.28	6.64	20.76
Torso curvature back	24.78	2.71	29.55	3.56	3.51	15.84
Bend torso right	33.84	2.41	39.5	2.82	3.91	14.33
Bend torso left	35.27	2.50	40.52	2.40	3.42	12.96
Turn torso right	15.55	2.27	20.2	2.72	4.30	23.02
Turn torso left	16.64	1.94	21.00	2.15	4.87	20.76

Table 6. The significant differences between the pre-and post-variable measurements of the strength of the muscle of the flexor and extensor muscles of the thighs.

<i>Suckles group</i>	<i>Pre</i>		<i>post</i>		<i>Value</i>	<i>%</i>
	M.	S.	M.	S.		
Differences grasp the right thigh	23.07	3.81	29.7	4.19	3.74	22.32
Between the extend the right thigh	36.84	3.96	42.01	4.22	4.18	12.80
Averages Grasp the right thigh	22.87	2.71	27.98	3.50	3.62	18.26
Extend the left thigh	36.01	3.67	42.33	4.42	3.92	14.72

Discussions

Through the apparent results of measuring the range of motion of the backbone (Bend the torso forward – Torso curvature – Bend the torso right – Bend the torso left – turn the torso right turn the torso left) and after performing the therapeutic rehabilitation program and the (T) value calculated in the tables (3) which expresses the motion range of the backbone for those who suffer from Lumbar herniated disc. Through the apparent results of measuring the range of motion of the thigh (Bend the right thigh joint and bring it to the body Bend the left thigh joint and bring it close to the body Extend the left thigh joint and

distance it to the body) and after performing the therapeutic rehabilitation program and the (T) value calculated in the table (4) which expresses the motion range of the thigh for those who suffer from Lumbar herniated disc. This indicates that the therapeutic rehabilitation program has contributed to improving the range of motion of the thigh and herniated disc patients. This indicates the validity of the rehabilitation program for those with a herniated disc and the relief of pressure on the vertebrae, which indicates flexibility and ease of movement and performing some sports movements, which has positively affected the patient's ability to enjoy normal movement, and the results of this study agree with the study of Both (Haddeen, 2001); (Tsourlou, 2006); (Donald & Roberson, 2007); (Orabi & Al Dababsa, 2011). The researcher attributes this result to the fact that muscle flexibility is linked to muscle relaxation, which allows for better motion performance. Also, the relaxation of the muscles working on the spine reduces the pressure of muscles working on the spine reduces the pressure of the vertebrae on each other and leads to the distance between the vertebrae becoming the normal distance between each vertebrae and this prepares for the disappearance of the mechanical obstacle of the partial movement. The range of the motion has improved notably well, which denotes that the flexibility of the backbone increased. Therefore, muscle spasms and stiffness have decreased to a great extent, as the stiffness of the spinal vertebrae causes pain and thus it is difficult to move and carry out normal, daily, and sporting activities. The improvement is due to the therapeutic rehabilitation program, as indicated by (Kramer et. al., 2003); (Rawanat & Metha, 2003); (Vince et. al., 1987), additionally, increasing the elasticity of the muscle, ligaments, and tendons increases the flexibility of the joints, So, practicing the rehabilitation exercises increases blood circulation activity and improves the metabolism process, which helps raise the temperature of the muscles and thus works to relax them, improving the flexibility of the joint, in addition to the therapeutic rehabilitation program containing flexibility and stretching exercises, which leads to an increase in the globules tendinous bodies. This result was consistent with what was reached by both (Amir et. al., 2005); (Almansi, 2011). The researcher attributes improving the range of motion from osteoarthritis of the knee joint to intensive therapeutic exercises after injection of platelet-rich plasma to restore the range of motion after removal of the osteoarthritis cartilage. This is what was confirmed in this research, and we see that the percentage of improvement increased at all levels of measurement as follows: - Bend the joint 69.83% - stretch the joint 62.42% - Rotation of the joint outward 159.59% - Rotation of the joint inward 98.84%) which indicates an improvement in the range of motion in its various measurements, and the second hypothesis is fulfilled, which states: There are statistically Significant differences for the pre-and-post – measurements of the experimental groups in the effect of the proposed rehabilitation program for patients with a herniated lumbar disc, in favor of the post – measurements.

The apparent results of measuring the pain degree after the rehabilitation program and the calculated value of (T) in table (5), express the pain degree for those with Lumbar herniated disc, which indicates a statistically significant difference between the pre-and measurement in favor of the post – measurement. This indicates that the therapeutic rehabilitation program has contributed to improving the pain degree for patients with herniated discs, which indicates the suitability of its use with herniated disc patients. Therefore, it relieves the pressure on the vertebrae, which indicates flexibility and ease of movement, and performing some spot movements has positively affected the lack of pain in the lumbar disc as it enables the patients to enjoy normal movement. The results of this study agree with (Orabi & Al Dababsa, 2011); (Izquerdo & Arrese, 2007); (Tase et. al., 2006). As the pain degree is reduced, the researcher attributes this to the practice of rehabilitative exercises directed to improve the strength of the back muscles and improve the range of motion, thus reducing pressure on the vertebrae, thus reducing the degree of pain in the lower back. Also practicing the rehabilitation exercises increases. As it is assured by (Sari et. al., 2005); (Amir et. al., 2005); (Ozturk et. al., 2006). Using the exercises works on increasing the space between the vertebrae in the lower back, thus, it will reduce the cartilage rushing towards neighboring nerves and as a result the pain degree will decrease and the functional performance will improve. This is in addition to the disappearance of pain as a result of the disappearance of spasms and stiffness as a result of the increase in the foamy substance in the muscles, which helps in improving the flexibility of the spine and increasing the strength of the back muscle. Therefore, practicing the exercise increases the secretion of Endorphins. Which reduces pain. (77: 4, 51: 5). Thus, the injured person's ability to meet the requirements of daily life and sports is restored without feeling handicapped as a result of the herniated disc, as (Amir et. al., 2005); (Almansi, 2011); (Rattanatharn et. al., 2004). Pointed out that the person's ability to do his daily requirements is connected strongly with the flexibility degree, the strength of the muscles, and the pain degree. The results of this study agree with (Yousef & Magelly, 2007); (Amir et. al., 2005); (Almansi, 2011); (Ozturk et. al., 2006); (Al Kady & Al-Abdein, 2011), as they cleared out that using the therapeutic exercises decrease the feeling of pain and the fear of the movement and improvement of the life that connected with health and the ability to do the daily requirements and decrease the level of pain and handicap. It also agreed with the study of (Tulder et. al., 2001); (Mannion et. al., 2001); (Tritilanunt & Wajanavisit, 2001).

Petersen et. al. (2002) that undergoing a rehabilitation exercise program, improves the research variables, which indicates the degree of pain and thus the second hypothesis is fulfilled which states:- There are statistically significant differences between the average of the pre-and post – measurements of the experimental group in the effect of the proposed rehabilitation program on the pain degree of the Lumbar herniated disc in favor of the prior-measurements averages.

Through the apparent results of measuring the muscle strength of the torso (bend the torso forward/stretch the torso forward bend the torso right/bend it left/rotate the torso right/rotate it left) after the rehabilitation program and the calculated value of (T) in the table (7) which expresses the strength of the flexor and extensor muscles of the right and left thighs for those with Lumbar herniated disc. The rehabilitation exercises for patients with lumbar herniated discs have contributed to increasing the strength of the working muscles, as the researcher attributes to the strength of muscles of the spines, which contribute positively if they are applied properly. Also, the continuity of exercises for the sample group of the research especially the back exercises, may increase the strength and flexibility of the back. The result of this study agrees with the study of (Orabi & Al Dababsa, 2011); (Haddeen, 2001) (Izquerdo & Arrese, 2007); (Danald & Roberson, 2007); (Tsourlou, 2006). The researcher attributes these

results to contributions within the program of rehabilitation exercises that have led to the resolution of blood clots and the restoration of muscle to normal functions through reduction of the dysfunction of the affected part, and reduce the weakness of some muscles, joints, and ligaments. Hence, Doing the exercises helps to improve the muscle strength and the flexibility of joints. The researcher also attributes that muscle weakness that occurs in patients with herniated discs is the result of a lack of operating value of the muscle groups in the lower back and therefore it is natural for these muscles to suffer from a trophy because of not using them properly enough, which may help to increase the temperature of the back muscles and be prepared for lengthening in addition to the positive stretching exercises which increase the length and flexibility of mechanically contracted muscles to allow improving the range of motion through its function and prepare to increase the amount of the resulted power as it is one of the factors that control the muscle strength and the muscle was able to achieve a longer length. This study agreed with the study of (Olivier et al., 2008), the rehabilitation program based on scientific factors leads to strength of the muscles of the back as it increases the resistance of the skeleton to the pressure on it, so it contributes to doing the tasks concerning the lumbar part of the spine, so it reduces or prevents the appearance of pain once again in the Lumbar part 36: 29 That presents the improvement of the muscle strength of the torso and thigh in the different measurement in the third hypothesis which states the following: There is a statistical difference between the pre-and post-measurements for the experimental group of the effect of the proposed rehabilitation program on some physical changes (under study) for the patients with Lumbar disc in favor of the premeasured.

Conclusions

1- Using the rehabilitation program that included the rehabilitation exercises had a clear positive impact on the research variables (motion rate – pain level – the strength of the working muscles).

2- There are statistically significant differences in the percentage of improvement between the averages of the pre-and post – measurements in the effect of the proposed rehabilitation program on the range of motion of the backbone (Bend the torso forward – Torso curvature – Bend the torso right – Bend the torso left – turn the torso right – turn the torso left). For herniated lumbar disc in favor of the pre-measurements with percentage (14.5%-21.11%).

3- There are statistically significant differences between the pre and post – post-measurements in the experimental group of the impact of the suggested rehabilitation program on the motion rate of the thigh (end the right hip joint – stretch the right hip joint – bend the left hip joint – stretch the left hip joint) in patients with a herniated lumbar disc. In favor of the pre – pre-measurements average with percentage (17.73% to 19.94%).

Recommendations

1- The importance of providing rehabilitation on a program that includes gradual movements is treating the injured to return to a healthy position.

2- Work on using more than one rehabilitation and therapeutic program for use in treating a herniated disc.

3- Encourage patients on the importance of using rehabilitation programs before directing surgical intervention.

4- Pay attention to developing and strengthening the back and abdominal muscles to strengthen the backbone to avoid injuries easily.

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References

- Al Kady, M., & Al Abdein, B. (2011). The effect of treating exercises in rehabilitating the patients with chronic disc herniation. *Science production, the educational science studies*,83(1):398-405. doi: 10.1016/j.saa.2011.08.052.
- Al Safa, S., et. al. (2011). *Football*. Directorate of Printing and Publishing House, part 2.
- Almansi, S. (2011). The effect of rehabilitation and treating program for patients with Lumbar disc. Unpublished master, Al-yarmook University. Jordan.
- Amir, B., Farokhi, Z., & Rezasoltan, A. (2005). Lumber Stabilizing Exercise improve activities of daily living in patients with lumbar disc herniation, *Journal of Back and Musculoskeletal Rehabilitation*.
- Bakkry, M. (2005). *The sports rehabilitation & the sports injuries*. Al Ketaak office co-publishing, Cairo.
- Donald, N. & Roberson, J. (2007). Learning Wellness: A Water Exercise Class in Zagreb, Croatia. *Educational Gerontology*, 33(8),631-648. /doi.org/10.1080/03601270701363901.
- Eliwa., M. (1997). *Sports injuries between prevention & treatment*. Al Fekre Al Arabi, Cairo.
- Haddeen, G. (2001). Identify the contribution of the water program in reducing the severity of pain associated with friction of the patella bone. unpublished master, Jordan University.
- Izquerdo, M. & ArreseA. (2007). Exercise in warm water decreases pain and improves cognitive function in middle-aged women with fibromyalgia. *Clinical an experimental rheumatology*, 25(6),823-30.
- Kramer, J., Speechley, M., Bourne,R., Rorabeck,, C. & Vaz, M. (2003). Comparison of the clinic – and Home – Based Rehabilitation programs after total knee arthroplasty. *Clinical Orthopaedics and Related Research*, 410, 24-225. Doi: 10.1097/01.blo.0000063600.67412.11.
- Mannion, A.F., Taimela, S., Muntener, M. & Dvorak, J. (2001). Active therapy for chronic low back pain part 1, Effect on back muscle activation, fatigability, and strength. *Spine Journal*, 26(8), 897-908.



- Olivier, N., Lepretre, A., Caby, I., Dupuis, M. A. & Prieur, F. (2008). Does exercise therapy for chronic lower-back pain require daily isokinetic reinforcement of the trunk muscles? *Ann Readapt Med Phys*, 51(4), 91-284. DOI: 10.1016/j.annrmp.2008.02.003.
- Orabi, S. & Al- Dababsa, M. (2011). The effect of an educational program for some skills in swimming to reduce the pain for those will pain at the lower back, unpublished master Al-Nagah National University magazine.
- Ozturk, B., Gundus, O.H., Ozoran, K. & Bostanoglu, S. (2006). Effect of continuous lumbar traction on the size of herniation. *Rheumatology International*, 26(7), 6-622. DOI: 10.1007/s00296-005-0035-x.
- Petersen, T., Kryger, P., Ekdahl, C., Olsen, S. & Jacobsen, S. (2002). The effect of McKenzie therapy as compared with that of intensive strengthening training for the treatment of a patient with sub-acute or chronic low back pain: A randomized controlled trial. *Spine Journal*, 27(16), 9-1702. DOI: 10.1097/00007632-200208150-00004
- Rattanatharn C., Sanjaroensuttikul, N., Anadirekkul, P. Chaivisatr, R. & Wannasetta, W. (2004). Effectiveness of lumbar traction with routine conservative treatment in acute herniated disc syndrome. *J Med Assoc Thai*, 87, 7-272.
- Rawanat, C. & Metha, A. (2003). Total Knee arthroplasty Rehabilitation protocol. *The Journal of arthroplasty*, 27-30. DOI: 10.1054/arth.2003.50080.
- Roshdy, M. (1997). The pain of the lower back. *Knowledge Establishment*.
- Sari, H., Akarirmak, U., Karacan, I., Akman, H. (2005). Computed tomographic evaluation of lumbar spinal structures during traction. *Physiother Theory Pract*, 21(1), 3-11.
- Tase, J., Basia, B., Thompson, F., Joanne, W., Kim, B. (2006). Effects of aquatic exercise on flexibility, Strength and aerobic fitness in adults with osteoarthritis of the hip or knee, *Journal of advanced Nursing*, 57(2).
- Tritilanunt, T., & Wajanavisit, W. (2001). The efficacy of an aerobic exercise and health education program for the treatment chronic low back pain. *Journal med association thai*, 8(12).
- Tsourlou, T., Benik, A., Dipla, K., Zafeiridis, A., & Kellis, S. (2006). The effects of a twenty-four-week aquatic training program on muscular strength performance in healthy elderly women. *J. Strength Cond Res*, 20(4), 8-811. DOI: 10.1519/R-18455.1.
- Tulder, V., Malmivaava, A., & Esmail, H. (2001). Exercise therapy for low back pain, *Spine Journal*, 25(21).
- Vince, K., Kelly, M., Beck, J. & Insall, J. (1987). Continuous Passive Motion after Total Knee Arthroplasty. *The Journal of Arthroplasty*, 2(4), 281-4. doi: 10.1016/s0883-5403(87)80060-8.
- Yousef, M. & Megally, I. (2007). The effect of using massage and therapeutic exercises in treating and rehabilitating the pains of the lower back. *The first scientific conference for the association of colleges, institutes, and physical departments in the Arab world*, the 1st volume, Amman, Jordan.