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The Impact of Employing a Semi-Rigid Lumbosacral Orthosis (LSO) on Trunk Muscle Strength in Individuals with Low Back Pain (LBP) and Spondylolisthesis

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Abstract

Background: Spondylolisthesis is a spinal condition in which one vertebra slips forward or backwards with the next vertebra. Disturbances caused by this condition include the lumbar region, muscle spasm, decreased muscle strength, limitation of motion, and radiating pain in the legs. Most people refrain from back pain treatment and prefer a more traditional approach. Although many studies have proven that wearing brace for LBP were successful, lack of study mentioned about negative effects on short-term wearing. Therefore, this study aimed to determine the effect of using semirigid *Lumbo Sacral Orthosis* on the strength of the Trunk muscles in the case of *Low Back Pain (LBP)* e.c *Spondylolisthesis.*
Aims: to determine the effect of using semirigid *Lumbo Sacral Orthosis* on the strength of the Trunk muscles in the case of *Low Back Pain (LBP)* e.c *Spondylolisthesis.*
Methods: This research was quasi-experimental research using a pretest and posttest design approach. It was conducted at the Yogyakarta General Hospital, UGM Academic Hospital, Dr. Soeradji Tirtonegoro Klaten hospital and Tugurejo Semarang Hospital. The number of participants was 35 patients with purposive sampling.
Results: There was an effect of using LSO Type Semirigid on trunk flexion muscles before and after treatments (Z = -5.099 with p value = 0.000), trunk rotational muscle strength before and after treatment (Z = -4.600 with p value = 0.000), trunk extension strength before and after treatment (Z = -4.472 with p value = 0.000).
Conclusion: There was an effect of semirigid *Lumbo Sacral Orthosis* on the strength of the trunk muscles in the case of Low Back Pain (LBP), e.c Spondylolisthesis. As a result, the most significant effect that experienced a decrease in trunk muscle strength after the patient used semirigid LSO was in the flexion muscle group (0.75), then extension muscle (0.58) and rotation muscle (0.65).

Keywords: Spondylolisthesis treatment, Orthotic intervention, Muscle strength assessment

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Introduction

In Indonesia, LBP is found in the age group of 40 years. Overall, LBP was the most common complaint (49%). In developed countries, people affected by LBP are around 70-80%. In workers in America, the fatigue of LBP increased by 68% between 1971-1981. Around 80-90% of LBP patients stated that they did not make any effort to treat the disease, so it can be concluded that although LBP has a high prevalence, this disease can be cured by itself[1].

In patients with LBP, e.c *Spondylolisthesis* can occur with or without pain. The incidence of lower back pain is due to the fifth lumbar vertebral body shifting forward above the lower vertebral body by including the entire vertebral column above it. Spondylolisthesis affects 5%-6% of the male population and 2%-3% of women[2]. In the case of spondylolisthesis, anti-inflammatory drugs are usually given in combination with acetaminophen. So, if there is severe nerve pain, corticosteroids may be given, including oral prednisone. Moreover, the *Lumbo Sacral Orthosis* (LSO) may be given not in too long period[3].

A study conducted by Choelewicki et al. explained that the use of LSO for three consecutive weeks with use for 3 hours per day showed no clinically significant changes in neuromuscular control of the trunk. However, the *Lumbo Sacral Orthosis* (LSO) increases the trunk stiffness and the number of agonist's muscles that become quiescent in response to pressure from the released LSO. Further research is needed to determine the significance of these effects[4].

Methods

The present research was a quasi-experimental type of research using a pretest and posttest design approach. It aimed to determine the effect of using the Semi-rigid *Lumbo Sacral Orthosis* (LSO) on the strength of the abdominal muscles in patients with LBP e.g *Spondylolisthesis*.

O1---------- X ---------- O2
Description :
O1 = Before treatment
X = Giving LSO type Semirigid
O2 = After treatment

The research was conducted at the Yogyakarta General Hospital, UGM Academic Hospital, Dr Soeradji Tirtonegoro Klaten hospital and Tugurejo Hospital Semarang. Moreover, it was conducted in March-May 2018. These implementation stages included (1) recording the subjects or samples, (2) conducting pretest on research subjects, (3) giving treatment in the form of using LSO Type Semirigid, (5) conducting the pot-test after four weeks.

Results and Discussion

The subject of the study amounted to 35 patients performing measurements with Manual Muscle Testing to find out the strength of muscles of the trunk (trunk, flexion rotation, and extension of the trunk) before the intervention. After measuring trunk muscle strength, the research subjects were given an LSO Type Semi-Rigid intervention for four weeks. Then, muscle strength was measured again after the intervention. The data obtained were then processed with descriptive statistics.

The researchers used extension and rotation of the trunk and the method of Daniels and Worthingham's Manual Muscle Testing to measure the strength of the muscles in the flexion[5]. The muscle assessment criteria used are as follows:

Table 1. The Assessment Criteria of Muscle Testing

Numerical Score	Qualitative score
5	Normal
4	Good
3	Fair
2	Poor
1	Trace activity
0	Zero (No activity)

Explanation of the general criteria for assessing muscle strength:

Grade 5 - The muscle demonstrates the ability to move the associated joint through a complete range of motion, opposing gravity, and resisting full examiner-applied force.

Grade 4 - The muscle exhibits the capacity to move the associated joint through its full range against moderate resistance.

Grade 3 - The muscle is capable of moving the associated joint through its entire range against gravity but lacks resistance.

Grade 2 - Full range of motion is achieved by the muscle only when the joint is correctly positioned to eliminate the impact of gravity.

Grade 1 - Palpable muscle contraction is present but insufficient to generate joint motion, even with gravity eliminated.

Grade 0 - No palpable muscle contraction is observed; indicative of paralysis.

Characteristics of respondents in continuous data research include age, trunk flexion muscle strength, trunk rotational muscle strength and trunk extension muscle strength. It can be seen in Table 4.1 as follows:

Variable	Min.	Max.	Mean	Std.Dev
Age	34,00	74,00	57,49	8,89
Flexion trunk muscle strength (pre-test)	3,00	5,00	3,86	0,69
Flexion trunk muscle strength (post-test)	2,00	5,00	3,11	0,76
Rotation trunk muscle strength (pre-test)	2,00	5,00	3,74	0,74
Rotation trunk muscle strength (post-test)	2,00	5,00	3,09	0,66
Extension trunk muscle strength (pre-test)	2,00	5,00	3,49	0,66
Extension trunk muscle strength (post-test)	1,00	4,00	2,91	0,66

Source: primary data processed, 2018

Characteristics of respondents in categorical data research in this study based on gender. It can be seen in Table 2 as follows:

Table 2. The characteristics of the subjects of the Data categorical

Sex	N	Percentage (%)
Male	9	25,7
Female	26	74,3
Amount	35	100

Source: primary data processed, 2018

Table 2 shows that of the total research subjects were 35 respondents. Moreover, most of the research subjects were female, with several 26 people (74.3%). The normality test of the data selected was processed with Shapiro Wilk because the research sample was less than 50. If a p-value obtained is higher than 0.05 at the test, it means that it has normally distributed data.

The results of the normality test for trunk muscle strength can be seen in Table 3 as follows:

Table 3. Normality Data

Variabel	p value	α	Description
Flexion trunk muscle	0,000	0,05	abnormal

strength (pre-test)			
Flexion trunk muscle strength (post-test)	0,000	0,05	abnormal
Rotation trunk muscle strength (pre-test)	0,000	0,05	abnormal
Rotation trunk muscle strength (post-test)	0,000	0,05	abnormal
Extension trunk muscle strength (pre-test)	0,000	0,05	abnormal
Extension trunk muscle strength (post-test)	0,000	0,05	abnormal

Source: primary data processed, 2018

The normality test results with Shapiro Wilk before and after the intervention showed that the data were not normally distributed. It was because the p-value was less than 0.05.

Data analysis of this study was carried out using the SPSS 21 program to determine the effect of using LSO Type Semirigid on trunk muscle strength (trunk flexion, trunk rotation and trunk extension). The hypothesis test in this study was tested using the Wilcoxon test because the data were not normally distributed. The results of the Wilcoxon test can be seen in Table 4 as follows:

Table 4. the Effect of using Semi-rigid LSO on Trunk Muscle Strength (Trunk Flexion, Trunk Rotation and Trunk Extension)

Variable	Mean		Z	P-value
	Pre-test	*Post test*		
Flexion trunk muscle strength	3,86	3,11	-5,099	0,000
Rotation trunk muscle strength	3,74	3,09	-4,600	0,000
Extension trunk muscle strength	3,49	2,91	-4,472	0,000

Source: primary data processed, 2018

There was an effect of using LSO Type Semirigid on the strength of the trunk muscle before and after the intervention.

The Wilcoxon test results showed three effects of Semirigid type of LSO before and after the treatments including trunk flexion muscle strength (Z = -5.099 with p-value = 0.000), trunk rotational muscle strength (Z = -4,600 with p-value = 0.000), and trunk extension muscle strength (Z = -4,600 with p-value = 0.000). It means that the longer use of Semirigid type of LSO in the case of Low Back Pain (LBP) e.c Spondylolisthesis will reduce trunk muscle strength, trunk flexion muscle strength, trunk rotation and trunk extension. It is in line with research from Borenstein, which states that the use of a lumbar girdle will provide passive stabilization of the vertebrae. Thereby, it will limit the movements that cause muscular pain[6]. Using a lumbar corset is less effective if it is more than two weeks because it can lead to a decrease in strength[7].

The use of a lumbar corset can significantly reduce pain complaints after the first two weeks. However, if there is no significant decrease in pain after the second two-week period, it can be concluded that the decrease in pain complaints only occurred in the use of the lumbar corset for the first two weeks. On the other hand, there was no significant decrease in pain complaints after the next two weeks[8]. Therefore, the dose or time of using the corset must be adjusted to the conditions and needs. Furthermore, the lumbar corset can be given by an orthotist. It is generally recommended to be worn when the patients awake and are active and then removed again when sleeping[2].

The research subjects were tested using Manual Muscle Testing to determine the strength of the trunk muscles (trunk flexion, trunk rotation and trunk extension) before being given the intervention. After that, the research subjects were given a semirigid type of LSO Type intervention for four weeks.

Then, muscle strength was measured again after the intervention. The data obtained were then processed with descriptive statistics. Moreover, it showed that the average value of trunk flexion muscle strength before treatment was (3.68) and after treatment (3.11); trunk rotational muscle strength before treatment was (3.74) and after treatment was (3.09); and trunk extension before treatment was (3.49) and after treatment was (2.91).

Conclusion and Recommendation

Spondylolisthesis generally occurs due to trauma and a shift in an *anterior-posterior* direction. Although it can occur to the right or left lateral, most *spondylolisthesis* appears at the lumbosacral joint towards the anterior. The most burden on the spine lies in this joint, so the use of *Lumbo Sacral Orthosis (LSO)* will increase trunk stiffness. Moreover, it can increase the number of agonist's muscles that become quiescent as a response to pressure from the released LSO. As for the results, the most significant influence that experienced a decrease in trunk muscle strength was the flexion muscle group, which was (0.75), the extension muscle (0.58), and the rotation muscle (0.65). Accordingly, the finding aligns with the theory that *spondylolisthesis* occurs at the lumbosacral joint towards the anterior (flexion movement).

Conclusion based on the above, the authors hope that the results of this study can be used as material to provide education and training to the public regarding how and when to use the semirigid type of Lumbo Sacral Orthosis correctly and adequately. Moreover, it is beneficial for people who experience complaints of low back pain to help them continue their activities properly. Based on the existing theory, it explains that the use of LSO is effective in reducing pain in the first two weeks of use. After that two-week use, it does not have a significant effect. So, the use of LSO must be adjusted to the condition and activity of the patient. It does not need to be used continuously.

An example of the use is when the patient has strenuous activities. LSO should be removed when the patient does not do strenuous activities or sleep. Accordingly, this study indicates that LSO has a side effect of reducing trunk muscle strength. For the Next Researchers, the researchers suggest that further researchers will increase the number and the characteristics of research subjects, including physical activity or work in detail, the duration of use. and the effectiveness of using LSO in certain activities.

References

1. Abdul Saad, W. A., Mat Dzahir, M. A., Mohamed, H., Ahmad, Z. A., Mohamad, M., Mad Saad, S., & Mat Dzahir, M. A. (2017). Posture Detection on Active and Inactive Vertebrae of Spine Biomechanics in Critical Daily Activities. *Journal of Mechanical Engineering (JMechE)*, (2), 49-74.
2. Azadinia, F., Takamjani, E. E., Kamyab, M., Parnianpour, M., Cholewicki, J., & Maroufi, N.. Can lumbosacral orthoses cause trunk muscle weakness? A systematic review of the literature. The Spine Journal, 2017, 17.4: 589-602.
3. Bimo Ariotejo, Low Back Pain. [internet]. 2010 [cited 23 March 2017]. Available from : http://www.emedicine.com
4. Borenstein, David, Calin, Andei. Fast facts: low back pain. Karger Medical and Scientific Publishers. 2012.
5. Cailliet, Rene D. Loren A. Helberg. "15 Organic Musculoskeletal Back Disorders." Handbook of Severe Disability: A Text for Rehabilitation Counselors, Other

Vocational Practitioners, and Allied Health Professionals. 1981: 205.
6. de Oliveira, F. C. L., Larivière, C., Dallaire, M., Mecheri, H., Ngomo, S., & da Silva, R. A. (2022). Immediate Effect of Lumbosacral Orthosis and Abdominal Drawing-In Maneuver on Postural Control in Adults with Nonspecific Chronic Low Back Pain. *Journal of Manipulative and Physiological Therapeutics*, *45*(6), 425-435.
7. Fujimoto, Y., Sakai, T., & Sairyo, K. (2020). What type of orthosis is optimal for conservative treatment of lumbar spondylolysis?: a biomechanical analysis. *Spine Surgery and Related Research*, *4*(1), 74-80.
8. Hislop, H. J., and J. Montgomery. "Daniels and Worthingham's manual muscle testing." *Techniques and manual examination, 8th ed. St. Louis: Saunders Elsevier*, 2007: 198-204.
9. Johnson, D. D. (2012). *Efficacy of a Novel Thoracopelvic Orthosis in Reducing Lumbar Spine Loading and Muscle Fatigue in Flexion: A Study with Weighted Garments* (Doctoral dissertation).
10. Kuntono HP. Penggunaan korset lumbal dan back exercise untuk mengurangi keluhan LBP di PT Sritex Solo. [Diss]. Yogyakarta: Universitas Gadjah Mada; 2002.
11. Larivière, C., Boucher, J. A., Mecheri, H., & Ludvig, D. (2019). Maintaining lumbar spine stability: a study of the specific and combined effects of abdominal activation and lumbosacral orthosis on lumbar intrinsic stiffness. *journal of orthopaedic & sports physical therapy*, *49*(4), 262-271.
12. Linton, A. A., & Hsu, W. K. (2022). A review of treatment for acute and chronic pars fractures in the lumbar spine. *Current Reviews in Musculoskeletal Medicine*, *15*(4), 259-271.
13. Mary Rodts, DNP. Spondylolisthesis: Treatment, Restrictions, Bracing, Medication. [internet]. Spineuniverse.2018 [cited 2 January 2018]. Available from : https://www.spineuniverse.com/conditions/spondylolisthesis/spondylolisthesis-treatment-restrictions-bracing
14. Neel Metha. Weill Cornell Medicine [Internet]. Pain management. 2015 [cited 5 January 2018]. Available from: https://painmanagement.weillcornell.org/health-library/spondylolisthesis
15. Rocha, R. (2018). Back Injuries and Management of Low Back Pain in Handball. *Handball Sports Medicine: Basic Science, Injury Management and Return to Sport*, 375-386.