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A Comparative Study on Efficacy of Core Strengthening Exercises and Interferential Therapy in Reduction of Pain in Patients with Spondylolisthesis

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Abstract: ***Background: Spondylolisthesis is a spinal condition that causes low back pain. Various studies are available that showed the beneficial effects in the management of spondylolisthesis, but there were only a few studies conducted comparing the effect of core strengthening exercises and electrotherapy modality to reduce the pain. Thus, in the present study, an attempt has been made to compare the efficacy of interferential therapy and core strengthening exercises in reducing pain in patients with spondylolisthesis. Materials and Method: A total of 42 purposively selected confirmed cases of spondylolisthesis (both male and female) aged 25-40 years were considered for the present study. The subjects were further divided into two groups for intervention. Group-A consisted of 21 subjects who were treated with interferential therapy (IFT) and Group-B consisted of 21 subjects who were treated with core strengthening exercises. Results: The results of the present study revealed that statistically significant differences were noted in reduction of pain between pre- and post treatment in patients treated both with interferential therapy (p<0.001) (Group-A) and core strengthening exercises (p<0.001) (Group-B). But in post-treatment, the patients treated with core strengthening exercises had greater percentage decrement in pain than the patients treated with interferential therapy. Conclusion: The findings of the present study showed that both the five weeks of treatment protocol with interferential therapy and core strengthening exercises can be used to reduce the pain in patients with spondylolisthesis, but the core strengthening exercises protocol showed considerably greater percentage reduction of pain than interferential therapy protocol.***

Keywords: Core strengthening exercises, Interferential therapy, Pain, Spondylolisthesis

1. Introduction

Spondylolisthesis is a condition that occurs when one vertebral body slips with respect to the adjacent vertebral body. Patients with this condition remain asymptomatic with only occasional back pain; chronic low back pain with or without radicular symptoms; radicular symptom with or without neurological deficit; and intermittent neurogenic claudication [1]. The incidence of spondylolisthesis varies considerably depending on ethnicity, sex, family history, relevant disease and sports activity [2]. Several epidemiological studies have revealed that the incidence of symptomatic spondylolisthesis in Caucasian populations varies from 4 to 6% [3], but rises as high as 26% in secluded Eskimo populations [4] and varies from 19 to 69% among first-degree relatives of the affected patients [5].

Spondylolisthesis should be treated first with conservative therapy, which includes physical therapy, rest, medication and brace [6]. There have been various studies available that showed the beneficial effects in the management of spondylolisthesis, but there were only a few studies conducted to compare the effect of core strengthening exercises and electrotherapy modality i.e., interferential therapy (IFT) in management of spondylolisthesis. The present study was designed for the comparison of core strengthening exercises and IFT in reduction of pain in patients with spondylolisthesis.

2. Materials and Methods

Subjects

The present study dealt with purposively selected 42 confirmed cases of spondylolisthesis (both male and female) aged 25-40 years, collected from Amandeep Hospital, Amritsar, Punjab, India. The subjects meeting the inclusion criteria were included in the study with Grade1 and Grade 2 spondylolisthesis. The subjects were further divided into two groups for intervention. Group-A consisted of 21 subjects who were treated with Interferential Therapy (IFT). Group-B consisted of 21 subjects who were treated with core strengthening exercises. A written informed consent was taken from each participating subject. A prior explanation regarding the treatment was given to the subjects who were enrolled in the study. The study was approved by institutional ethical committee.

Intervention given to the subjects

The treatment program was performed daily for five days per week i.e., Monday to Friday for five weeks. Patients with spondylolisthesis in both the groups were assessed for functional disability (through ODI) and pain (VAS, MG-S and MG-A).

Interferential Therapy (IFT)

IFT was performed after Hurley et al. [7]. Patients were asked to lie down in prone position. Two electrodes were placed unilaterally or bilaterally at the periphery of the LBP painful

area. In subjects with unilateral pain, the, cathode (-) electrode was positioned at the proximal extent and the anode (+) electrode at the distal extent of the painful area. Treatment of subjects with bilateral LBP involved paraspinal application of the cathode and anode electrode at the lateral limits of the painful area, parallel to the vertebral column. IFT spinal nerve root electrode placement technique involved the placement of the midpoint of the cathode and anode electrodes lateral to the intervertebral foramen of the target spinal nerve, parallel to the vertebral column. For unilateral symptoms. The proximal cathode was placed 2 cm lateral intervertebral foramen and the distal anode electrode was placed 2 cm further laterally. Treatment of subject with bilateral LBP involved paraspinal application of the cathode and anode electrodes parallel to the vertebral column at the level of the intervertebral foramen of the paraspinal target spinal nerves. The treatment session lasted for 20-25 min.

Core Strengthening Exercises

The **c**ore strengthening exercises were performed after Venu et al. [8]. The treatment session lasted for 40-45 minutes with the protocol - day 1-3: back flexion exercises, day 3-6: pelvic tilt exercises, day 7-11: bridging Exercises, day 11-15: partial sit ups, day 11-15: partial sit ups, 3rd week: glutei stretch, 4th week: unilateral knee to chest exercises, 5th week: quadruped arm/ leg raise (bird dog exercise).

Oswestry Disability Index (ODI)

This index was made to evaluate low back pain invalidated people in their daily activities (sleeping, self -care, sex life, social life and travelling). Each question contained 6 categories (starting from 0: no limitation, upto 6: most limitation). The score was calculated by the sum of the 10 questions, multiplied by 2. This value represented the percentage of invalidation.

Pain Self-efficacy Questionnaire (PSEQ)

This questionnaire rated how confident patients felt performing activities despite the pain. This indicted on a scale from 0 (no confidence) to 6 (completely confident). All the scores were then added up to a score from 0 to 60. Where the closer to 60 did mean that the patients had a stronger self- efficacy belief. There were also short versions of the questionnaire available that showed a great responsiveness (9).

The Visual Analogue Scale (VAS)

Ii was a single term measure that was an instrument measuring the whole construct at once. The VAS most commonly consisted of a 100 mm horizontal line anchored with two opposite labels; patients marked a score on the scale using a horizontal line. A VAS was easy to use and therefore applicable to a variety of practice and research settings. The VAS was a commonly used assessment instrument for pain intensity in rehabilitation, which had to be proved to be reliable and valid.

McGill pain questionnaire (MPQ)

It was a self- reporting measure of pain used for patients with a number of diagnoses. It assessed both quality and intensity of subjective pain. The MPQ was composed of 78 words, of which respondent was asked to choose that best described their experience of pain. Seven words were selected from the following categories: dimension 1 to 10 (pain descriptors), three words; dimensions 11 to 15 (affective components of pain), dimensions 16 (evaluation of pain), and dimensions 17 to 20 (miscellaneous). Scores were tabulated by summing values associated with each word; scores ranged from 0 (no pain) to 78 (severe pain). Widely used in multiple studies, the MPQ has had good reliability and validity (10) and has discriminated among different pain diagnoses. Two outcome variables were considered from this questionnaire – McGill affirmative (MG-A) and McGill sensory (MG-S).

Statistical Analysis

Data were analyzed using SPSS (Statistical Package for Social Science) version 20. Standard descriptive statistics (mean ± standard deviation) were determined for the measured pain variables. The independent t-test was used for the comparison of selected pain related variables between patients with Group-A and B as well as within group comparison; paired t-test was applied. A 5% level of probability was used to indicate statistical significance.

3. Results

Table 1 showed the descriptive statistics of age, height, weight and BMI in patients treated with Group-A and Group- B. The patients treated in Group A had lower mean values of age (32.19 years) and higher mean value of height (160.10 cm), weight (74.33 kg), and BMI (28.97 kg/m^2) than the patients treated in Group-B (32.76 years, 156.90 cm, 68.20 kg and 27.74 kg/m^2 respectively). However, no significant difference was noted in any case.

The descriptive statistics of different pain related variables between pre- and post-treatment conditions of patients treated in Group-A were shown in Table 2. Patients with pre-treatment condition had higher mean values in ODI (35.66), VAS (7.61), MG-S (26.76) and MG-A (9.28) as compared to post- treatment condition of the patients (20.40, 4.42, 18.71 and 5.80 respectively). Statistically highly significant differences ($p<0.001$) were noted in ODI ($t=15.732$; $p<0.001$), VAS ($t=13.564$; $p<0.001$), MG-S ($t=16.415$; $p<0.001$) and MG-A ($t=9.764$; $p<0.001$) between the pre- and post-treatment conditions of the patients treated in Group-A.

Table 3 showed the descriptive statistics of different pain related variables between pre- and post- treatment of Group-B. The patients with pre-treatment group had higher mean values in ODI (36.85), VAS (7.71), MG-S (27.95) and MG-A (9.38) as compared to post-treatment (17.57, 2.52, 16.42 and 3.95 respectively). Statistically significant differences ($p<0.001$) were found in ODI ($t =14.872$; $p<0.001$), VAS ($t=25.620$; $p<0.001$), MG-S ($t=16.327$; $p<0.001$) and MG-A ($t=14.982$; $p<0.001$) between them.

The descriptive statistics of different variables between post-treatment of Group-A and Group-B were given in Table 4. Patients with Group-A had higher mean values in ODI (20.80), VAS (4.42), MG-S (18.71) and MG-A (5.80) than the patients with Group-B (17.57, 2.52, 16.42 and 3.95 respectively). Statistically significant difference was observed in ODI ($t=2.247$; $p<0.030$), VAS ($t=5.500$;

p<0.001), MG-S (1.904;p<0.064) and MG-A (t=5.860; p<0.001) between them.

Table 1: Descriptive statistics of age, height, weight, BMI in patients treated with Group-A and Group-B

Variables	Group-A (IFT)		Group-B (CSE)		t- value	p-value
	Mean	SD	Mean	SD		
Age (years)	32.19	3.54	32.76	4.59	4.51	6.54
Height (cm)	160.10	6.21	156.90	5.34	1.787	0.82
Weight(kgs)	74.33	8.27	68.20	7.09	2.575	0.014
BMI (kg/m2)	28.97	3.38	27.74	2.94	1.259	0.215

Table 5 showed the percentage decrement of different pain related variables of the patients treated with Group-A and Group-B. Patients treated with Group-B had higher percentage of decrement in pain variables, i.e. ODI (54.02%), VAS (70.26%), MG-S (43.28%) and MG-A (56.18%) than patients treated with Group-A (42.79%, 41.56%, 30.52% and 37.71% respectively).

Table 2: Descriptive statistics of different variables between pre- post treatment in Group-A

Variables	Pre-treatment		Post-treatment		t-value	p-value
	Mean	SD	Mean	SD		
ODI	35.66	4.46	20.40	4.74	15.732	0.001
VAS	7.61	0.58	4.42	1.12	13.564	0.001
MG-S	26.76	3.31	18.71	2.86	16.415	0.001
MG-A	9.28	1.45	5.80	1.24	9.764	0.001

ODI = Oswestry disability index; VAS = Visual analogue scale; MG-S = McGill sensory and MG-A = McGill affirmative.

Table 3: Descriptive statistics of different variables pre-post treatment in Group B

Variables	Pre-treatment		Post-treatment		t- value	p-value
	Mean	SD	Mean	SD		
ODI	36.85	5.57	17.57	4.58	14.872	0.001
VAS	7.71	0.56	2.52	1.12	25.620	0.001
MG-S	27.95	3.30	16.42	4.69	16.327	0.001
MG-A	9.38	1.43	3.95	0.74	14.982	0.001

Table 4: Descriptive statistics of different variables between post- treatment of Group-A and Group-B

Variables	Group A (IFT)		Group B (CSE)		t-value	p-value
	Mean	SD	Mean	SD		
ODI	20.80	4.74	17.57	4.58	2.247	<0.030
VAS	4.42	1.12	2.52	1.12	5.500	<0.001
MG-S	18.71	2.86	16.42	4.69	1.904	0.064
MG-A	5.80	1.24	3.95	0.74	5.860	<0.001

Table 5: Descriptive statistics of percentage decrement of lumbar range of motion variables in Group A and B

Variables	Group A (IFT)	Group B (CSE)
ODI	42.79%	54.02%
VAS	41.56%	70.26%
MG-S	30.52%	43.28%
MG-A	37.71%	56.18%

4. Discussion

Spondylolisthesis is a presumed cause of back pain. Degenerative spondylolisthesis was most commonly observed at the L4-5 level (male 3.9%, female 8.8%, total 5.9%) [11].

The finding of present study showed that the patients treated with IFT had significantly lesser mean values in post-treatment phase for ODI, VAS, MG-S and MG-A as compared to pre-treatment phase. These changes in Group-A was seen due to the fact that a number of hypoalgesic mechanisms have been attributed to IFT: stimulation of pain 'gating' and opioid mechanisms, stimulation of the reticular formation, and elimination of nociceptive substances. Prolonged afferent nociceptive impulses may lead to increased excitability of the central sensory neurons and changes in their plasticity, which leads to hypersensitivity resulting in an exaggerated response to pain; therefore, central sensitization reduction should be targeted for the treatment of patients with chronic low back pain and spondylolisthesis [12]. IFT reduces pain by stimulating thick nerve fibres. Improved circulation and muscle relaxation also reduces pain. A primary objective of patients is to improve their level of functional disability. Despite the significantly better reduction in ODI scores in the IFT with electrode group compared with the other groups, had slightly higher baseline ODI values, meaning greater functional disability, and accordingly having greater potential for change [13].

Similarly, the patients treated with core strengthening exercises had significantly lesser mean values in post-treatment phase for ODI, VAS, MG-S and MG-A as compared to pre-treatment phase.

These differences were seen due to effectiveness of core strengthening of back muscles. According to Arab and Nourbakhsh [14], specific muscle tightness (i.e. erector spinae, psoas, iliotibial band, hip external rotators, hamstrings, and gastrocnemius) was commonly found in association with low back pain. Tightness of these specific muscles affected the biomechanics of the lumbar spine, diminishing the shock absorbing capacity of the lumbar segments and increasing compression force on the lumbar spine. Muscular stretching programs are designed to progressively stretch. The muscle groups which are assumed to be too tight and improve the body biomechanics [15].

Though, the reduction of pain in patients with spondylolisthesis was found in both Group-A and B, the core strengthening exercises protocol showed greated percentage reduction of pain than interferential therapy protocol in all the pain variables studied. the results of this study supported by the previous studies and there were evidences to support exercise therapy for patients with chronic low back pain, spondylolisthesis. Exercise therapy can be performed as self-care exercise performed by the patient or as supervised exercise. Supervised exercise therapy is recommended by clinical practice guidelines as an effective intervention for patients with chronic low back pain. So the exercise therapy or core strengthening exercises should be done in case of spondylolisthesis in order to reduce pain.

5. Conclusion

The findings of the present study showed that both the five weeks of treatment protocol with interferential therapy and core strengthening exercises can be used to reduce the pain and improve the functional disability. but the core strengthening exercises protocol showed greater percentage decrement of pain than interferential therapy protocol in all the pain variables studied.

Declaration by Authors
The authors hereby declared that it was their original peace of research and had not been sent to any other journal for publication.

Ethical Approval: Approved.

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