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Research Article

EFFECT OF ISOMETRIC AND ISOTONIC EXERCISE TRAINING ON CORE MUSCLE IN PATIENTS WITH NON-SPECIFIC LOW BACK PAIN

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ABSTRACT

Objective: To compare the effects of isometric (stability) and isotonic training on core muscle in patients with non-specific low back pain on pain, endurance, and functional disability.

Methods: Forty participants of both genders aged between 20 and 35 years suffering from non-specific low back pain were taken and equally divided into two groups: Group A isometric exercise and Group B isotonic exercise, both the group received baseline treatment of transcutaneous electrical nerve stimulation and hot moist pack. Outcomes measure visual analog scale, endurance test, and modified Oswestry disability index were used the pre-treatment and at the end of 4 weeks.

Results: Experiment of both the groups showed a non-significant improvement in pain, endurance, and functional disability. Except for extensor endurance test which shows significant different in Group A.

Conclusion: Both isometric and isotonic exercises are equally effective in reducing pain, increase endurance, and improve functional disability in patients with non-specific low back pain.

Keywords: Isometric and isotonic exercise, Non-specific low back pain, Core muscle.

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INTRODUCTION

The human spine acts as a multisegmental, flexible rod forming the central axis of neck and trunk. Normal bony spine forms three major curves on the sagittal plan which consist of 24 presacral vertebrae [1]. Lumbar muscles play a role in lumbar segmental stability and give a basic support which consists of global outer muscles and local deeper muscles [2]. The global (outer) muscle - rectus abdominal, oblique's, latissimus dorsi, and erector spinae. The local (deeper) muscle - transverse abdominis, multifid, and quadratus lumborum [3,4].

Around 80% of the population having low back pain at some point in their life which may be due to heavy physical workload, frequent lifting, extreme sports activities, frequent bending, and twisting [5]. Prevalence data from population-based studies conducted worldwide indicate a substantial variation in overall prevalence ranging from 10% to 25% in women and from 10% to 27% in men [6].

Pain is defined as low back pain with unknown specific pathology, e. g., infection, tumor, osteoporosis, fracture, structural deformity, inflammatory disorder, radicular syndrome, or cauda equina syndrome [7].

History of a non-specific low back is lifting and/or twisting while holding heavy object, operating a machine that vibrates, prolonged sitting, fall [8], coughing, sneezing, and straining [9].

Isometric exercise training (static exercise): Isometric (stability) exercises are a static form of exercise, in which muscle contracts and produces force without an appreciable change in the length of the muscle and without visible joint motion [10,11].

Isotonic exercise training (dynamic exercise): Isotonic exercises are a dynamic form of exercise, in which muscle contraction causes joint movement and excursion of a body segment as the muscle contracts and shortens (concentric muscle action) or lengthens under tension (eccentric muscle action) [12].

METHODS

It was a comparative study conducted in the physiotherapy department of Krishna Institute of Medical Sciences. Ethical permission was obtained from the Institutional Ethical Committee, Krishna Institute of Medical Sciences Deemed University, Karad. 40 patients were equally divided into 2 groups using simple random sampling with random allocation. Baseline treatment was given to both the groups which consisted transcutaneous electrical nerve stimulation (TENS) and hot moist pack (HMP). Group A was given isometric exercise and Group B was given isotonic exercise. Participants were selected according to inclusion and exclusion criteria. Written informed consent was taken, and the whole study was explained to them. A detailed musculoskeletal evaluation was done to screen the patients. Inclusion criteria were as follows: (1) Both male and female, (2) age group - 20-35 years, (3) patients willing to participate in exercise program, and (4) history of non-specific low back pain since 3 months.

Exclusion criteria were as follows: (1) Any back injury or pathology within the previous 6 months, (2) resistance training or any type of core muscle training within the past 6 months and history of back surgery, and (3) rheumatologic disorder and spine infection.

Group A: HMP, TENS, isometric (stability) exercise.

Group B: HMP, TENS, isotonic exercise.

Isometric (stability) exercise

- Curl up: Supine lying, one leg straight, the other leg flexed at 90°, support lower back with hands, elbow on the floor, keep torso and neck in line, engage core in raising head, and shoulders slightly off the ground.
- Side bridge: Side lying, lie on side with knees bent and prop upper body up on elbow, raise hips off the floor, and hold 10 seconds.
- Bird dog: Quadruped position, both hands are under the shoulder and knees are under the hips, opposing arms and legs raised off the floor separately.

Isotonic exercise

- Bent knee sit-up: Supine lying, hands by side, knee flexed 60°, heels flat on floor, head and upper back raise.
- Cross curl up: Supine lying, bent knee about 60°, feet flat on the floor, hands placed behind neck, one leg across the other, the participant raised their contralateral elbow to the opposite knee.
- Prone back extension: Prone lying, bodies cantilevered over the end, lowered their upper body at 90° of table after feet were secured with a strap and return to starting position.

Post-intervention scoring was recorded on the last day of treatment in the form of pain on visual analog scale (VAS), functional disability on modified Oswestry disability index (MODI), and strength on endurance test.

RESULTS

Outcome measures: VAS

Table 1 shows intragroup analysis of VAS score revealed statistically considered extremely significant in pain postinterventionally for both the groups. This was done using Wilcoxon matched pairs t-test (Group A: p<0.0001 and Group B: p<0.0001).

Table 2 shows intergroup analysis of VAS score was done using Mann–Whitney test. Pre-interventional analysis showed no significant difference between Group A and Group B (p=0.5769). Post-intervention analysis showed no significant difference between Group A and Group B (p=0.7525).

Endurance test

Abdominal

Table 3 shows intragroup statistical analysis revealed statistically extremely significant increase in abdominal endurance postinterventionally for both the groups. This was done using Wilcoxon matched pairs t-test (Group A: p<0.0001 and Group B: p<0.0001) (Table 3).

Table 4 shows Intergroup analysis of abdominal endurance test was done using Mann–Whitney test. Pre-interventional analysis showed no significant difference between Group A and Group B (p=0.8468). Post-intervention analysis showed no significant difference between Group A and Group B (p=0.4972) .

Extensors

Table 5 shows intragroup statistical revealed statistically extremely significant increase in extensor endurance postinterventionally for both the groups. This was done using Wilcoxon matched pairs t-test (Group A: p<0.0001 and Group B: p<0.0001).

Table 1: Comparison of pre- and post-VAS score within groups

Group	Pre-treatment		Post-treatment		p
	Mean±SD	Median	Mean±SD	Median	
A	7.05±1.317	7	1.7±0.6569	2	<0.0001
B	7.3±0.9787	5	1.65±0.7452	1	<0.0001

VAS: Visual analog scale, SD: Standard deviation

Table 2: Comparison of pre and post VAS score in between groups

Group	Pre-treatment		Post-treatment	
	Mean±SD	Median	Mean±SD	Median
A	7.05±1.317	7	1.7±0.6569	2
B	7.3±0.9787	7	1.65±0.7452	1.5
p	0.5769		0.7525	

VAS: Visual analog scale, SD: Standard deviation

Table 6 shows intergroup analysis of extensor endurance test was done using Mann–Whitney test. Pre-interventional analysis showed no significant difference between Group A and Group B (p=0.8475). Post-intervention analysis showed significant difference between Group A and Group B (p=0.0363).

Side support

Table 7 shows intragroup statistical analysis revealed statistically extremely significant increase in side support endurance postinterventionally for both the groups. This was done using Wilcoxon matched pairs t-test (Group A: p<0.0001 and Group B p<0.0001).

Table 8 shows intergroup analysis of side support endurance test was done using Mann–Whitney test. Pre-interventional analysis showed no significant difference between Group A and Group B (p=0.2762). The post-intervention analysis also showed no significant difference between Group A and Group B (p=0.3848).

MODI

Table 9 shows intragroup analysis of MODI score revealed statistically considered extremely significant in disability postinterventionally for both the groups. This was done using Wilcoxon matched pairs t-test (Group A: p<0.0001 and Group B: p<0.0001).

(Table 10) SHOWS intergroup analysis of MODI was done using Mann–Whitney test. Pre-interventional analysis showed no significant

Table 3: Comparison of pre- and post-abdominal endurance test within groups

Group	Pre-treatment		Post-treatment		p
	Mean±SD	Median	Mean±SD	Median	
A	2.1±0.6407	2	4.05±0.6048	4	<0.0001
B	2.15±0.5871	2	3.9±0.5525	4	<0.0001

SD: Standard deviation

Table 4: Comparison of pre and post abdominal endurance test in between groups

Group	Pre-treatment		Post-treatment	
	Mean±SD	Median	Mean±SD	Median
A	2.1±0.6407	2	4.05±0.6048	4
B	2.15±0.5871	2	3.9±0.5525	4
p	0.8468		0.4972	

SD: Standard deviation

Table 5: Comparison of pre- and post-extensor endurance test within groups

Group	Pre-treatment		Post-treatment		p
	Mean±SD	Median	Mean±SD	Median	
A	2.05±0.5104	2	4±0.5620	4	<0.0001
B	2±0.7255	2	3.55±0.5104	4	<0.0001

SD: Standard deviation

Table 6: Comparison of pre and post extensor endurance test in between groups

Group	Pre-treatment		Post-treatment	
	Mean±SD	Median	Mean±SD	Median
A	2.05±0.5104	2	4±0.5620	4
B	2±0.7255	2	3.55±0.5104	4
p	0.8475		0.0363	

SD: Standard deviation

difference between Group A and Group B (p=0.0186). Post-intervention analysis also showed no significant difference between Group A and Group B (p=0.1589).

DISCUSSION

The purpose of this study was to compare the effect of isometric and isotonic exercise training on core muscle in patients with non-specific low back pain.

Stranjalis *et al.* reported in his study that low back pain is more common in females [13]. In this study, the total number of participants included was 40, of which 8 were males and 32 were females. Group A contained 3 males and 17 females whereas Group B contained 5 males and 15 females.

TENS works on the principle of Pain Gate Theory which was explained by Melzack and Wall in 1965 [14]. Noxious impulses are influenced by "gating mechanism." Large diameter fibers inhibit the transmission of pain, thus "closing the gate" and when small fibers are stimulated, the gate is opened. When the gate is open, pain signals excite the dorsal horn transmission cell, and when the gate is closed, it does not excite the dorsal horn transmission neurons. The gating mechanism is influenced by nerve impulses that descend from the brain [14].

Superficial heating modalities usually do not heat deep tissue, including muscles, because there is a subcutaneous layer of fat beneath the skin which acts as thermal insulator and also inhibits heat transfer [15,16].

Table 7: Comparison of pre- and post-side support endurance test within groups

Group	Pre-treatment		Post-treatment		p
	Mean±SD	Median	Mean±SD	Median	
A	2.3±0.4702	2	4.2±0.6156	4	<0.0001
B	2.5±0.5130	2.5	4.4±0.5026	4	<0.0001

SD: Standard deviation

Table 8: Comparison of pre and post side support endurance test in between groups

Group	Pre-treatment		Post-treatment	
	Mean±SD	Median	Mean±SD	Median
A	2.3±0.4702	2	4.2±0.5156	4
B	2.5± 0.5130	2.5	4.4±0.5026	4
p	0.2762		0.3848	

SD: Standard deviation

Table 9: Comparison of pre and post-MODI score within groups

Group	Pre-treatment		Post-treatment		p
	Mean±SD	Median	Mean±SD	Median	
A	23.5±2.245	23	7.5±0.1.573	7	<0.0001
B	27.75±5.884	27	8.8±3.002	8.5	<0.0001

MODI: Modified Oswestry disability index, SD: Standard deviation

Table 10: Comparison of pre and post MODI score in between groups

Group	Pre-treatment		Post-treatment	
	Mean±SD	Median	Mean±SD	Median
A	23.25±2.245	23	7.5±1.573	7
B	27.75±5.884	27	8.8±3.002	8.5
p	0.0186		0.1589	

MODI: Modified Oswestry disability index, SD: Standard deviation

Isometric (stability) exercise training is a static form of exercise, in which a muscle contracts and produces force without an appreciable change in the length of muscle without visible joint motion [11,12]. Park *et al.* indicated that an exercise program that simultaneously strengthens the deep abdominal muscles and muscles of trunk is an ideal method for maintaining spinal stability physical balance [17].

In isotonic exercises, when a body segment moves through its available range, the tension that the muscle is capable of generating varies is through the range as a muscle shortens or lengthens which is due to changing length, tension relationship of the muscle and the changing load [13-15]. Hence, the isotonic exercise helps in relieving pain and improving strength by both of these mechanisms. Laird *et al*. and Byström *et al.* concluded that core stability exercises are more effective in reducing pain and long-term compared to no treatment or general exercise in patients with non-specific low back pain [18,19].

Comparison of pain, strength, and disability between two groups was done using Mann-Whitney test to find effectiveness between two groups.

The statistical analysis revealed that there was no significant difference in pain, abdominal strength, lateral flexors strength, and disability in both groups. Both the groups were equally efficient to reduce pain (p<0.0001), disability (p<0.0001), and improve strength of abdominal and lateral flexors (p<0.0001). The intragroup evaluation revealed that there was significant difference in improving strength of extensors. Group A was more efficient in improving strength of extensors (p<0.0363).

The result from the statistical analysis of the present study supported null hypothesis which stated that there will be no significant difference in isometric (stability) and isotonic exercise training in core muscle in patient with non-specific low back pain for all other outcome measures except extensors.

Thus, it can be stated from above study that isometric (stability) and isotonic exercises along with HMP and TENS are most efficacious and cost effective.

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CONCLUSION

In conclusion, in the present study, there is no significant different between effect of isometric (stability) and isotonic exercise training except extensor endurance test which shows a significant difference in Group A.

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