

Comparative effects of isometric and isotonic global neck muscles strengthening exercise programme on pain, range of motion, strength, function and quality of life in patients with chronic mechanical neck pain

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Abstract

The randomised clinical current study was planned to determine the comparative effects of isometric and isotonic global neck muscles strengthening exercises on pain, range of motion, strength, function and quality of life in patients with chronic mechanical neck pain. The study comprised 22 patients with chronic mechanical neck pain. The subjects were randomly divided into two interventional groups, with group A receiving isometric exercises and group B receiving isotonic exercises. Numeric Pain Rating Scale, Neck Disability Index, goniometer, dynamometer and Short Form-36 questionnaire were used for data collection. Isometric and isotonic exercise groups showed significant improvement ($p < 0.05$) in terms of decreasing pain and functional disability, and increasing range of motion and strength. Intergroup comparison showed no significant differences ($p > 0.05$), indicating similar efficacy of isometric and isotonic global neck muscles strengthening exercises.

Trial Registration Number: This study was registered at ClinicalTrials.gov ID: NCT05865951.

Key Words: Neck pain, Neck muscles, Quality of life, Exercise, Range of motion.

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Introduction

Chronic mechanical pain is defined as ongoing discomfort or distress in the body brought on by mechanical factors, such as trauma, overuse or injury, that have not been adequately treated¹. Neck discomfort can be caused by poor workstation ergonomics, such as incorrect desk height, monitor positioning, or chair alignment. Chronic neck pain might be exacerbated by dysfunctional movement patterns or different muscle

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activation techniques. Management of chronic neck pain includes thermotherapy, transcutaneous electrical nerve stimulation (TENS), muscle strengthening and stretching, and manual therapy^{2,3}. Strength training protocols commonly witnessed in clinical practice are isometric and isotonic. Isometric workouts involve static muscular contraction against resistance without any prevalent movement. It has the potential to cause muscular relaxation and pain alleviation by stimulating the Golgi tendon organs⁴. The enhanced neuromuscular control may aid in modulating pain signals to lessen their frequency and severity. The increased blood flow may facilitate tissue repair, lessen inflammation, and perhaps even lessen chronic mechanical neck pain⁵. Increasing muscle strength can increase stability, lessen pressure on the cervical spine, and lessen pain⁶. Isometrics can help address muscular imbalances and encourage better head, neck and shoulder alignment, improving posture and reducing back pain⁷. Exercises that are isometric can improve neck muscular coordination and control, enhancing functional capacities⁸. Isotonic exercises involve dynamic motions against resistance, which can aid in neck muscle strengthening. Isotonic exercises exert tension on these structures through regulated resistance and repetitive motions, and this can encourage tissue remodelling and improved flexibility. As a result, the neck's range of motion (EOM) might be increased^{9,10}.

The cervical neck muscles strength training has emerged as an effective training to counter disabilities caused by cervical musculoskeletal disorders. The immediate effects of isometrics on pain and strength have gained popularity, but there is scarce knowledge of the use of isotonic neck muscles strengthening in clinical trials. Moreover, the literature has not satisfied the long-term effects of isometric and isotonic strength training exercises of cervical muscles on improving the health-related quality of life (HR-QOL) and restoring the normal function of cervical spine. The current study was planned to fill the gap in literature by assessing long-term effects of neck muscles strengthening alleviating pain and functional disability, restoring strength and normal ROM, and enhancing QOL.

Methods and Results

The randomised clinical trial was conducted from April 15 to September 15, 2023, at the Noor Fatima Hospital, Dinga, Pakistan. After obtaining approval from the institutional ethics review committee, the study was registered with ClinicalTrials.gov ID: NCT05865951. The sample size was calculated using Epitool sample size calculator with 5% variance and 95% confidence interval (CI) in line with literature¹¹. The sample was inflated to cover for 10% attrition. The sample was raised using non-probability convenience sampling technique. Those included were individuals of either gender aged 25-55 years with >6 months of neck pain. Those with a history of malignancy, cervical fracture, spinal cord injury, systemic or soft tissue disease, ankylose spondylitis and neck deformity were excluded.

After taking informed consent, the subjects were randomised through lottery method into 2 treatment groups, with group A receiving isometric exercises and group B receiving isotonic exercises. There was no blinding in the study. A total of 1 patient dropped out from each group due to personal reasons after 1 week of intervention.

Pain was assessed by using the Numeric Pain Rating Scale (NPRS), functional disability with Neck Disability Index (NDI) and ROM through a goniometer¹². Baseline hydraulic hand dynamometer was used to measure strength, whose values were measured in Kg unit. The strength of group of muscles performing certain movements of the neck was assessed¹³. Short Form 36 (SF36) survey was used to quantify QOL¹⁴. Both the groups received a 12-week treatment regime with 3 sessions per week. The same baseline treatment therapy of 10 min hot pack, followed by cervical postero-anterior mobilisation was applied to each segment from C2-C7 in prone lying, and trigger points of cervical muscles were released manually by applying sustained pressure on taught band and holding it until the pain was reduced. Group A received isometric exercises along with conventional treatment. To apply isometric exercises, the patients were comfortably seated on a chair, and resistance was applied through the therapist's hand in all six cervical ROM holding for 3 seconds with 10 repetitions per day for 3 days a week for 12 weeks. Group B received isotonic exercises along with conventional treatment. To apply isotonic exercises, the patients were comfortably seated on a chair, and resistance was applied through the Thera-band in all six cervical ROM with 10 repetitions per day for 3 days a week for 12 weeks. Baseline parameters were also assessed post-intervention.

Data was analysed using SPSS 25. Shapiro-Wilk test showed data was normally distributed. Therefore, parametric tests were applied. Paired t-test was used to assess differences within the group, while the differences between the groups were assessed using independent t-test. $P \leq 0.05$ was considered significant.

Of the 24 patients enrolled, 22(%) finished the study. Both the groups showed significant improvement in terms of decreasing pain and functional disability, and increasing ROM and strength ($p < 0.05$), but intergroup comparison showed no significant differences ($p > 0.05$) (Tables 1-3).

Table-1: Intergroup and intragroup comparisons of outcome measures..

Outcome Measures	Group A	Group B	M.D	P-value
Pre-NPRS	6.50±1.7	6.40±1.2	0.1	0.88
Post-NPRS	0.70±0.6	0.80±0.7	-0.1	0.76
M.D	5.8	5.6		
P-value	0.00	0.00		
	Group A	Group B	M.D	P-value
Pre. NDI	18.4±6.4	15.00±5.7	3.4	0.23
Post. NDI	5.8±2.4	4.7±3.8	1.1	0.45
M.D	12.6	10.3		
P-Value	0.00	0.00		
	Group A	Group B	M.D	P-value
Pre.SF-36 (mental)	48.4±17.7	60.6±22.3	-12.2	0.19
Post.SF-36	79.9±12.9	85.7±8.6	-5.8	0.25
M.D	-31.5	-25.1		
P-value	0.00	0.00		
	Group A	Group B	M.D	P-value
Pre.SF-36 (physical)	52.0±18.4	63.9±16.9	-11.9	0.15
Post.SF-36	76.1±12.5	84.4±9.1	-8.3	0.1
M.D	-24.1	-20.5		
P-value	0.00	0.00		

SD: Standard deviation, LVT: Left ventricle thickness, RVT: Right ventricle thickness, M.D: Mean Difference

Table-2: Intergroup and intragroup comparison of range of motion (ROM).

Outcome Measures	Group A	Group B	M.D	P-value
Pre-Flexion	28.9±3.7	30.5±3.9	-1.6	0.36
Post-Flexion	37.4±2.6	38.3±2.7	-0.9	0.47
Mean Difference	8.5	7.8		
P-value	0.00	0.00		
	Group A	Group B	M.D	P-value
Pre. Extension	27.7±3.3	29.6±3.2	-1.9	0.21
Post. Extension	38.7±2.8	40.2±3.0	-1.5	0.26
Mean Difference	11	10.6		
P-value	0.00	0.00		
	Group A	Group B	M.D	P-value
Pre. Side Flexion (Rt)	27.8±3.4	28.5±2.8	-0.7	0.62
Post.Side Flexion (Rt)	39.0±2.9	38.9±2	0.1	0.93
Mean Difference	11.2	10.4		

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P-value	0.00	0.00		
	Group A	Group B	M.D	P-value
Pre. Side Flexion (3)	30.3±2.0	30.8±3.8	-0.5	0.72
Post.Side Flexion (3)	39.8±3.0	38.8±2	1.0	0.5
Mean Difference	9.5	8		
P-value	0.00	0.00		
	Group A	Group B	M.D	P-value
Pre.Right Side Rotation	30.1±3.3	29.1±3.1	1.0	0.49
Post.Right Side Rotation	38.7±2.9	38.3±2.0	0.4	0.72
Mean Difference	8.6	9.2		
P-value	0.00	0.00		
	Group A	Group B	M.D	P-value
Pre.Left Side Rotation	28.8±2.4	29.8±2.8	-1	0.41
Post.Left Side Rotation	38.7±2.4	39.4±2	-0.7	0.54
Mean Difference	9.9	9.6		
P-value	0.00	0.00		

SD: Standard deviation, LVT: Left ventricle thickness, M.D: Mean Difference, RVT: Right ventricle thickness.

Discussion

The results of the current study are in line with a previous study that concluded that isometric training interventions were effective in reducing neck discomfort, improving joint mobility, and addressing neck dysfunction, with long-term effects on NDI and Visual Analogue Scale (VAS) scores⁵. Incorporating isometric exercises into the regular exercise routine may help alleviate neck pain and improve overall neck function¹⁵. Another study showed that regular isotonic exercises stimulated the neuromuscular system, improving communication between the brain and neck muscles, potentially enhancing neck ROM over time¹⁶. Not only pain, disability, ROM and strength was affected, but also mental health improved as a part of QOL within both the groups in the current study, which was in line with the literature¹⁷.

The current study has limitations as it used many outcome tools that may have exhausted the patients more, which could have affected their ability to provide accurate answers. Besides, data was collected from a single setting.

Conclusion

Both isometric and isotonic treatment groups showed significant clinical effects in the management of chronic mechanical neck pain. There was no difference between isometric and isotonic exercises.

Disclaimer: The text is based on an academic thesis.

Conflict of Interest: None.

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