INTI JOURNAL | Vol.2023:47
eISSN:2600-7320

Comparative Effects of Percussion Theragun Versus Physical Activity in Non-Specific Neck Pain in Young Adults – A Randomized Clinical Trial

Reshi Chockalingam[1*], Senthil Kumar[1], Pranata Dalal Inamdar[2]

[1] Saveetha College of Physiotherapy, SIMATS Chennai, Tamil Nadu, India
[2] Department of Geriatric Physiotherapy, KAHER Institute of Physiotherapy, Belagavi, Karnataka, India

***Email**: reshi.chocka@gmail.com

Abstract

Background: The percussion theragun uses fast oscillatory back and forth movements to produce vibrations of different frequencies. Handheld percussive massage treatment has acquired fame as of late, for both remedial use and in sports practice. Physical activity is any movement that uses energy that improves strength, flexibility. With both the possible treatment options, the study raises the question of which of the two produces better results in subjects with Non-specific neck pain in terms of reduction of pain and increase in range. The objective of this study was to assess and compare the therapeutic effects of the percussion theragun with physical activity for the treatment of non-specific neck pain.
Method and Measures: The study was conducted on 36 subjects with non-specific neck pain who were given 3 consecutive sessions (in a span of 3 days) of intervention. Through randomized method subjects were divided into the percussion theragun group (group A) and conventional physical activity group (group B). Outcome measures such as VAS (visual analogue scale) and Neck range of motion were assessed
Results: The nonspecific neck pain participants in Group A and Group B showed significant improvement in extension, right lateral flexion, left lateral flexion neck ROM and reduction in VAS after exposed to the respective intervention. However, the Group A showed a significant improvement in VAS and ROM when compared with Group B.
Conclusion: The current study provided the evidence to prove that the protocols used in this study show significant reduction in pain and range of motion in subjects with non-specific neck pain in both the groups. The percussion theragun group showed significantly greater improvement than the physical activity group.

Keywords

Percussion Theragun, Vibration Therapy, Hot Moist Pack, Neck Isometrics, Theraband Strengthening

Introduction

After low back pain, neck discomfort is the second most prevalent musculoskeletal pathology (Meleger and Krivickas, 2007). Pain that may or may not radiate to the upper limbs is described as being felt in the anatomical posterior region of the neck, between the superior nuchal line and

Submission: 16 August 2023; **Acceptance:** 17 August 2023

the first thoracic spinous process. The risk of substantial impairment is there, and the majority of neck pain sufferers do not completely recover from their symptoms (Germann et al., 2018). Studies have also proved that neck and shoulder pain are very common in younger populations (Roesch and Tadi, 2019). Neck pain can result from disorders of any of the structures in the neck. The neck muscles have an isometric function that helps to fight gravity forces and keep the head and neck in an upright position. (Hoy et al., 2010). The neck muscles also play a role in the dynamic positioning of the cervical spine and head for better use of olfaction, sight, hearing and mouth (Siivola , 2003).

Physical activity plans for treating neck pain vary in terms of duration, frequency of training, intensity, and method of exercise (Bender et al., 2007). Interventions may include various forms of heat and cold applications, ultrasound, mechanical traction, LASER, isometric exercises (Ylinen, 2007), manual therapy techniques (Hassan, 2016). The aim of the study is to explore the healing capabilities of 2 different techniques and its effects on pain (Hoy et al., 2010) and its effects on the range of motion. Therapeutic vibration causes muscles to contract and relax. The theragun is a comparably small device capable of delivering high intensities of vibration. It's easy to use and handle. The percussion theragun uses fast oscillatory back and forth movements to produce vibrations of different frequencies (Celletti et al., 2017). Research has shown that vibration therapy has the ability to improve range of motion and increase strength. However, the influence of localized vibration therapy on neck range of motion, strength, and pain is not well researched (Rabini et al., 2015). Melzack and Wall's 'closed door' argument states that, inhibiting interneurons are activated by low intensity mechanical stimuli (Katz and Melzack, 2013). Vibration applied superficially also stimulates the muscle spindles and alpha motor neurons, this promotes contractions, which in turn promotes the electromyographic activity, oxygen consumption, muscle temperature and skin blood flow (Konrad et al., 2020)]. Myofascial release tools like the percussion theragun have been found to increase joint range of motion and decrease the risk of injury after treatment (Kayoda, 2019). The mechanical pressures coupled with low frequency vibration acts together to accelerate the recovery processes (Rabini et al., 2019).

Physical activity has a positive impact on the mental state of people as well. It helps alleviate the negative effects of anxiety and depression and also reduces the sensitivity to stress (Yilnen 2007). Physical activity also helps in developing and sharpening the cognitive skills of an individual (Hakkinen et al., 2007). Physical activity and exercise keep the entire body in check and helps in complete blood circulation. The parts of the body that are being targeted get supplied by fresh blood and all the metabolites get cleared, which ensures proper metabolism and healthy growth of the tissues (Behm and Chaouachi, 2011). Physical activity helps in improving the lengthening the muscle and in turn this increases the range of motion (Andersen et al., 2008). During the complete range of motion, a significant portion of the muscle fibers are activated and then contract through their length (Schoenfeld & Grgic, 2020). This helps in preventing the build-up of metabolites in between the fibers that will eventually cause discomfort and pain (Sarig-Bahat., 2003). Physical inactivity is one of the main reasons for neck pain. The prevalence of neck pain was found to be significantly higher in individuals who were physically inactive in the sporting context as compared to active individuals (Yilnen, 2007). An active lifestyle is one of the key factors in maintaining a healthy, pain free and mobile neck. The habit of doing physical exercises has a positive effect on neck pain. Exercises can strengthen muscles and ligaments to maintain the neck's alignment for optimal functioning and injury prevention. They can also increase strength, flexibility, and pain threshold (Hakkinen et al., 2007).

Methodology

A randomized clinical trial, by non-probability sampling, with target population of both male and female adults between the age group of 18-55 years with non-specific neck pain Sample Size of Z_{α} = 1.96 (5% Significance level); Z_{β} = 1.0364 (85% power); σ = 3; d = 3 and n = 18. The values related to σ and d, are approximated from the with reference to baseline values respondents. There will be 18 respondents in each group and overall sample size will be 36 [18x2] for the study based on the probability systematic sampling method. Group inclusion of Adults 18-55 years of age of either gender diagnosed with non-specific neck pain but exclusion with Individuals diagnosed with specific cause of neck pain, Individuals recently diagnosed with fracture around the cervical area, Individuals diagnosed with radiculopathy, individuals diagnosed with neurological disorders, individuals on long term corticosteroid therapy, Pregnant women, Individuals with a cardiac pacemaker, individuals addicted to alcohol, Individuals diagnosed with systemic illness. Goniometer, visual analogue scale. Theraband, percussion theragun are the equipment used. The statistical analysis for this study was done manually as well as by using Statistical Package of Social Sciences (SPSS) version 20, so as to verify the results. The results were measured by pain using visual analogue scale. This includes a straight line of 10 cm on which the subject is asked to mark his/her level of pain. The two ends of the straight line represent the two markings of pain i.e '0'is 'no pain' and '10'is worst pain experienced. The change in score represents a change in the intensity of pain. The range of motion for neck flexion, extension, and lateral flexion was measured using a universal goniometer. The participants recruited voluntarily, the need of the study described in the language which is familiar to them and a written consent will be taken. All the participants will be examined based on the inclusion and exclusion criteria before their treatment sessions begin. The subjects will be divided into two groups by randomization method (Ramalingam et al., 2023).

Group A, Patients treated using percussion theragun. The subjects were appropriately positioned and the treatment protocols followed. The pre-treatment values are recorded now. The range of motion of lateral flexion and forward flexion are taken using a goniometer and recorded in the data collection sheet. Now the patient is placed in a sitting position with the shoulder area exposed. The comfort of the subject is ensured by placing extra pillows or changing to a more relaxed position. The tender points are identified and specific trigger points are identified. The gun is then fitted with an appropriate application head according to the trigger point location. At first the origin of the muscle being targeted is treated for around 1 minute till redness is seen and the muscle becomes spongy. The same is then done for the insertion of the targeted muscle. The pressure pain threshold, Range of motion and VAS values are taken after the treatment and recorded. Vibration therapy using the percussion theragun was given by a specific order. The applicator head of theragun was placed in light contact to skin with a deeper pressure applied at the points where tightness or bands were felt. Treatment will start with the percussion head applied at the origin and insertion heads of the targeted muscle for 3-4 minutes each. Next the muscle was palpated along the length and tender points and tight bands were identified. Percussion therapy was applied to these points for 3-4 minutes. Following this the percussive theragun applicator was applied with circular strokes along the length of the muscle for 3 minutes. The pressure of application was adjusted to the subject's tolerance. Total treatment session would last for 25-30 minutes.

Group B, patients treated using physical activity and exercise. The subjects are properly oriented to the treatment principles and the methods of treatment. The pre-treatment values are recorded. The range of motion is taken using a goniometer and the readings are recorded. The subject is then asked to quantify the pain out of 10, with 10 being the most painful. Now all the equipment being used is sanitized. The area to be treated is exposed. The subject is carefully evaluated and a suitable treatment plan is established. The intensity and frequency of the exercises are varied according to the extent of pain, physical capability and level of disability. The designed protocol would consist of strengthening, isometric exercises, stretching, postural exercises, passive mobilization and advice. The treatment is planned for 5 mins a person for 3 continuous days. The pressure pain threshold, Range of motion and VAS values are taken before and after the treatment. Subjects were given an option to rest their head on a pillow if needed. Moist heat was given over the shoulder region along the muscle course for 10 minutes. General stretching was taught to the subjects and they were asked to perform it actively. Passive stretching was given whenever needed. This was followed by isometrics neck exercises and theraband exercises for 10 repetitions of 3 sets each. The theraband exercises included placing the theraband around the circumference of the head and then asking the patient to move the head in a specific targeted direction. The session would end with stretching and cryotherapy if necessary. Total treatment session would last for 25-30 minutes.

Results

The tests of normality were performed and the data set was found to be NOT normally distributed. Therefore, a non-parametric test (Wilcoxon test) used.

Group A

Table 1. Pre and Post Scores paired Wilcoxon test for Day 1

Variable	Pre		Post		Diff		Effect	z -	p -
	Mean	SD	Mean	SD	Mean	SD	size	value	value
VAS	6.61	0.92	4.33	0.84	2.28	0.89	2.55	10.80	0.001*
FLEX	37.33	4.13	40.61	3.48	-3.28	1.13	2.91	12.33	0.001*
EXT	44.90	4.88	48.28	4.75	-3.00	1.28	2.34	9.92	0.001*
L FLEX RT	31.50	3.93	35.72	3.54	-3.56	1.29	2.75	11.66	0.001*
L FLEX LT	32.23	2.95	35.50	2.79	-2.39	0.85	2.81	11.93	0.001*

Table 2. Pre and Post Scores paired Wilcoxon test for Day 2

Variable	Pre		Post		Diff		Effect	z -	p -
	Mean	SD	Mean	SD	Mean	SD	size	value	value
VAS	5.11	0.90	2.61	0.50	2.50	0.71	3.54	15.00	0.001*
FLEX	40.11	3.56	43.17	3.26	-3.06	1.16	2.63	11.16	0.001*
EXT	47.56	4.71	50.78	4.78	-3.22	0.88	3.67	15.57	0.001*
L FLEX RT	34.83	3.37	37.78	3.10	-2.94	1.43	2.05	8.71	0.001*
L FLEX LT	34.78	2.69	37.72	2.61	-2.94	1.16	2.53	10.75	0.001*

Table 3. Pre and Post Scores paired Wilcoxon test for Day 3

Variable	Pre		Post		Diff		Effect	z -	p -
	Mean	SD	Mean	SD	Mean	SD	size	value	value
VAS	3.17	1.04	1.28	0.67	1.89	0.90	2.10	8.90	0.001*
FLEX	42.50	3.29	45.11	3.61	-2.61	1.14	2.28	9.68	0.001*
EXT	49.89	4.57	53.28	4.10	-3.39	1.38	2.46	10.43	0.001*
L FLEX RT	36.89	2.91	40.06	2.78	-3.17	0.99	3.21	13.64	0.001*
L FLEX LT	37.11	2.72	40.50	2.77	-3.39	1.85	1.83	7.77	0.001*

Group B

Table 4. Pre and Post Scores paired Wilcoxon test for Day 1

Variable	**Pre**		**Post**		**Diff**		**Effect**	**z -**	**p -**
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**size**	**value**	**value**
VAS	6.17	1.25	4.83	0.99	1.33	0.59	2.24	9.52	0.001*
Flex	36.09	4.13	39.06	4.01	-1.72	0.57	3.00	12.72	0.001*
Ext	45.28	4.88	47.61	4.64	-2.33	0.77	3.04	12.91	0.001*
L Flex right	32.17	3.93	35.00	3.55	-2.83	0.99	2.88	12.20	0.001*
L Flex left	33.11	2.95	35.28	2.70	-2.17	0.71	3.06	13.00	0.001*

Table 5. Pre and Post Scores paired Wilcoxon test for Day 2

Variable	**Pre**		**Post**		**Diff**		**Effect**	**z -**	**p -**
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**size**	**value**	**value**
VAS	4.94	1.00	3.17	1.15	1.78	0.65	2.75	11.66	0.001*
Flex	38.72	3.97	41.06	3.95	-2.33	0.84	2.78	11.78	0.001*
Ext	47.28	4.55	49.89	4.85	-2.61	0.85	3.07	13.04	0.001*
L Flex right	34.39	3.52	36.72	3.36	-2.33	0.84	2.78	11.78	0.001*
L Flex left	34.61	2.68	36.89	2.89	-2.28	0.75	3.03	12.85	0.001*

Table 6. Pre and Post Scores paired Wilcoxon test for Day 3

Variable	**Pre**		**Post**		**Diff**		**Effect**	**z -value**	**p -value**
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**size**		
VAS	3.39	1.20	1.83	1.10	1.56	0.78	1.98	8.42	0.001*
Flex	40.50	4.12	42.56	4.06	-2.06	0.80	2.56	10.87	0.001*
Ext	49.22	4.56	51.94	4.65	-2.72	0.89	3.04	12.91	0.001*
L Flex right	36.06	3.30	38.83	3.15	-2.78	1.11	2.49	10.58	0.001*
L Flex left	36.33	2.99	39.00	3.05	-2.67	0.84	3.17	13.47	0.001*

Tables 1-6, indicates that for VAS, range of motion which included neck flexion, neck extension, right side neck lateral flexion, left side neck lateral flexion, were significant in both the groups; but group A was found to be more effective than group B.

Table 7. Between group analyses using Mann Whitney test for day 1,2 and 3

Variable	Time frame	Group	Day 1				Day 2				Day 3			
			Mean	SD	z-value	p-value	Mean	SD	z-value	p-value	Mean	SD	z-value	p-value
VAS	Pre	Theragun	6.61	0.92	1.217	0.232	5.11	0.90	0.526	0.602	3.17	1.04	0.594	0.556
		Physical	6.17	1.25			4.94	1.00			3.39	1.20		
	Post	Theragun	4.33	0.84	1.638	0.111	2.61	0.50	1.878	0.069	1.28	0.67	1.833	0.076

		Physical	4.83	0.99			3.17	1.15			1.83	1.10		
Flex	Pre	Theragun	37.33	4.13	0.001	0.999	40.11	3.56	1.105	0.277	42.50	3.29	1.609	0.117
		Physical	36.09	4.13			38.72	3.97			40.50	4.12		
	Post	Theragun	40.61	3.48	1.243	0.222	43.17	3.26	1.750	0.089	45.11	3.61	1.995	0.054
		Physical	39.06	4.01			41.06	3.95			42.56	4.06		
Ext	Pre	Theragun	44.90	4.88	0.001	0.999	47.56	4.71	0.180	0.858	49.89	4.57	0.438	0.664
		Physical	45.28	4.88			47.28	4.55			49.22	4.56		
	Post	Theragun	48.28	4.75	0.426	0.673	50.78	4.78	0.554	0.583	53.28	4.10	0.913	0.368
		Physical	47.61	4.64			49.89	4.85			51.94	4.65		
L Flex right	Pre	Theragun	31.50	3.93	0.001	0.999	34.83	3.37	0.387	0.701	36.89	2.91	0.804	0.427
		Physical	32.17	3.93			34.39	3.52			36.06	3.30		
	Post	Theragun	35.72	3.54	0.611	0.545	37.78	3.10	0.980	0.334	40.06	2.78	1.236	0.225
		Physical	35.00	3.55			36.72	3.36			38.83	3.15		
L Flex left	Pre	Theragun	32.23	2.95	0.001	0.999	34.78	2.69	0.186	0.853	37.11	2.72	0.816	0.420
		Physical	33.11	2.95			34.61	2.68			36.33	2.99		
	Post	Theragun	35.50	2.79	0.243	0.810	37.72	2.61	0.909	0.370	40.50	2.77	1.545	0.132
		Physical	35.28	2.70			36.45	2.7			39.55	2.8		

Statistical analysis between the groups using Mann Whitney Test (Table 7) was then performed to provide a clearer representation of the acquired data. VAS, Difference in mean pre and post treatment values for group A: 5.33; Difference in mean pre and post treatment values for group B: 4.34. Flexion, Difference in mean pre and post treatment values for group A: 7.78; Difference in mean pre and post treatment values for group B: 6.47. Extension, difference in mean pre and post treatment values for group A: 8.38; Difference in mean pre and post treatment values for group B: 6.66. Right lateral flexion, Difference in mean pre and post treatment values for group A: 8.56; Difference in mean pre and post treatment values for group B :6.58. Left lateral flexion, Difference in mean pre and post treatment values for group A: 8.27; Difference in mean pre and post treatment values for group B :5.89. It can be observed that in all the recorded parameters there is a greater, more positive change in Group A (Theragun) as compared to that of Group B (physical Activity). The Difference in mean pretreatment value for day 1 and the post treatment value of day 3 was always greater in Group A compared to Group B proving that the Theragun group was more effective in a 3-day treatment period.

Discussion

The aim of the present randomized control was to study and compare the effects of percussion theragun and physical activity on non-specific neck pain in young adults for three consecutive days in terms of pain, range of motion and functional disability.

In the present study 36 subjects were included with the age group of 18-55 years. They were divided into 2 groups of 18 members each. Group A was the group that was receiving percussion theragun intervention and it consisted of 7 males and 11 females. Group B was the group receiving physical therapy as the intervention and it consisted of 10 males and 8 females. Bartley and Fillingim (2013) stated that, testosterone hormone in males is more anti-nociceptive when compared to estradiol and progesterone. The results obtained say that female participants have a smaller degree of reduction in pain and VAS values when compared to the male participants, this is in agreement with the above study which states that males are able to deal with pain and its chemical counterparts better and more efficiently.

Ylinen (2007) study suggested that the type of intervention given and the intensity was highly variable according to the specific condition of the patient. Yilnen (2007) also discovered that individuals with chronic neck discomfort had much decreased blood flow to the trapezius muscle, and that both strength and endurance training increased the Na+-K+ pump concentration and capillary density in the muscle. Hence this study is in agreement with our study for the use of isometric exercises, endurance training and hot moist packs in treating non-specific neck pain. This is in line with a study done by Coulter et al., 2019 which concluded that supervised exercise interventions are more effective than using alternate methods like spinal manipulation, general practitioner care or TENS.

The use of local vibration therapy was studied by Germann et al. (2018) and he concluded that the use of vibration was able to reduce any perception of stiffness around the area and improve the range of motion. This was in accordance with our study as our subjects demonstrated similar results after the treatment session. Cochrane (2015) conducted a study where he proved that the immediate effect of a session of vibration was able to produce a significant increase in muscle power and range of motion. These features were also noted in our subjects as they demonstrated a better range of motion after the treatment session. Cheung et al. (2013) explored the relationship between neck pain and physical activity. The study suggested that physical activity improved confidence of movement and helped in fear avoidance, but it was found that is not a very effective tool to treat conventional neck pain and associated activities. The study highlighted that rest and pain-relieving modalities help treat the problem a lot quicker. This is not in accordance with the current study, as all the participants in the group that had physical activity as an intervention for neck pain had significant improvement in their ranges and a noticeable change in the VAS values.

Contradicting our study and the results is a study done by Rosendal et al. (2004) proved that muscles that were subjected to physical activity had elevated levels of glutamate and serotonin than normal muscles. Glutamate and serotonin are chemicals that are released in the body as a product of muscle breakdown and metabolism; and these substance's concentrations correlate with the intensity of pain and they're also associated with muscle cell damage and necrosis. This was not the case in our study as the volunteers actually found a reduction in their pain intensity and showed signs of strengthening.

A study on vibration and its effects was conducted by Beinert K (2013). The study focused on the sensorimotor functions of patients with neck pain. It was found that vibration had opposite effects in patients and healthy subjects. Although the patients showed an improved joint position sense and a decreased postural sway was observed after vibration, the subjects were noted to have a reduced joint position sense acuity and a decrease in fine control. It also worth noting that the subjects chosen in Beinert and Taube (2013) study was at a comparatively older group. No observations of reduced joint position sense nor a reduce in fine control was noted in our study. Hence the results of our study are concurrent with the studies mentioned above.

Conclusion

Research study has provided sufficient evidence that the protocols used has shown a significant improvement in reducing the pain intensity and in increasing the range of motion in subjects with non-specific neck pain. Both physical activity and vibration help in alleviating symptoms of pain and discomfort; however, in our 3-day intervention we found that the subjects that had vibration theragun [Group A] as the intervention had overall better improvement in the range of motion and a more significant decrease in VAS values. The subjects in this group were also visually more pleased and relaxed after every treatment session. This may be due to the fact that vibration directly acts on the pain receptors and produces a numbing effect that’s perceived as relaxing. Interesting to note is that the physical activity group maintained their ranges and VAS value when measured 1 week after the last intervention day, as compared to the vibration group that showed a slight decrease in range of motion. A deeper study needs to be done into both these methods with a higher sample size and a longer intervention period to provide a better understanding of these methods.

Acknowledgements

This research work is presented during Stride'23 International Physiotherapy conference on April 6th and 7th and the abstract is published as conference proceedings in International Journal of Physiotherapy and Occupational therapy (IJPOT).

References

Andersen, L. L., Kjaer, M., Søgaard, K., Hansen, L., Kryger, A. I., & Sjøgaard, G. (2008). Effect of two contrasting types of physical exercise on chronic neck muscle pain. Arthritis and Rheumatism, 59(1), 84–91. doi:10.1002/art.23256

Bartley, E. J., & Fillingim, R. B. (2013). Sex differences in pain: a brief review of clinical and experimental findings. British Journal of Anaesthesia, 111(1), 52–58. doi:10.1093/bja/aet127

Behm, D. G., & Chaouachi, A. (2011). A review of the acute effects of static and dynamic stretching on performance. European journal of applied physiology, 111, 2633-2651.

Beinert, K., & Taube, W. (2013). The effect of balance training on cervical sensorimotor function and neck pain. Journal of motor behavior, 45(3), 271-278.

Bender, T., Nagy, G., Barna, I., Tefner, I., Kádas, E., & Géher, P. (2007). The effect of physical therapy on beta-endorphin levels. European Journal of Applied Physiology, 100(4), 371–382. doi:10.1007/s00421-007-0469-9

Celletti, C., Fara, M. A., Filippi, G. M., La Torre, G., Tozzi, R., Vanacore, N., & Camerota, F. (2017). Focal muscle vibration and physical exercise in postmastectomy recovery: An explorative study. BioMed Research International, 2017, 1–6. doi:10.1155/2017/7302892

Cheung, J., Kajaks, T., & Macdermid, J. C. (2013). The relationship between neck pain and physical activity. The Open Orthopaedics Journal, 7(Suppl 4), 521–529. doi:10.2174/1874325001307010521

Cochrane, D. J. (2015). The acute effect of direct vibration on muscular power performance in master athletes. International journal of sports medicine, 144-148.

Coulter, I. D., Crawford, C., Vernon, H., Hurwitz, E. L., Khorsan, R., Booth, M. S., & Herman, P. M. (2019). Manipulation and mobilization for treating chronic nonspecific neck pain: a systematic review and meta-analysis for an appropriateness panel. Pain physician, 22(2), E55.

Germann, D., El Bouse, A., Shnier, J., Abdelkader, N., & Kazemi, M. (2018). Effects of local vibration therapy on various performance parameters: a narrative literature review. The Journal of the Canadian Chiropractic Association, 62(3), 170–181.

Häkkinen, A., Salo, P., Tarvainen, U., Wirén, K., & Ylinen, J. (2007). Effect of manual therapy and stretching on neck muscle strength and mobility in chronic neck pain. Journal of Rehabilitation Medicine: Official Journal of the UEMS European Board of Physical and Rehabilitation Medicine, 39(7), 575–579. doi:10.2340/16501977-0094

Hassan, W. (2016). Comparison of effectiveness of isometric exercises with and without stretching exercises in non specific cervical pain. International Journal of Physiotherapy, 3(3). doi:10.15621/ijphy/2016/v3i3/100848

Hoy, D. G., Protani, M., De, R., & Buchbinder, R. (2010). The epidemiology of neck pain. Best Practice & Research. Clinical Rheumatology, 24(6), 783–792. doi:10.1016/j.berh.2011.01.019

Hoy, D., Protani, M., De, R., & Buchbinder, R. J. B. P. (2009). Resistance exercise and nutrition to counteract muscle wasting. Best Practice & Research Clinical Rheumatology, 24(6), 817–828.

Katz, J., & Melzack, R. (2013). Phantom limb pain. Handbook of Neuropsychology: Plasticity and Rehabilitation.

Kayoda, K. A. (2019). The Influence of the HypervoltTM on Shoulder Range of Motion, Strength, and Pain following Rotator Cuff Repair Surgery (Doctoral dissertation).

Konrad, A., Glashüttner, C., Reiner, M. M., Bernsteiner, D., & Tilp, M. (2020). The acute effects of a percussive massage treatment with a Hypervolt device on plantar flexor muscles' range of motion and performance. Journal of Sports Science & Medicine, 19(4), 690–694.

Meleger, A. L., & Krivickas, L. S. (2007). Neck and back pain: musculoskeletal disorders. Neurologic clinics, 25(2), 419-438.

Rabini, A., De Sire, A., Marzetti, E., Gimigliano, R., Ferriero, G., Piazzini, D. B., & Gimigliano, F. (2015). Effects of focal muscle vibration on physical functioning in patients with knee osteoarthritis: A randomized controlled trial. Eur. J. Phys. Rehabil. Med, 51, 513-520.

Ramalingam, V., Jagatheesan, A., & Suganthirababu, P. (Eds). (2023). Proceedings of International Physiotherapy Conference - Stride'23 in International Journal of Physiotherapy and Occupational therapy (pp 1-143). https://ijpot.com/conference.html

Roesch, Z. K., & Tadi, P. (2019). Anatomy, head and neck, neck In *StatPearls [Internet]*. StatPearls Publishing.

Rosendal, L., Larsson, B., Kristiansen, J., Peolsson, M., Søgaard, K., Kjær, M., ... & Gerdle, B. (2004). Increase in muscle nociceptive substances and anaerobic metabolism in patients with trapezius myalgia: microdialysis in rest and during exercise. Pain, 112(3), 324-334.

Sarig-Bahat, H. (2003). Evidence for exercise therapy in mechanical neck disorders. Manual Therapy, 8(1), 10–20. doi:10.1054/math.2002.0480

Schoenfeld, B. J., & Grgic, J. (2020). Effects of range of motion on muscle development during resistance training interventions: A systematic review. SAGE open medicine, 8, 2050312120901559.

Siivola, S. (2003). Neck and shoulder pain in a young population: prevalence and etiological factors. Academic Dissertation, Faculty of Medicine, University of Oulu, August 30th, 2003

Ylinen, J. (2007). Physical exercises and functional rehabilitation for the management of chronic neck pain. Europa Medicophysica, 43(1), 119–132.