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Effect of Different Head-Neck Positions on Hand Grip Strength in Management of Chronic Mechanical Neck Pain

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Abstract

Background: *Neck pain is a common musculoskeletal condition and a significant contributor to global disability. The estimated one-year prevalence of neck pain was about 45.5% within office workers, with a range from 45.8% to 54.7% within healthcare professionals. This study was done to examine the impact of mechanical neck pain with different neck positions [neutral, rotation to either left or right] on hand grip strength among young adults.*

Methods: *This pre-test post-test randomized control group experimental double-blind study was conducted on 57 patients suffering from chronic mechanical neck pain (CMNP), aged from 18 to 25 years old. They were randomized into three equivalent groups. Group A: was given conventional treatment for CMNP from neutral head-neck position. Group B: was given conventional treatment for CMNP from rotation 45 ° to the right. Group C: was given conventional treatment for CMNP from rotation 45 ° to the left. All groups were given treatment three sessions a week for 4 successive weeks. Pain was measured by visual analogue scale, hand grip strength was evaluated by hand-held dynamometer and upper extremity function was measured by Arabic version of the Disability of the Arm, Shoulder and Hand (DASH-Arabic).*

Results: *Post-treatment within-group results indicated a statistically significant enhancement in the mean values of pain, hand grip strength, as well as upper limb function in groups A, B, and C in relation to pre-treatment values. However, no statistically significant improvement was noted in group C post treatment in pain, hand grip strength and upper extremity function in relation to group A and B.*

Conclusions: *Different Head - neck positions in patients with CMNP not significantly proved to have an effect on pain, hand grip strength, and upper limb function. However, Hand grip strength was highest in head-neck right rotation followed by the neutral position of head-neck and head-neck left. Future studies should be conducted, considering potential factors that may influence hand grip strength (HGS), including age, sex, as well as body mass index.*

Key words: *Neck Pain, Hand Grip Strength, Head-Neck Positions.*

Introduction

The measurement of hand grip strength (HGS) is essential for assessing upper-extremity impairments and for creating of effective exercise prescriptions [1, 2]. The hand serves as an essential tool for manipulating and controlling our environment [3].

Research indicates that body and upper extremity positions may affect hand grip strength measurements [4, 5]. The tonic neck reflex (TNR) is a reflexive response in which head positions influence the tone of limb muscles [6]. While it may affect all four limbs, its impact is more pronounced in the upper extremities

compared to the lower extremities [3].

The tonic neck reflex (TNR) includes two elements: the symmetrical tonic neck reflex (STNR) as well as the asymmetrical tonic neck reflex (ATNR). Ralli et al. [7] suggested for the incorporation of head-neck rotations in the strengthening of the upper-limb muscles to elicit ATNR [8].

Mechanical neck pain (MNP) is commonly characterized by diffuse, nonspecific pain, particularly during neck movements [9]. Neck pain is classified as "non-specific" or mechanical when it is triggered or worsened by neck movements or prolonged neck positions, and no identifiable underlying pathology is present [10].

Neck pain associated with activity is a significant symptom of various mechanical neck disorders (MND), including whiplash-associated problems, torticollis, as well as myofascial neck pain. Neck pain represents a prevalent and economically costly musculoskeletal condition, with an estimated overall prevalence of around 23% in the general population [11]. Prevalence is greater in females than in males, particularly during middle age [12]. A variety of causes, including depression, anxiety, bad posture, muscle strain from sports involvement, along with occupational antecedents, can cause MNP, which can include symptoms in the neck as well as upper extremities with a gradual onset [13].

The aim of this work was to detect the impact of different head neck positions (neutral, rotation to the right 45 °, rotation to the left 45°) on pain, hand grip strength and upper extremity function in patients with chronic mechanical neck pain (CMNP).

Methods:

This study utilized a randomized controlled trial methodology, incorporating a pre and post-test design along with an experimental double-blind design. The study was carried out at the outpatient clinic of Delta University. The research was approved by the Research Ethical Committee of the Physical Therapy faculty at Cairo University, Egypt (P.T.REC/ 012/005292) before the study was started. Written consent was acquired from the patients, ensuring they were fully informed.

Sample size calculations

It was done using hand grip strength as reported in Zafar et al, [14], with 90% power at $\alpha = 0.05$ level and effect size = 0.45, using F-test repeated measures MANOVA, for 3 groups. The minimum proper sample size is 51 subjects, adding 6 (12%) subjects as drop out, so total sample size is 57 subjects, 19 subjects in each group. The sample size was estimated utilizing the G*Power software (version 3.0.10) (Figure 1).

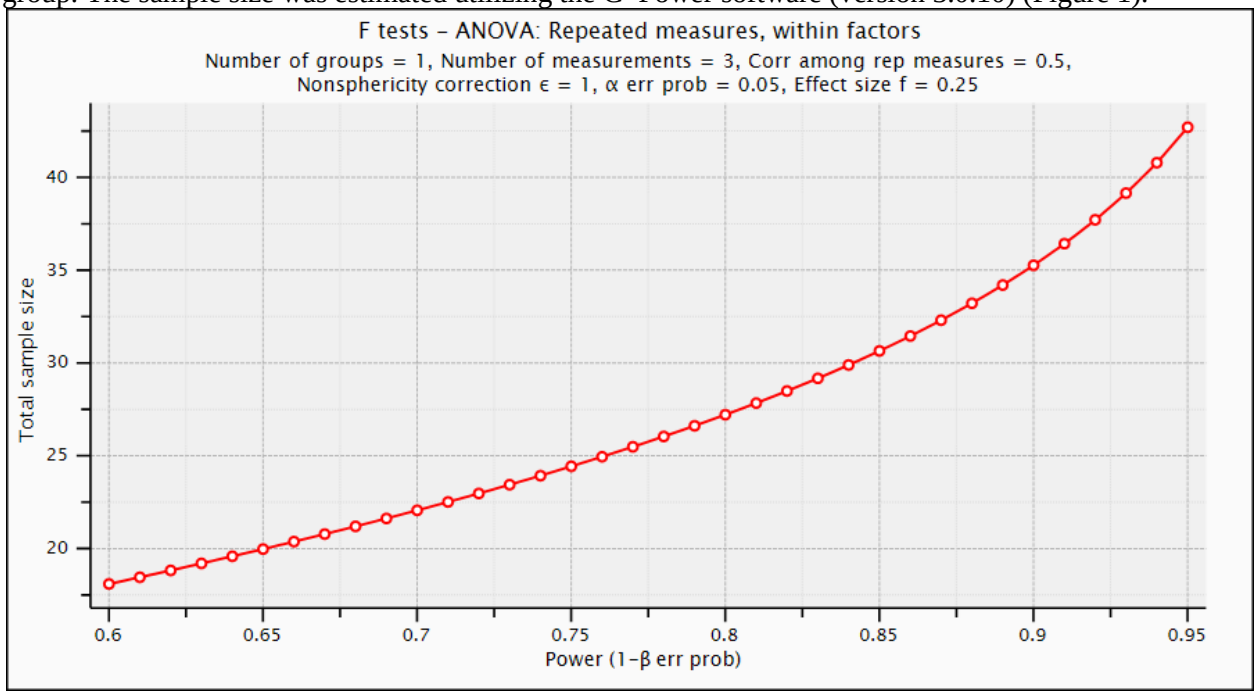

Figure 1: Sample Size calculation

Randomization

Sixty subjects with CMNP were examined for eligibility. 3 subjects were excluded because 1 subject didn't fulfill the inclusion requirements and 2 subjects refused to take-part. Fifty-seven individuals were randomized into three equivalent groups by simple randomization, labelled as Groups A, B, and C, utilizing the envelope method. An independent person, not associated with recruiting participants or treatment, carried out this allocation process and selected one envelope. Based on the card selection, participants were assigned to their corresponding group. The envelope of each eligible individual was opened before their initial session. No individual randomization during the entire study (Figure 2). Subjects: The study participants were 57 patients from both genders diagnosed with CMNP recruited from Delta University outpatient clinic. They were aged from 18 to 25 years old. They were randomized into three equivalent groups. Group A: 19 patients were given conventional treatment for CMNP from neutral head-neck position. Group B: 19 patients were given conventional treatment for CMNP from rotation 45 ° to the right. Group C: 19 patients were given conventional treatment for CMNP from rotation 45 ° to the left. Patients in all groups received the same conventional physical therapy program. This involved ultrasound and hot packs followed by isometric strengthening exercises for three times a week for 4 consecutive weeks.

Inclusion criteria involved patients diagnosed with CMNP for at least 3 months referred from the orthopedist. Patients doesn't receive any physical therapy treatment for the last 3 months. All Patients described a mean pain intensity of at least 5 on visual analogue scale (VAS), Symptoms of neck pain triggered by specific neck postures, movements, or by palpating the neck muscles. Patients were eliminated from the study if they had history of surgical intervention at the neck, neurological disorders such as cervical spondylosis, spondylolisthesis or disc prolapse and rheumatic diseases. [13]

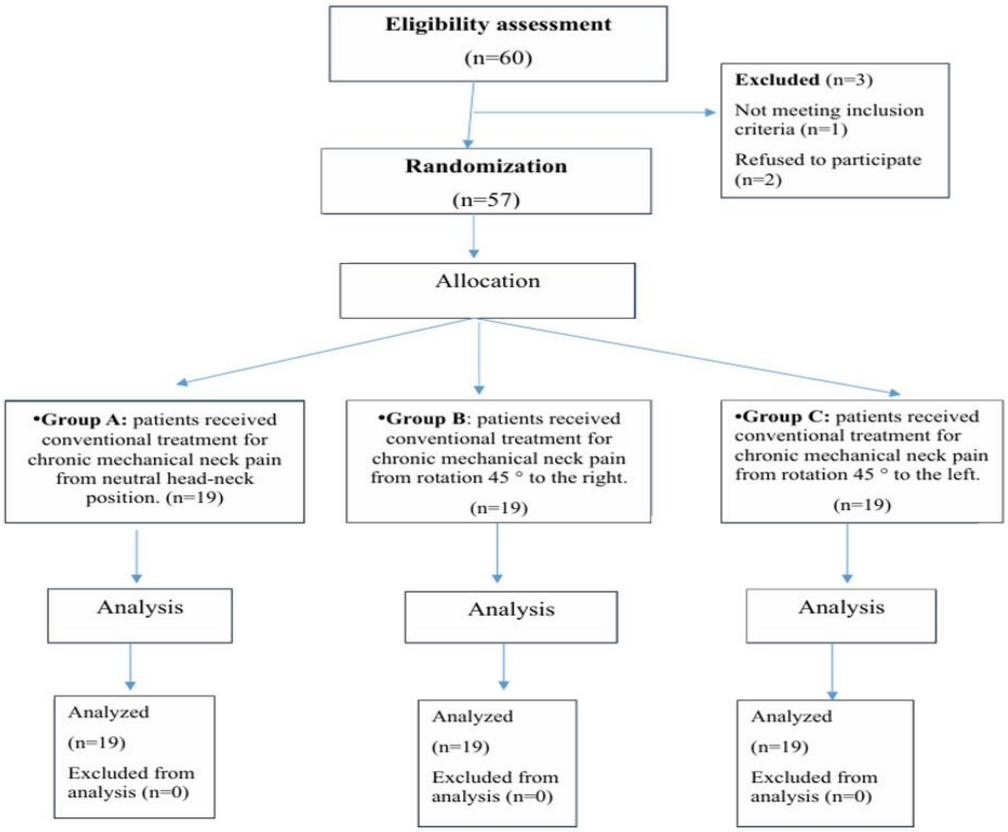

Figure 2: Consort Flow-Chart

Evaluation Tools

Visual Analog scale (VAS): The leftmost value along the 10-cm horizontal line utilized for VAS represents a painless condition, represented by 0, and was employed to evaluate pain intensity. The maximum value is 10, indicating the highest level of pain experienced. The participants independently assessed their pain levels along the line, thus providing a quantifiable measure of their pain [15]

Hand-held dynamometer: The assessment involved measuring hand grip strength across three distinct head-neck positions: neutral, rotation to the left, as well as rotation to the right. The dynamometer is regarded as the reference standard in muscle testing, serving as the gold standard for performing hand-grip strength measurements, demonstrating excellent validity and reliability in both clinical and research settings (Figure 3). [16]

Figure 3: Hand-held dynamometer

Arabic version of the Disability of the Arm, Shoulder and Hand (DASH-Arabic):

It was used to measure upper extremity function disability and the Arabic version of the DASH questionnaire has shown strong reliability, validity, as well as responsiveness in assessing patients with UEDs. This 30-item tool evaluates symptoms along with physical function, specifically focusing on the level of disability, and offers five response options for each item. Each item offers five response options, spanning from 1, indicating "no difficulty or symptoms present," to 5, indicating "incapable of participating in an activity or experiencing very severe symptoms." An greater score on the DASH indicates increased levels of disability [17]

Treatment procedure

Prior to participation in this study, the aim and procedures were explained to the participants and every participant signed an informed consent. Hand held dynamometer, visual analogue scale and the Arabic version of DASH were used to evaluate subjects' pre- and post-treatment statuses in three different head neck-position.

Neck isometric exercises: Patient position: sitting on chair, Physiotherapist position: stride standing behind the patient, one hand at the lateral aspect of the occiput give resistance to rotation for isometric contraction on each side, ask patients to rotate against maximum resistance. Physiotherapist put the hand anteriorly to give resistance to neck flexion for isometric contraction and put the hand at the posterior aspect of the occiput to give resistance to neck extension for isometric contraction, ask patients to contract against maximum resistance, duration: 3 sets of 10 repetitions with 1 to 3 minutes' rest between each set. [14]

Conventional treatment

1- Continuous Ultrasound; was utilized with 1.5 W/cm2 intensity in addition to a frequency of 1 MHz. Ultrasound was applied perpendicular from prone position on the upper fibers of trapezius for 5 minutes. [14]

2-Hot packs: The patient was requested to lie prone with exposed cervical and upper trapezius region, then hot packs (a standard size that had been maintained in a hydrocollator tank at 74.5–80°C for 30 minutes) were applied on the cervical spine for 20 minutes. [14]

Statistical Analysis

Statistical analysis was conducted using SPSS v20 (IBM Inc., Chicago, IL, USA). The quantitative parameters were reported as mean and standard deviation. Repeated measures MANOVA will be used to compare measured variables between and within groups. A two-tailed P value of less than 0.05 was accepted as significant.

Results:

The mean values ± SD values of age of groups A, B and C were 22.1 ± 1.4, 22.46 ± 1.3 and 21.6 ± 1.4 years respectively. The number (%) of females of groups A, B, and C were 12 (63%), 7 (37%) and 9 (47%) and the number (%) of males 7 (37%), 12 (63%), and 10 (53%) respectively. also no significant difference was detected among three groups in the mean values of age (p = 0.268), also no significant difference was detected in gender distribution, among the three groups (p =0.263) (table 1).

Table 1. General characteristics of subjects of three groups.

Variables	Group A (n=19)	Group B (n=19)	Group C (n=19)	f- value	p-value
Age (years)	22.1 ± 1.4	22.46 ± 1.3	21.6 ± 1.4	1.35	0.268
Sex: Females **Males**	12 (63%) 7 (37%)	7 (37%) 12 (63%)	9 (47%) 10 (53%)	$\chi^2 = 2.67$	0.263

Data was expressed as mean ± standard deviation or number (%), χ^2: chi square

Regarding effect of treatment on pain:

The mean value ± SD of pain pre-study of the group A was 7.7 ± 1.5 and post study was 5.2 ± 1.2 cm. A statistically significant decline was noted in mean value of pain post study compared with pre study (p = 0.001), it was decreased by 32%. The mean value ± SD of pain pre-study of the group B and C was 7.3 ± 1.5, and 6.8 ± 1.4 and post study was 5.6 ± 1.3 cm and 5.5 ± 1.3 cm A statistically significant decline was observed in mean value of pain post study compared with pre study (p = 0.001), it was decreased by 22% and 19% respectively. There was no significant difference in the mean values of pain pre study between the three groups (p = 0.168), also there was no significant difference post study between the three groups (p = 0.655).

Regarding effect of treatment on hand grip strength the mean value ± SD of hand grip strength pre-study of the group A, B and C was 23 ± 11.2, 26.6 ± 10.3 and 26.5 ± 7.4 and post study was 27.9 ± 10.5 kg, 35 ± 12.5 kg29.2 ± 6.6 kg respectively. A significant improvement was noted in mean value of hand grip strength post study compared with pre study (p = 0.001), it was increased by 21%, 31.5% and10% respectively. No significant difference was noted in the mean values of hand grip strength pre study among the three groups (p = 0.060), no significant difference was observed post study among the three groups (p = 0.370).

Concerning effect of treatment on upper extremity function:

The mean value ± SD of upper extremity function score pre-study of the group A, B and C was 57.1 ± 11.7, 53.4 ± 10.8 and 49.1 ± 7 and post study was 50.2 ± 10.1, 47.4 ± 9 and 46.4 ± 6.3 respectively. There was a significant decline in mean value of upper extremity function score post study compared with pre study (p = 0.001), it was decreased by 12%, 11% and 5.5% respectively. No significant difference was noted in the mean values of upper extremity function score pre study between the three groups (p = 0.433), also there was no statistical significant difference post study among the three groups (p = 0.082) (table 2).

Table (2): Comparison between pre- and post-study mean values of pain, hand grip strength and function between and within groups

Measured variables	Group A	Group B	Group C	f-value	P value
Pain (cm) Pre-study	7.7 ± 1.5	7.3 ± 1.5	6.8 ± 1.4	1.7	0.186
Post-study	5.2 ± 1.2	5.6 ± 1.3	5.5 ± 1.3	0.42	0.655
% of change	32%	22%	19%		
(P-value)	0.001*	0.001*	0.001*		
Hand grip strength (kg) Pre-study	23 ± 11.2	26.6 ± 10.3	26.5 ± 7.4	2.9	0.060
Post-study	27.9 ± 10.5	35 ± 12.5	29.2 ± 6.6	1	0.370
% of change	21%	31.5%	10%		
(P-value)	0.001*	0.001*	0.001*		
Function (DASH score) Pre-study	57.1 ± 11.7	53.4 ± 10.8	49.1 ± 7	0.85	0.433
Post-study	50.2 ± 10.1	47.4 ± 9	46.4 ± 6.3	2.6	0.082
% of change	12%	11%	5.5%		
(P-value)	0.001*	0.001*	0.001*		

p-value: probability value *: significant

Discussion

The Hand grip strength of a hand is the amount of force that the forearm and hand muscles can produce when gripping an object. It was thought to be a major sign of general fitness and strength in the upper part of the body. [14] Age, sex, general muscular strength, and physical health are some of the variables that can affect HGS. Other factors that can affect HGS include physical activity, diet, and pre-existing health issues. [18]

The HGS was typically evaluated with a hand dynamometer for determining the maximal force exerted during a static grip. The individual securely holds the dynamometer. The apparatus quantifies force in pounds or kilograms. HGS is crucial in athletic performance, occupational health, as well as rehabilitation. It was often utilized as a measure of total strength and functional capacity [19].

There is a lack of studies regarding the impact of various head and neck positions on HGS in healthcare professionals experiencing neck pain, resulting in a knowledge deficit on this matter among healthcare practitioners [20]. The objective of this study was to examine the impact of MNP in various neck postures [neutral, left rotation, right rotation] on HGS among young adults.

The study found that treatment significantly improved outcomes within all groups (A, B, and C) but did not show significant differences between groups. Pain levels decreased, hand grip strength improved, and upper extremity function scores showed enhancement post-treatment compared to pre-treatment within each group. However, there were no significant differences in these metrics either before or after treatment when comparing the three groups.

The improvement observed in all groups can be attributed to the efficacy of the conventional therapy itself. This treatment likely involved a combination of electrotherapy, hydrotherapy and strengthening exercises which are known to help reducing pain, alleviate muscle tension, improve flexibility, and promote healing in chronic neck pain conditions, and enhancing overall mobility [21]. Moreover, the increase in hand grip strength and upper extremity function suggests that the therapy not only addressed the neck pain but also improved the strength and function of the surrounding muscles, likely contributing to better overall body mechanics and comfort [22].

Interestingly, the position in which the treatment was administered did not significantly impact the outcomes.

Whether the neck was in a neutral position or rotated to the right or left, the improvements in pain levels and function were similar across all groups. Thus, the therapeutic effects of conventional treatment may not be sensitive to head-neck positioning. Rather, the therapy itself regardless of starting position seems to be the key factor driving improvement [23].

The findings align with previous studies Lytras et al. and Mata et al. [24, 25] on CMNP, which have consistently demonstrated that traditional physical therapy, including manual therapy and exercise, can significantly reduce pain and improve physical function in patients suffering from CNP. These therapies typically target the musculoskeletal system, aiming to restore range of motion, alleviate discomfort, and enhance muscle strength.

In agreement with our investigations, Tutar et al. [26] as they found that treatment significantly enhanced outcomes in the patient group compared to the control group, specifically in hand grip strength. There was a statistically significant increase in the right-hand grip strength (from 45.21 ± 11.47 lb-f to 56.50 ± 4.59 lb-f) and left-HGS (from 42.62 ± 12.34 lb-f to 53.83 ± 7.36 lb-f) for both women and men in the patient group in comparison with the control group ($p < 0.05$). Additionally, a statistically significant difference was found in the right hand finger lateral grip strength for women (from 13.56 ± 2.07 lb-f to 14.90 ± 1.86 lb-f) in comparison with the control group ($p < 0.05$). However, no significant differences were found for the left hand finger lateral grip strength in women or for both hands in men ($p > 0.05$).

Consistent with our findings, Alatawi's study [14] determined that HGS was maximal in the neutral head as well as neck position (HNP) and minimal in extension (30°) across both dominant and non-dominant sides. After testing both dominant as well as non-dominant hands in neutral, flexion (40°), along with extension (30°) positions, researchers found no statistically significant difference in HGS ($p > 0.05$). On the other hand, when comparing dominant HGS in neutral with non-dominant HGS in extension, a statistically significant difference was seen ($p = 0.021$; $p = 0.018$).

On the other hand, Kumar et al. [27] found that the left side of the head-neck rotation had the strongest grip. This difference may be attributed to that they involved healthy young volunteers, whose responses to head-neck movements are likely more typical and predictable, which may explain why left head-neck rotation resulted in superior grip strength in their study.

On the other hand, when measuring grip strength in healthy people, Lee et al. [28] found that the head-neck rotation position had somewhat better results than the head-neck neutral position. The difference may be explained to the use of kinesio tape on the hand's flexor muscle during the assessment of grip strength. The proprietor of Kinesio tape asserts that it enhances muscle performance by strengthening muscles that are weak. Kinesio tape may induce physiological alterations in muscle and myofascial activities by enhancing blood and lymph circulation in the taped region. [29].

Limitations of The Study

The study was limited to young adults, which limits its applicability to other age groups or populations. We did not compare HGS based on age, sex, or BMI. Specifically, these factors could have affected the outcomes. Furthermore, the course of treatment was brief, lasting only four weeks.

Conclusion

Head - neck different positions in patients with CMNP not significantly proved to have an effect on pain, hand grip strength, and upper extremity function. However, HGS was highest in head-neck rotation to the right followed by the head-neck neutral position and head-neck rotation to the left. Considerations such as sex, age, and BMI should be included in future research on HGS.

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Conflict of Interest: Nil.

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