Original Article

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Effect of Proprioceptive Training on Neck Pain Intensity, Joint Position Sense and Functional Performance Among Non-Specific Neck Pain Desk-Job Workers with Kinesiophobia

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Abstract:

Objective: The current study aimed to examine the effect of 4 weeks of proprioceptive training on neck pain intensity, neck disability, degree of kinesiophobia, joint position sense, and functional performance among desk-job workers with chronic non specific neck pain (NNP).

Material and Methods: Twenty-four desk-job workers (12 males and 12 females) with a mean (standard deviation) age of 30.86 (9.37) were recruited. Proprioceptive training with laser maze and postural correction techniques were given as interventions to the participants. After the interventions, all the participants underwent assessments to evaluate neck pain intensities, the degree of neck disability scores, and joint position errors (neutral head position).

Results: Significant differences were found pre- and post-four-week intervention in the intensity of neck pain and the neck disability score (p-value<0.05). There was a significant improvement in neck pain intensity, neck disability index and kinesiophobia scores after the four-week treatment (p-value<0.05). Significant results were also seen in cervical joint position error in neutral head position (p-value<0.05).

Conclusion: Proprioception training significantly reduced neck pain, neck disabilities, and degree of depressive symptoms while improving joint position sensitivities and functional performances among desk workers with neck pain. The findings of

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this study validate our hypothesis that integrating proprioceptive training into the rehabilitation process can greatly enhance the results for patients suffering from neck pain by promoting the development of enhanced control and awareness of their neck muscles, which in turns contributes to a healthy lifestyle.

Keywords: desk-job workers, health risks and well-being, kinesiophobia, nonspecific neck pain, proprioceptive training, rehabilitation

Introduction

Chronic nonspecific neck pain (NNP) is a debilitating condition among desk-job workers[1] and has been categorized as the fourth leading cause of disability in the current decade[2]. Recent studies have indicated an increasing occurrence of NNP, with desk-job workers exhibiting one-year prevalence rates ranging from 42% to 69%[3,4]. Additionally, research has shown that office workers experience a higher prevalence of neck pain compared to the general population[5]. Whereas, in a recent survey conducted among 398 public-office workers in Malaysia, a notable 43% disclosed their experiences of contending with neck disorders[6]. Considering that chronic pain remains a prominent contributor to global disability rates and exerts a significant economic burden on society, the need for an effective strategy for the prevention of neck disorders among office workers holds a significant demand.

NNP is widely described as pain in the posterior neck or shoulders induced by aberrant tension and pressure on cervical musculoskeletal tissues in the absence of significant pathology, such as radiculopathy, tumour, fracture, or infection[7,8]. Neck pain can be caused by physical factors such as extended periods of sitting, prolonged active muscle contraction, pressure on the neck, challenging job conditions, an unfavourable work environment, and repetitive monotonous tasks[9-11]. In addition to the usage of keyboard and mouse, office workers are required to sit in front of a video display unit for almost the entirety of their work shift, hence the long hours of static positioning of their spine, further increasing their risk of neck disorders[12]. Furthermore, a recent study conducted on office workers experiencing neck pain who underwent craniocervical flexion testing has demonstrated an altered muscle recruitment strategy to stabilize the head and neck[13]. This alteration resulted in a decreased range of rotation and, conversely, an increased activation of superficial muscles and abnormal proprioception in the neck joint[13,14]. In the long run, these changes increase the load on the neck region, leading to an increase in pain and the development of chronic disabilities and adverse psychological behaviors, such as anxiety, depression, and kinesiophobia[15,16].

Kinesiophobia is a term used to describe a disorder in which a patient has an unjustified and deteriorating fear of bodily movement and acts as a result of the worry of a painful injury or re-injury[15]. Pain-related fear frequently obscures the true functional capacity of these patients, which is concerning because individuals with high pain-related fear avoidance have a reduced range of motion and diminished strength, hindering their overall functional performance and eventually affecting their quality of life[17]. Therefore, it is crucial to design efficient rehabilitation techniques for those with neck pain by assessing the psychological aspects both before and after therapy, and by identifying which psychological deficits substantially contribute to recovery.

Proprioception refers to sensory information that contributes to an individual's conscious awareness of muscle sense, overall posture, and specific body segment

positions[18]. Proper proprioceptive feedback affects the precision of movement, the timing of motor instructions, and the ability to adjust to movement conditions that involve non-sequential coordination patterns[19]. An extensive analysis of proprioception training through a systematic review has demonstrated its efficacy in diminishing neck pain, enhancing range of motion, and enhancing the overall quality of life over a prolonged duration[19]. While extensive research has been undertaken on proprioception training in individuals with neck pain[20–24], there remains a dearth of studies specifically addressing proprioception training in individuals with neck pain who also exhibit kinesiophobia.

Therefore, our study aimed to examine the effect of 4 weeks of proprioceptive training on neck pain intensity, neck disability, degree of kinesiophobia, joint position sense, and functional performance among desk-job workers with nonspecific neck pain with kinesiophobia. We hypothesized that proprioceptive training significantly reduces neck pain intensity, neck disability, and degree of kinesiophobia while improving joint position sense and functional performance among desk-job workers with nonspecific neck pain and kinesiophobia.

Material and Methods

Participants

The current study recruited 24 desk-job workers (12 males and 12 females) (age: 30.86±9.37) based on the predefined inclusion and exclusion criteria. Participants in this study were recruited based on the purposive sampling method; they varied in age from 21 to 55 years old, worked at a desk job for at least one year, and experienced nonspecific persistent neck discomfort for at least 3 months with a pain score of more than 4 on the visual analog scale. Participants were excluded from the study if they reported a history of cervical surgery or injury or accidents, were on any painkiller medication, or had inflammatory disease, neurological, sensorial, or muscular paralysis. They were also excluded if they were engaged in any other sports, activities or training.

Prior to their participation in the study, all the participants were provided with comprehensive information regarding the testing procedures and intervention protocol and subsequently acknowledged their agreement by signing a written consent form. INTI International University's Research and Ethics Committee approved the project (INTI-IU/FHLS-RC/BPHTI/7NY12022/011).

Procedure

A pre-post interventional study design examined the effect of 4 weeks of proprioceptive training on neck pain intensity, joint position sense, and functional performance among desk-job workers with nonspecific neck pain and kinesiophobia.

Neck pain was evaluated using a numerical pain scale ranging from 0 to 10, where 0 represents no pain, and 10 indicates the worst or most severe pain imaginable. Patients were asked to self-report their pain intensity by selecting a number on the scale that best corresponds to their pain level. Whereas neck disability was assessed using the neck disability index (NDI). The NDI is a 10-item questionnaire that includes activities of daily living, such as personal care, lifting, reading, work, driving, sleeping, recreational activities, pain intensity, concentration, and headache, with 6 response categories for each item (range 0---5, total score between 0 and 50); a lower score means a lower disability[25].

The Tampa Scale kinesiophobia is a questionnaire composed of 17 questions on pain-related fear avoidance[26]. This scale used a 4-30-point score (1=I do not agree, 4=I strongly agree) for each question. The total score ranges between 17 and 68. The cut-off value of the Tampa Scale kinesiophobia is 37 points, and >37 points was accepted as a high degree of kinesiophobia[26].

The Cervical Range of Motion (CROM) device was used to assess the cervical spine range of motion (ROM) and proprioception. The principles for joint position errors (JPE) measurements for neutral head position (NHP) and target head position (THP) have been adopted from a previous study[27]. The JPE is calculated based on the participant's ability to voluntarily relocate his or her head to a previously shown target point by the examiner. In the context of the study, participants were directed to assume a seated position and don the CROM device, akin to donning a pair of glasses. The device was secured around the head using a Velcro band. A magnetic yoke directed north was placed directly over the participant's shoulders. During the testing procedure, the examiner employed a webbing strap to limit the participant's shoulder and trunk mobility. At the baseline, the examiner instructed the participant to maintain his or her head in the neutral position (starting point) in order to standardize the CROM device.

For the neutral head position (NHP) test, participants were instructed to close their eyes while maintaining their heads in a neutral position. The inclinometer was calibrated by the examiner to a starting point of 0 degrees, representing the neutral head position. Participants were allowed a brief moment to familiarize themselves with this position before actively performing full cervical extension. Following the extension, they were required to return their heads to the neutral position. Throughout the procedure, participants were instructed to perform the task with maximum accuracy, verbally indicating when they believed they had returned to the starting position. No visual or verbal feedback was provided during the test. Relocation accuracy was assessed in 3 directions: cervical extension, right cervical rotation, and left cervical rotation. Each participant completed 3 trials for each movement direction, with the average of the 3 trials calculated for the final analysis.

Whereas for the target head position (THP) test, the examiner gently guided the participant's head to a predetermined position, which was set at 50% of their maximal range of motion (ROM). Participants held this target position for 3 seconds in order to learn the posture. The examiner then gradually returned the participant's head to the starting neutral position. Participants were asked to consciously reposition their head back to the target position, which was measured as the absolute error. Once they relocated their head to the reference position, the examiner recorded the relocation accuracy in degrees.

Joint Position Error (JPE) testing was conducted in 3 directions, similar to the NHP test: cervical extension, right rotation, and left rotation. A simple chit method was employed to randomize the order of JPE testing across these 3 directions. Each participant completed 3 trials for each movement direction, and the average of the 3 trials was used for the final analysis. By following these protocols, both NHP and THP tests provide a standardized approach to evaluating joint position sense and relocation accuracy in cervical movements, allowing for reliable comparisons across participants.

Participants were administered cervical proprioceptive training/exercises using laser maze and postural correction methods. The participants were instructed to sit in a chair, position the laser on their forehead, and place the laser target maze on a wall located 3 meters away from them. They were then guided to aim the laser at the maze's starting point and slowly move their head along the path toward the endpoint, ensuring that the laser remained within the boundaries of the line.

The postural correction methods included suboccipital stretching and chin tuck-in exercises. For the suboccipital stretching exercise, the participants assumed a supine position on a couch, while the therapist positioned their forearm under the participant's neck with the forearm initially in a supinated position. The therapist then proceeded to pronate the forearm and held this position for 10 seconds. This sequence was repeated 10 times for a total of 3 sets.

In the chin tuck-in exercise, the participants were seated on a chair in an upright posture, ensuring that the head remained in a neutral position. The therapist then directed the participants to perform the chin tuck-in hold for 5 seconds, with 10 repetitions per set and a total of 3 sets.

These 3 interventions were administered over the course of 4 weeks, with 3 weekly sessions. After the intervention, all the participants underwent assessments to evaluate neck pain intensity, the extent of kinesiophobia, functional performance, and cervical joint position sense. The participants were advised to refrain from any other activities or training throughout the four-week intervention. The proprioception training was conducted by an experienced physiotherapist with 12 years' experience. The same physiotherapist provided training to all the participants in order to ensure consistency. However, a different examiner was assigned for taking the readings in order to minimize any potential bias in the data collection process.

Statistical analysis

The data were analyzed using IBM SPSS Statistics version 28.0. Descriptive statistics (Mean, standard deviation, median, interquartile range (IQR) frequencies, and percentages) were used to analyze the degree of kinesiophobia, neck pain intensity, neck disability score, and joint position error. All the data demonstrated a normal distribution, except for joint position errors in both the average head position and the targeted head position. Pearson correlations were employed to examine the relationship between kinesiophobia, neck pain intensity, and disability, while the Spearman correlation was used to examine the relationship between kinesiophobia and joint position error.

Paired t-tests were used to evaluate the differences in the neck pain intensity and neck disability index scores before and after four-week treatments. As data were not normally distributed for joint position error, the Wilcoxon Signed Rank test was used to examine the differences between the pre and post-four-week interventions. The significance level was set at p-value<0.05.

Results

In the current study, 24 participants with a mean (standard deviation) age of 30.86 (9.37) were recruited. The baseline demographic details of the participants are presented in Table 1.

Table 2 reveals the differences in neck pain intensity, level of neck disability, and joint position error following 4 weeks of intervention. Significant differences were found pre- and post-four-week intervention in the neck pain intensity and neck disability scores (p-value<0.05). In joint position error, significant differences were only seen in the neutral head position (cervical extension and left cervical rotation) (p-value<0.05).

Table 1 Demographic characteristics of the participants (n=24)

Variables	Frequency (%)
Gender	
Male	12 (50.0)
Female	12 (50.0)
Age (years)	
18-25	8 (33.3)
26-35	9 (37.5)
36-45	4 (16.7)
46-55	3 (12.5)
BMI (kg/m^2)	
Underweight	3 (12.5)
Normal weight	14 (58.3)
Overweight	4 (16.7)
Obese	3 (12.5)
Engagement in physical activity	
Yes	16 (66.7)
No	8 (33.3)

BMI: body mass index

Table 2 Effect of 4 weeks of proprioceptive training on neck pain intensity, joint position sense, and functional performance among desk-job workers with nonspecific neck pain and kinesiophobia

Variables (Mean (S.D.))	Four weeks of intervention (n=24)			
	Pre intervention	Post intervention	t	p-value
Neck pain intensity	6.43 (0.93)	1.33 (0.93)	19.125	<0.000*
Neck disability	16.81 (4.02)	13.14 (2.95)	4.864	<0.000*
Kinesiophobia	37.81 (5.17)	19.10 (6.49)	7.263	<0.000*
Variables (Median)	**Pre intervention**	**Post intervention**	**z**	**p-value**
****Joint position error** Neutral head position				
Cervical extension	3.00	2.00	-2.195	0.028*
Left cervical rotation	1.00	0.00	-2.359	0.018*
Right cervical rotation	2.00	0.00	-0.592	0.554
****Joint position error** Targeted head position				
Cervical extension	1.00	0.00	-1.027	0.305
Left cervical rotation	1.00	0.00	-0.994	0.320
Right cervical rotation	2.00	0.00	-0.265	0.791

*p-value<0.05, significant results **Wilxocon signed rank test for joint position error as data were not normally distributed

Discussion

The current study aimed to examine the effect of proprioceptive training on neck pain intensity, degree of kinesiophobia, joint position sense, and functional performance among desk-job workers with nonspecific neck pain and kinesiophobia. The results of this study validate our hypothesis that proprioceptive training significantly reduces neck pain intensity, neck disability, and degree of kinesiophobia while improving joint position sense and functional performance among desk-job workers with nonspecific neck pain and kinesiophobia.

The current study revealed that proprioceptive training among desk-job workers significantly reduced the intensity of neck pain and the level of neck disability. A previous study regarding 3 weeks of proprioceptive training among chronic neck pain patients aged 25-55 years showed similar results with a reduction in pain score and improvement in level of neck disability[24]. Neck pain can lead to maladaptive behaviors, alter the coordination of neck muscles, and decrease the precision of neck muscle activation. This can occur, for example, through decreased activation of the deep segmental muscles and increased activation of the superficial muscles[28]. Further, these anatomical and functional changes in the cervical deep and superficial muscles might alter muscle spindle discharge, affecting afferent input and leading to changes in proprioception[29]. In the long run, the erroneous proprioceptive information can cause greater and prolonged reflex activation of neck muscles, which can lead to neck discomfort over time, creating a vicious cycle and severe neck disability[28].

Following the 4 weeks of proprioceptive training, the study reported a significant reduction in the mean score of the Tampa scale of kinesiophobia. The term "fear of movement," or "kinesiophobia," refers to an overwhelming, agitated, illogical, and crucial worry that results from exerting strength and movement because

of a perception of vulnerability to a painful injury or re-injury[15,30]. According to the Fear-avoidance model (FAM), a strong fear of movement is associated with an increase in avoidance behavior, which leads to greater impairment and physical deconditioning (inactivity or disuse)[31] and has been associated in terms of prevalence and prognosis with chronic musculoskeletal pain, particularly neck discomfort[32]. Additionally, kinesiophobia has been reported to impact muscle activation and recruitment patterns, which impact neuromuscular functioning and rehabilitation results, delaying the return to pre-injury levels[33]. Several studies have reported significant improvement in the level of kinesiophobia following proprioception exercises, similar to the current study results1[9,33,34]. This might be explained as an increased effect on the neuromuscular control and cognitive neural processing of the brain through proprioceptive training, decreasing negative emotion and fear, which reduces pain and enhances functional performance[33].

The results of the study also show improvements in the mean score of joint position error in both the neutral head position and the targeted head position. However, only the neutral head position showed significant improvement following the four-week intervention of proprioception training. This could possibly be due to the fact that THP involves reaching a predetermined target (e.g., 50% of maximum range of motion), which requires more complex proprioceptive and motor control. Relocating the head to a specific non-neutral position may be more difficult due to increased variability in muscle length-tension relationships, joint angle perception, and coordination demands, especially with just 4 weeks of training. Previous studies conducted among chronic neck pain patients have reported similar findings[24,35,36]. Additionally, research has indicated that proprioceptive training can facilitate the re-establishment of proprioceptive impairments, including static and dynamic balance, locomotion, cervical kinesthetic sensitivity, body position, and self-motion awareness among chronic neck pain patients[24,37].

One main limitation of the present research is that a significant proportion of the participants (70.8%) fell within the age range of young adults to 35 years; thus, representation of older adults may be limited. Furthermore, to enhance precision, augmenting the sample size and implementing proprioceptive training for a minimum of 6 months in order to evaluate the sustainability of the results among the participants is recommended.

Conclusion

There was a significant improvement in neck pain intensity, level of neck disability, kinesiophobia, and joint position error (neutral head position), following the 4 weeks of proprioception training. Although there was no significant improvement in the targeted head position, mean score differences can be seen in the post-four-week intervention in all 3 neck movements. Therefore, integrating proprioception training into the rehabilitation process can greatly enhance the results for patients suffering from neck pain by promoting the development of enhanced control and awareness of their neck muscles. This, in turn, can alleviate pain and reduce fear towards movement, enhance stability, and prevent the risk of future injuries.

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Conflict of interest

The authors declare that there is no conflict of interest.

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