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ORIGINAL

Effect of TheraBand-assisted isometric neck exercises with pressure biofeedback on cervical proprioception and postural stability among prolonged computer users: a pilot study

Efecto de los ejercicios isométricos de cuello asistidos con TheraBand y biorretroalimentación de presión sobre la propiocepción cervical y la estabilidad postural en usuarios de computadora de uso prolongado: un estudio piloto

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ABSTRACT

Background: Prolonged computer use has become a common aspect of modern life, often leading to musculoskeletal problems, particularly affecting the neck and upper back. Maintaining correct neck posture and postural stability is essential to minimize discomfort and reduce injury risk. This study aimed to examine the effects of TheraBand-assisted isometric neck exercises combined with pressure biofeedback on cervical proprioception and postural stability among prolonged computer users. Materials & Methods: The study included professional computer users with a history of using computers for over 4 hours daily, at least 4 days a week, for the past 2 years. Participants were randomly assigned into two groups: the Experimental Group (Group A) and the Control Group (Group B). Group A received TheraBand-assisted isometric exercises with pressure biofeedback, while Group B underwent conventional therapy. Outcome measures included cervical proprioception tests for head positioning accuracy, the Y Balance Test (YBT), Berg Balance Scale (BBS), Sway Test, and neck angle measurements. Results: Both groups demonstrated improvements in cervical proprioception and postural stability after intervention. The Control Group showed greater gains in dynamic balance (YBT), while both groups displayed similar improvements in static balance (BBS) and reduced postural sway (Sway Test). The Experimental Group, however, showed a significant increase in neck angle, reflecting better cervical alignment and posture compared to the Control Group. Conclusion: TheraBand-assisted isometric exercises with pressure biofeedback and conventional therapy are effective for enhancing cervical proprioception, postural stability, and neck posture in prolonged computer users, supporting musculoskeletal health and reducing discomfort risk.

Keywords: Prolonged computer use, Cervical proprioception, Postural stability, TheraBand assisted isometric exercises, Pressure biofeedback

RESUMEN

Antecedentes: El uso prolongado de la computadora se ha convertido en un aspecto común de la vida moderna, lo que a menudo provoca problemas musculoesqueléticos, especialmente en el cuello y la parte superior de la espalda. Mantener una postura correcta del cuello y la estabilidad postural es esencial para minimizar las molestias y reducir el riesgo de lesiones. Este estudio tuvo como objetivo examinar los efectos de los ejercicios isométricos de cuello asistidos con TheraBand, combinados con biorretroalimentación de presión, sobre la propiocepción cervical y la estabilidad postural en usuarios de computadora de uso prolongado. Materiales y métodos: El estudio incluyó a usuarios profesionales de computadora con un historial de uso de computadoras de más de 4 horas diarias, al menos 4 días a la semana, durante los últimos 2 años. Los participantes fueron asignados aleatoriamente a dos grupos: el Grupo Experimental (Grupo A) y el Grupo Control (Grupo B). El Grupo A recibió ejercicios isométricos asistidos con TheraBand con biorretroalimentación de presión, mientras que el Grupo B se sometió a terapia convencional. Las mediciones de resultados incluyeron pruebas de propiocepción cervical para la precisión del posicionamiento de la cabeza, la Prueba de Equilibrio Y (YBT), la Escala de Equilibrio de Berg (BBS), la Prueba de Balanceo y mediciones del ángulo del cuello. Resultados: Ambos grupos mostraron mejoras en la propiocepción cervical y la estabilidad postural tras la intervención. El grupo control mostró mayores ganancias en equilibrio dinámico (YBT), mientras que ambos grupos mostraron mejoras similares en equilibrio estático (BBS) y una reducción del balanceo postural (prueba de balanceo). Sin embargo, el grupo experimental mostró un aumento significativo del ángulo cervical, lo que refleja una mejor alineación y postura cervical en comparación con el grupo control. Conclusión: Los ejercicios isométricos asistidos por TheraBand con biorretroalimentación de presión y terapia convencional son eficaces para mejorar la propiocepción cervical, la estabilidad postural y la postura del cuello en usuarios de ordenadores de larga duración, lo que favorece la salud musculoesquelética y reduce el riesgo de molestias.

Palabras clave: Uso prolongado del ordenador, Propiocepción cervical, Estabilidad postural, Ejercicios isométricos asistidos por TheraBand, Biorretroalimentación de presión

INTRODUCTION

In today's digital age, prolonged computer use has become an integral part of our daily lives. While technology offers unprecedented convenience, it has also led to an increase in musculoskeletal issues, particularly those affecting the cervical spine, because of the static and sustained postures maintained during computer work[1]. Longer computer users often experience neck pain, stiffness, and decreased postural stability, which can negatively impact their overall well-being and work productivity. Among the various factors contributing to these issues, cervical proprioception and postural stability play crucial roles in maintaining optimal neck function and preventing potential injuries[2].

Cervical proprioception refers to the ability to perceive the position and movement of the neck in space through sensory information from specialized receptors in the cervical spine[3]. Impairments in cervical proprioception can disrupt the neuromuscular control of neck muscles, leading to reduced postural stability and an increased risk of neck-related problems. Therefore, enhancing cervical proprioception is essential for mitigating the adverse effects of prolonged computer use on neck health[4].

The neck, also known as the cervical spine, is a crucial and complex region of the vertebral column that connects the head to the rest of the body. It plays a vital role in supporting the weight of the head, facilitating its movement, and protecting the spinal cord and nerves that transmit signals between the brain and the body[5]. Understanding the anatomy of the neck is essential for understanding the mechanisms underlying cervical proprioception and postural stability. The cervical spine consists of seven vertebrae, designated C1 through C7, starting at the base of the skull and extending to the upper back. Each cervical vertebra is separated by intervertebral discs, which act as shock absorbers and provide flexibility to the neck[6]. The first cervical vertebra, C1——is also known as the atlas, and it supports the weight of the skull, allowing for the nodding motion of the head. The second cervical vertebra, C2, is referred to as the axis and allows the head to rotate from side to side. The cervical vertebrae are interconnected by facet joints, which are small synovial joints that enable smooth movement and contribute to the stability of the neck. Additionally, strong ligaments surrounding the cervical spine provide further support and limit excessive movement, potentially leading to injury[7,8]. The cervical spine houses the spinal cord, a bundle of nerves that extends from the brain and transmits sensory and motor signals to and from various parts of the body. The spinal cord is protected by the vertebral column, including the cervical spine, and is surrounded by cerebrospinal fluid, which acts as a cushion[9,10]. The neck is rich in muscles that are responsible for its movement and stability. The major neck muscles include the sternocleidomastoid, splenius capitis, trapezius, levator scapulae, and scalene muscles. These muscles work together to allow various movements of the neck, such as flexion, extension, rotation, and lateral bending[11]. Cervical proprioception is the body's ability to sense the position and movement of the neck in space, and it relies on specialized receptors known as proprioceptors. Proprioceptors are located in the muscles, tendons, ligaments, and joint capsules of the cervical spine and provide sensory feedback to the brain regarding the orientation and motion of the neck. This sensory information is essential for the accurate control and coordination of neck movements, contributing to postural stability and the prevention of musculoskeletal problems[12].

An understanding of the neck's anatomy and the role of cervical proprioception is fundamental for exploring interventions aimed at improving postural stability and alleviating neck-related issues, particularly in populations exposed to prolonged computer use[13]. By targeting specific muscles and proprioceptive receptors in the cervical spine, rehabilitation programs can be tailored to enhance neck function and overall well-being among individuals facing the challenges of modern-day sedentary work environments.

TheraBand-assisted isometric exercises with pressure biofeedback have emerged as a promising rehabilitation approach for neck-related issues[14]. The TheraBand is a versatile and widely used resistance band that allows for targeted strengthening of neck muscles. Coupled with pressure biofeedback, this technique enables individuals to monitor and adjust the amount of force applied during exercises, facilitating precise control and proprioceptive training.

This pilot study aims to address the growing musculoskeletal issues, particularly in the neck, faced by prolonged computer users by exploring the combined effects of TheraBand-assisted isometric exercises with pressure biofeedback on cervical proprioception and postural stability. While previous research has examined these interventions separately, their combined impact on this specific population remains largely unexplored.

By assessing the feasibility and preliminary efficacy of a structured exercise program, this study seeks to determine whether this approach can enhance proprioception and stability compared with a control group. These findings could provide valuable evidence for developing targeted, effective rehabilitation strategies to reduce neck discomfort, promote occupational health, and improve the overall well-being of individuals engaged in prolonged computer work.

METHODS

This experimental study involved 100 subjects from Noida, selected through a sampling method that included 100 participants from the same area. The dependent variables of the study are forward head posture, Y balance, and both static and dynamic balance. The independent variable is the study's design, which distinguishes between the experimental and control groups. The control group, which served as the control variable, comprises participants who will not receive TheraBand-assisted isometric exercises with pressure biofeedback intervention but will instead receive either routine care or placebo exercises.

The inclusion criteria specify that participants must be between the ages of 18 and 35, include both males and females, and be long-term computer users with impaired cervical proprioception, dynamic balance, static balance, and forward head posture. These subjects must have been professional computer users who had used a computer for more than 4 hours a day for at least 4 days a week over the past 2 years. Individuals with severe neck pain, traumatic neck injuries, other musculoskeletal disorders, vestibular disorders, communication problems, pregnancy, fractures, diseases, neurological disorders, or cognitive impairments that might hinder their ability to follow instructions or provide reliable data were excluded.

The study procedure begins with participants—all professional computer users—filling out a form to discuss the inclusion and exclusion criteria, followed by receiving a patient information sheet detailing the research aim, objectives, and methodology. Eligible participants are then randomly divided into two groups and undergo pretest measurements of forward head posture (CV angle), cervical proprioception, static balance, and dynamic balance (YBT) on the basis of the inclusion criteria. The experimental group performs neck isometric exercises with pressure biofeedback, including stabilizer exercises such as flexion, extension, side-to-side rotation, chin tucks, and neck isometrics, whereas the control group performs chin tucks, manual stretching, strengthening with isometrics, and conventional therapy.

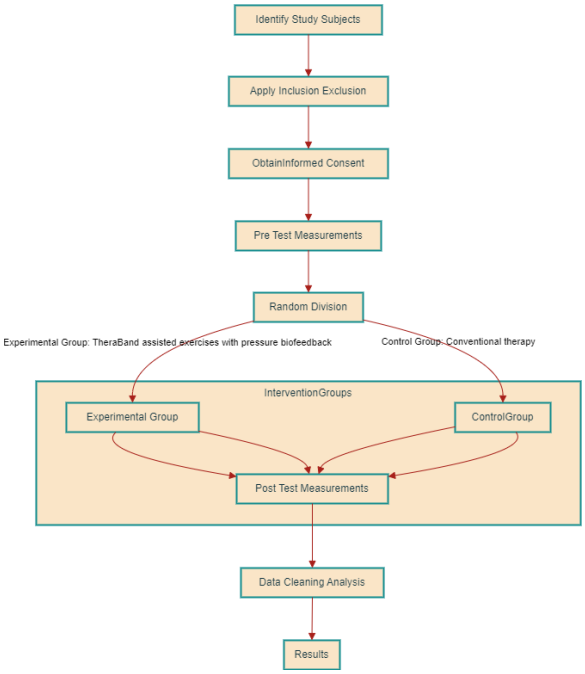

Figure 1: Flowchart of the Procedure

RESULTS

Table 1 shows the demographic characteristics of the participants in the experimental group (Group A) and control group (Group B). The groups were similar in terms of age (24.88 ± 3.29 vs. 23.72 ± 2.75 years, p=0.183), weight (86.92 ± 9.92 vs. 87.88 ± 10.93 kg, p=0.746), and height (p=0.822), with no significant differences. This finding indicates that randomization effectively balanced the groups, supporting the validity of the study.

TABLE 1: DEMOGRAPHIC DESCRIPTIVE STATISTICS.

VARIABLES	GROUP A	GROUP B	P-VALUE
AGE	24.88±3.295	23.72±2.747	0.183
WEIGHT (kg)	86.92±9.920	87.88 ± 10.929	0.746
HEIGHT (ft)	5.465±0.3057	5.44±0.292	0.822

TABLE 2: Y TEST (CM)

VARIABLES	GROUP B	GROUP A	P-VALUE
Y TEST PRE	123.08±14.265	124.88±16.518	0.682
AND POST TEST	127.76±13.358	171.88 ± 14.354	<0.001
P-VALUE	<0.001	<0.001	

Pretest YBT scores were comparable between groups (Group A: 123.08; Group B: 124.88; p=0.682). After the intervention, Group A improved slightly (127.76), whereas Group B significantly improved (171.88; p<0.001). These findings indicate that compared with the control treatment, the control treatment was more effective at enhancing postural stability.

TABLE 3: NECK ANGLE

VARIABLES	GROUP A	GROUP B	P-VALUE
NECK ANGLE BEFORE	42.6820±0.192	42.784±0.222	0.423
NECK POST	44.533±0.926	42.54±0.850	<0.001
P-VALUE	<0.001	0.222	

Table 3 presents the findings of the neck angle measurements for both the experimental group (Group A) and the control group (Group B). The pretest values were similar (Group A: 42.68; Group B: 42.78; p=0.423). The posttest results revealed a significant improvement in Group A (44.53) compared with Group B (42.54; p<0.001). These findings suggest that compared with conventional therapy, TheraBand-assisted isometric exercises with pressure biofeedback were more effective at improving the neck angle

Table 4 presents the results of the static test for both the control group (Group B) and the experimental group (Group A). Both groups had similar pretest scores (Group B: 6.68; Group A: 6.52; p=0.423). The posttest results revealed a minimal change in Group B (6.56), whereas Group A significantly improved to 11.44 (p<0.001). This highlights the effectiveness of TheraBand-assisted exercises with pressure biofeedback in enhancing static postural stability compared with conventional therapy.

TABLE 4: STATIC TEST

VARIABLES	GROUP B	GROUP A	P-VALUE
STATIC TEST PRE	6.68 ± 1.108	6.52±1.122	0.423
STATIC TEST POST	6.56±1.083	11.44±2.417	<0.001
P-VALUE	0.465	<0.001	

TABLE NO. 5. Cervical proprioception test (PRE-POST)

Variable	Group A (Experimental)	Group B (Control)	p value (Between Groups Post)	p value (Within Group A)	p value (Within Group B)
Head to NHP	Pre: 2.0 ± 1.4 Post: 1.6 ± 0.9	Pre: 2.0 ± 1.4 Post: 1.6 ± 0.9	0.912	0.041*	0.047*
Head to THP: Flexion	Pre: 2.5 ± 0.9 Post: 2.4 ± 0.9	Pre: 2.4 ± 0.8 Post: 2.4 ± 1.0	0.864	0.225	0.287
Head to THP: Extension	Pre: 4.0 ± 0.8 Post: 3.8 ± 0.8	Pre: 4.1 ± 0.8 Post: 4.1 ± 0.9	0.793	0.038*	0.321
Head to THP: Side Bend Left (SBL)	Pre: 1.1 ± 0.8 Post: 1.1 ± 0.8	Pre: 1.1 ± 0.8 Post: 1.1 ± 0.8	0.999	0.687	0.611
Head to THP: Side Bend Right (SBR)	Pre: 1.5 ± 1.1 Post: 1.1 ± 1.1	Pre: 1.5 ± 1.1 Post: 1.1 ± 1.1	0.933	0.044*	0.048*
Head to THP: Rotation Left (RL)	Pre: 2.4 ± 1.5 Post: 2.4 ± 0.9	Pre: 2.4 ± 1.5 Post: 2.4 ± 0.9	0.985	0.521	0.614
Head to THP: Rotation Right (RR)	Pre: 2.1 ± 1.4 Post: 2.1 ± 1.2	Pre: 2.1 ± 1.4 Post: 2.1 ± 1.2	0.978	0.615	0.572

Table 5 presents the findings of the Cervical Proprioception Test for both the Experimental Group (Group 1) and the Control Group (Group 2). Both groups had similar pretest scores across all the proprioceptive measures. Posttest results revealed improvements in both groups, particularly in terms of reduced error scores for head repositioning tasks (e.g., NHP, flexion, extension, side bending, rotation). The findings indicate that both interventions were effective at enhancing cervical proprioception, with improvements in accuracy and control observed across participants.

DISCUSSION

The present study sought to investigate the effects of TheraBand-assisted isometric neck exercises combined with pressure biofeedback on cervical proprioception and postural stability among individuals who use computers for prolonged periods. The rationale for undertaking such a study stems from the growing prevalence of musculoskeletal discomfort and postural dysfunctions among individuals who spend extended hours working on computers. Prolonged screen use often leads to alterations in cervical alignment, reduced proprioceptive accuracy, and impaired balance, which in turn contribute to chronic neck pain and reduced functional capacity. In this context, the study compared two different therapeutic approaches—an experimental intervention consisting of TheraBand-assisted isometric exercises with pressure biofeedback and a control intervention consisting of conventional physiotherapy exercises—to determine their relative efficacy in improving neck posture, proprioception, and dynamic postural stability.

The results of the demographic analysis presented in Table 1 indicate that the participants in both groups were well matched in terms of age, height, and weight. This balance between groups is an important methodological strength of the present study, as it minimizes the likelihood of demographic variables acting as confounding factors. A homogeneous distribution ensures that any observed postintervention changes in outcomes can be more confidently attributed to the specific interventions rather than differences in participant characteristics. Therefore, the randomization process was successful in generating comparable groups, thereby enhancing the internal validity of the study findings. Balanced demographics are particularly significant in musculoskeletal research, since anthropometric variables such as height, weight, and age can independently influence posture, muscle endurance, and proprioceptive acuity.

The analysis of postural stability using the Y balance test (YBT) provided valuable insights into the participants' dynamic balance capacity. The results revealed that both the experimental and control groups demonstrated measurable improvements in YBT scores following their respective interventions, indicating that both therapeutic approaches had a positive impact on balance. Interestingly, however, the magnitude of improvement was greater in the control group than in the experimental group. These findings suggest that the conventional physical therapy program may have been more effective at enhancing dynamic balance than the TheraBand-assisted isometric protocol with pressure biofeedback was. One possible explanation for this outcome is that conventional therapy, which often includes a wider range of active mobilization and functional strengthening exercises, may provide more direct stimulation of the neuromuscular systems responsible for whole-body balance control. Dynamic balance requires the coordinated activity of the lower extremity musculature, vestibular input, and proprioceptive integration, and it is possible that compared with the relatively localized isometric neck exercises of the experimental protocol, conventional therapy provided a more comprehensive challenge to these systems.

The findings from the YBT also invite further reflection on the relationship between cervical interventions and global balance outcomes. While cervical proprioception plays an important role in postural control, balance is inherently a multisystem function. Thus, although neck-specific training may improve proprioceptive accuracy at the cervical level, this may not directly translate into substantial gains in dynamic stability compared with more generalized physical therapy. This could explain why the control group, which engaged in broader conventional exercises, outperformed the experimental group in terms of Y test improvements. Nevertheless, the improvements seen in both groups reinforce the notion that therapeutic exercise, regardless of modality, has a beneficial effect on postural stability among individuals exposed to prolonged sedentary screen work.

Neck angle measurements, presented in Table 5, were used to paint a contrasting picture by highlighting the strengths of the experimental intervention. The posttest results indicated a significant increase in the neck angle among participants in the experimental group compared with those in the control group. These outcomes suggest that TheraBand-assisted isometric exercises with pressure biofeedback were particularly effective at correcting forward head posture and improving cervical alignment. Forward head posture is a common musculoskeletal deviation associated with computer use, resulting from the habitual anterior displacement of the head and upper cervical spine. By engaging the deep cervical flexors and extensors through resistance-based isometric contractions, the TheraBand protocol likely promoted greater postural awareness and strengthening of the stabilizing muscles responsible for maintaining an optimal neck position. The addition of pressure biofeedback may have further enhanced motor learning by providing participants with real-time awareness of their alignment, thereby reinforcing correct posture and discouraging maladaptive movement patterns.

These findings have important clinical implications because poor cervical alignment is closely linked to musculoskeletal discomfort, increased strain on cervical tissues, and long-term degenerative changes. Improvements in the neck angle are therefore not merely cosmetic but are directly associated with reducing the biomechanical stresses that contribute to neck pain and dysfunction. In this context, the superior performance of the experimental group in improving neck posture underscores the value of targeted, feedback-driven interventions for individuals vulnerable to postural deviations due to occupational demands.

Cervical proprioception outcomes further supported the efficacy of both interventions. As shown in Table 5, both the experimental and control groups exhibited notable improvements in proprioceptive accuracy after their respective treatment programs. Enhanced cervical proprioception reflects improved joint position sense, which is essential for maintaining cervical stability and for coordinating head and trunk movements during functional tasks. The positive changes observed in both groups suggest that therapeutic exercise, regardless of modality, has the capacity to recalibrate and improve sensorimotor control in the cervical spine. Given that impaired proprioception is frequently implicated in the development of chronic neck pain and dizziness, these findings are encouraging for the design of preventive rehabilitation strategies among computer users.

The observation that both groups improved in proprioceptive accuracy may be explained by the fact that both interventions included structured, repetitive, and purposeful movements that stimulated mechanoreceptors within the cervical joints and musculature. Such sensorimotor training enhances afferent feedback to the central nervous system, thereby sharpening proprioceptive acuity. While the experimental group benefited from the combination of resistance and biofeedback, the control group's conventional therapy likely incorporated stretching and strengthening elements that also promoted proprioceptive re-education. This highlights the adaptability of the cervical proprioceptive system and its responsiveness to diverse exercise modalities.

Taken together, the results of the present study point to a nuanced understanding of the benefits of different exercise approaches. While the control group demonstrated superior improvements in dynamic balance, the experimental group showed a distinct advantage in correcting neck posture. Both groups achieved meaningful improvements in cervical proprioception, suggesting that multiple exercise strategies can effectively enhance sensorimotor control. These findings highlight the importance of tailoring therapeutic programs to the specific functional outcomes desired by patients. For instance, individuals with pronounced postural deviations may benefit most from targeted resistance and biofeedback interventions, whereas those with balance-related concerns may respond better to conventional exercise approaches.

The implications of these findings extend beyond the immediate study sample. In occupational health contexts, interventions that improve cervical posture and proprioception may reduce the risk of musculoskeletal pain syndromes, decrease absenteeism, and increase productivity among computer-based workers. Similarly, improvements in dynamic balance have broader functional significance, reducing the risk of falls and enhancing physical independence. The present study therefore contributes evidence to support the integration of structured physical therapy programs into workplace wellness initiatives.

It is important, however, to acknowledge the limitations of the study. The sample size was relatively small, which may limit the generalizability of the findings to larger populations. Additionally, the duration of the intervention and follow-up period was short, raising questions about the long-term sustainability of the observed improvements. The reliance on specific outcome measures such as the YBT and neck angle assessments, while informative, may not fully capture the complexity of functional performance and quality of life outcomes. Future research should aim to replicate these findings with larger sample sizes, longer intervention durations, and a broader range of outcome measures, including subjective reports of pain, fatigue, and functional capacity.

CONCLUSION

In conclusion, the results of the present study demonstrated that both TheraBand-assisted isometric exercises with pressure biofeedback and conventional therapy are effective strategies for improving cervical proprioception, neck posture, and postural stability among individuals who use computers for prolonged periods. The control group achieved greater gains in dynamic balance, suggesting the superiority of conventional therapy in this area. In contrast, the neck angle significantly improved in the experimental group, indicating the specific utility of resistance- and feedback-based training for correcting postural deviations. Both groups improved in terms of cervical proprioception, underscoring the adaptability of the cervical sensorimotor system to diverse exercise modalities. Collectively, these findings emphasize the value of physiotherapy-based interventions for mitigating the musculoskeletal consequences of prolonged computer use and call for further research to optimize and individualize treatment protocols.

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Validation: BA, SS, SG, SZ, VKR, and PKS
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Drafting: BA, SS, SG, SZ, VKR, and PKS
Writing: BA, SS, SG, SZ, VKR, and PKS