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Comparative Effects Of Visual And Pressure Biofeedback On Pain, Range Of Motion And Disability In Symptomatic Forward Head Posture

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Abstract
To understand the forward head posture, this study aims to study the impact of visual and pressure biofeedback on pain, range of motion, and disability. The main objective of our study is to understand the difference between these two interventions on the patients presenting with forward head posture. This randomized control trial study was conducted in Bahawal Victoria Hospital, Bahawalpur. A total of 32 patients were included in this study of which 16 was for the visual and 16 were for the pressure biofeedback. A purposive sampling technique was used and the 32 patients were equally distributed in groups A and B. The data was compared between two groups using the SPSS software and this revealed that significant improvements were recorded in the neck flexion, left-right rotation and flexion, NRPS, and NDI score. However, when comparative post-intervention analysis was done within the groups, it

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revealed a significant difference in neck flexion, right side rotation, ROM, and NDI score. However, no significant difference was found in NRPS score and neck extension. The study findings reveal that although both visual and pressure biofeedback therapies were successful in enhancing range of motion and lowering disability however, based on their mean value Pressure biofeedback is slightly more effective as compared to visual feedback in terms of outcome measure indicated. Advanced interventions are required that take into account individual characteristics and investigate the long-term effects on a varied population. To further our understanding of effective therapies for people with forward head posture, future research should address the limitations that have been discovered. A large sample size and prolonged intervention of clinical approaches could achieve more reliable results as compared to our 32-sample size and 4-weeks intervention duration. A Study on patients with more similar backgrounds in the context of demographics and biomechanical features would enhance the study's reliability.

Keywords: Forward Head Posture, Pressure Biofeedback, Visual Biofeedback, Range Of Motion, Pain

INTRODUCTION:

Forward head posture (FHP) is a common musculoskeletal condition characterized by an anterior translation of the head in relation to the shoulders (1, 2). When the head is forward of a vertical line passing through the person's center of gravity, it is referred to as forward head posture, or FHP (4). One of the most prevalent postural abnormalities in the sagittal plane is forward head posture (FHP), and an excessively anterior head posture in relation to the shoulder is the typical sign of FHP (4). The head is positioned forward in the sagittal plane with respect to the neck, which is known as forward head posture (FHP), and it is linked to lower cervical spine flexion (C4–C7) and hyperextension of the upper cervical spine (C1–C3), increased cranial rotation angle, and decreased craniovertebral angle (CVA). Craniovertebral angle <49° is considered as FHP in previous studies (5, 6).

Forward head posture is a common source of postural disability, causing humane suffering and affecting individuals' well-being, as well as incurring significant costs for the individual and society (7). This condition is associated with various musculoskeletal symptoms, including neck pain, reduced range of motion and disability with pain confined to the back of the neck (7). Symptoms associated with FHP, such as neck pain and limited range of motion, can significantly affect the person’s overall life quality. The ability to perform daily activities, work efficiently, and engage in recreational pursuits can be compromised, underscoring the importance of effective interventions (7). The annual incidence of neck difficulty varies between 27.1% and 47.8% across various nations (8).

According to earlier studies, FHP significantly affects the musculoskeletal system. Dizziness, CGH, and compression of the cervical nerve root are among the most

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common of the conditions that can result from FHP (9). FHP can cause the anterior cervical muscles to stretch and become weaker, as well as the posterior region to shorten, and it can also cause an upper cervical extension and a lower cervical flexion (9). If this unusual variation in the cervical region's muscles and joints persist, it could lead to restricted cervical movement and reduced muscle function (5). It is believed that a prolonged forward head posture is damaging for the spinal cord, and due to an increase in the head's lever arm, the anterior movement of the head's center may result in an increase in the force exerted by the head (10).

A musculoskeletal balance that places the least amount of strain and stress on bodily components is referred to as proper posture, and many people have bad posture that can negatively affect one's musculoskeletal equilibrium as well as psychological well-being (10). Improper or changing spine posture may place significant strain on the surrounding muscles and ligaments, which may ultimately compromise the stability of the spine and frequently result in pain (11). Forward head posture (FHP) is linked to an imbalance in the muscles around the cervical spine, including the levator scapulae, sternocleidomastoid (SCM), shortened upper trapezius, suboccipital muscles, and lengthened deep neck flexor muscles (15). It has been demonstrated that forward head posture (FHP), which affects a conservative estimate of 66% of patients, is a common postural displacement (12). FHP not only affects the musculoskeletal system but also has potential psychological and psychosocial implications, including decreased quality of life, increased stress, and reduced productivity (13).

The prevalence of FHP can be attributed to the modern lifestyle characterized by prolonged sitting, desk work, and extensive use of handheld devices (14). It is a prevalent condition in modern society, primarily attributed to the increasing use of technology devices such as computers, smartphones, and tablets (1). Furthermore, more time is being spent using computers and sending texts on mobile phones as a result of the growing use of new information and communication technologies (ICTs), which could potentially result in long-term neck pain as a result of extended durations of neck flexion (15). Forward head posture (FHP), the most common cervical postural error in the sagittal plane, is found in almost all populations, albeit in varied degrees of severity (16).

Biofeedback is a therapeutic technique that has gained recognition in the management of musculoskeletal conditions. It involves providing real-time information to individuals about physiological processes, allowing them to gain greater awareness and control over their body functions (17). In the context of FHP, two forms of biofeedback are commonly employed: visual biofeedback and pressure biofeedback (17). Understanding the comparative effects of visual and pressure biofeedback in managing FHP is not only scientifically but also highly relevant to clinical practice (18). The gap in knowledge regarding the comparative effects of visual and pressure biofeedback in FHP management calls for rigorous research to fill this void, and our study will be a significant contribution to the management of forward head posture by

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studying the effect of visual and pressure biofeedback focusing on the exploring of insights of these two therapies.

MATERIALS AND METHODS

This study employed a randomized control trial to study the effect of pressure and visual biofeedback on the range of motion, pain and disability in patients with symptomatic forward head posture (FHP). The study was conducted at Bahawal Victoria Hospital, Bahawalpur, where a controlled and clinical environment was provided for this study. The duration of this study was 10 months. A total sample size of 28 was calculated from G power analysis version 3.1.9.7, and a 10% attrition rate was added which makes the sample size a total of 32. A purposive sampling technique was used.

Both genders i.e. males and females were included. Age 20 to 35 years and craniovertebral angle (CVA) <49 degrees or less than included in the study, score more than 3 on NPRS and score more than 10 on NDI. Subjects having a history of vertebra-basilar artery insufficiency, any systemic illness, fever, malnutrition, or malignancy, history of recent fracture in shoulder and neck region, and history of recent surgery in the neck region were excluded.

The research only included eligible patients who met the inclusion requirements. Following a baseline evaluation, patients were divided into the two groups at randomly and each group contain 16 members respectively. Group A patients received stabilization exercises (isometric stretching and strengthening exercises) + pressure biofeedback by using a sphygmomanometer. Group B patients received stabilization exercises (isometric stretching and strengthening exercises) + visual biofeedback by using a laser head light. Treatment lasted for four weeks in total, with three sessions held each week on different days, and sessions lasting a total of 25 to 30 minutes.

Using a neck disability index, goniometer, and numeric pain rating scale, the baseline values of each dependent variable were collected on day one and at the end of four week follow-up. NPRS was used to assess pain, goniometry was used to evaluate neck flexion, extension, right lateral bend, and left lateral bend, and NDI was used to assess neck pain-related self-rated disability. To observe the long-term effects of the therapy, assessment of patients was also recorded after 4 weeks from the start of the treatment protocol.

Data was analyzed using IBM SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Normality of the data was checked by applying Shapiro-wilk test and tests were applied accordingly. Paired sample t-test to compare the effectiveness of isometric stretching and strengthening with pressure bio feedback and visual biofeedback within groups whereas independent sample t-test, used to find significant difference between Group A and Group B.

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RESULTS:

The mean age of participants in this study of group A was 29.25 years (SD = 4.10). On the other hand, Group B comprised individuals with an average age of 29.38 years (SD = 2.87) in figure 1 and 2.

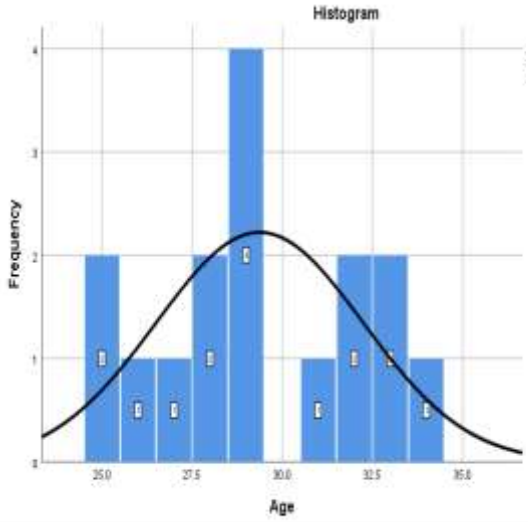

Fig 1: Age of Participant (Group A)

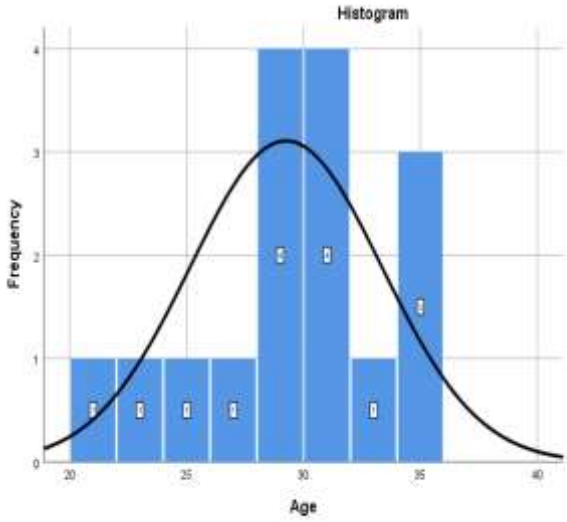

Fig 2: Age of Participant (Group B)

According to gender distribution, In Group A, 56.3% of the participants were male, while 43.7 % were female. In Group B, the gender distribution was evenly split, with 50% male and 50% female participants as in figure 3.

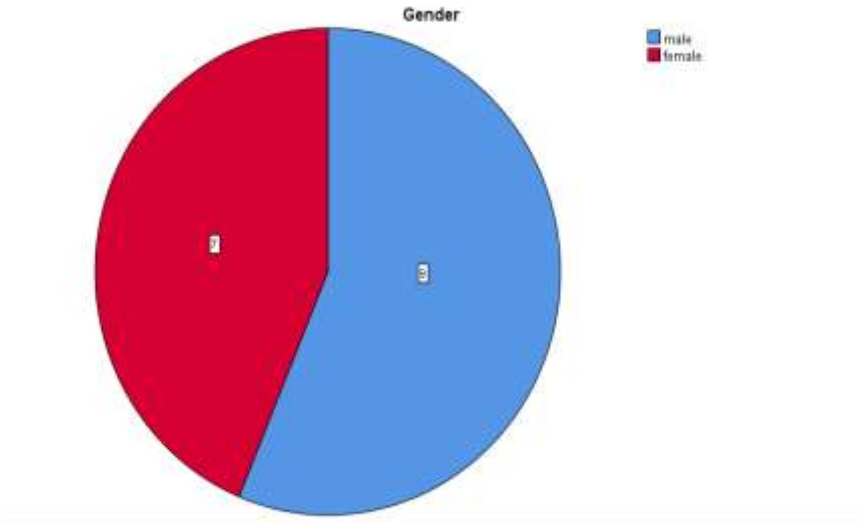

Fig 3: Gender distribution of group B

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Table 1: Within group analysis of neck ROM, NPRS AND NDI

	Group A (Pressure)		Group B (visual)		P-value
	Mean ± SD (95% CI)		Mean ± SD (95% CI)		
	Pre-test	Post-test	Pre-test	Post-test	
Flexion	37.01 ± 4.51	46.31 ± 4.86	36.56 ± 3.89	41.69 ± 4.55	<0.001
Extension	38.38 ± 5.08	45.26 ± 6.38	38.25± 4.66	44.12 ± 4.24	<0.001
Rotation(R)	57.69±7.82	67.01±6.13	55.31±8.72	61.06±7.91	<0.001
Rotation(L)	58.50±6.71	69.19±6.75	56.50±6.68	63.65±6.65	<0.001
NPRS	5.88 ± 1.25	3.98 ± 1.52	6.06 ± 1.43	4.81 ± 1.42	<0.001
NDI	17.13± 1.45	12.19 ± 1.96	16.81 ± 1.47	13.56± 1.26	<0.001

Table 1 represents pre-intervention and post-intervention Mean ± SD of within group analysis of neck ROM, and NPRS which showed that both groups had a significant improvement in neck flexion, extension, right rotation, and left rotation, and pain ($p < 0.05$). While group analysis of NDI scores, which showed that both groups had a significant decrease in NDI scores after relative interventions ($p < 0.05$).

Table 2: Intergroup analysis for Neck ROM, NPRS AND NDI

	Group A (Pressure)		Group B (visual)		Mean difference		P value	
	Mean ± SD (95% CI)		Mean ± SD (95% CI)					
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Pre-test
Flexion	37.01 ± 4.51	46.31 ± 4.86	36.56 ± 3.89	41.69 ± 4.55	0.43	4.6	.77	.009
Extension	38.38 ± 5.08	45.26 ± 6.38	38.25± 4.66	44.12 ± 4.24	0.12	1.1	.94	.56
Rotation(R)	57.69±7.82	67.01±6.13	55.31±8.72	61.06±7.91	2.37	5.93	.42	.02
Rotation(L)	58.50±6.71	69.19±6.75	56.50±6.68	63.65±6.65	2.0	5.56	.40	.02
NPRS	5.88 ± 1.25	3.98 ± 1.52	6.06 ± 1.43	4.81 ± 1.42	-.18	-.87	.69	.10
NDI	17.13± 1.45	12.19 ± 1.96	16.81 ± 1.47	13.56± 1.26	.31	-1.37	.55	.003

Based on the statistical analysis of the independent sample t-test, we found that a significant difference between Group A and Group B in post-intervention means of neck range of motion (ROM) for neck flexion, right rotation, and left rotation ($P<0.05$), while no significant difference was found for neck extension ($p=.56$). The post-intervention means of neck disability index (NDI) scores also showed significant

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difference among groups (p=0.003). However, when it comes to pain levels, we did not find a significant difference between Group A and Group B.

DISCUSSION:

In this study, we aimed to focus on examining the effects of isometric strengthening and stretching exercises with the guidance of pressure biofeedback and visual biofeedback on forward head posture. The stretching exercises were designed to increase flexibility and lessen muscular imbalances, while the isometric strengthening exercises focused on the muscles needed to maintain correct head and neck alignment. Through the integration of these strengthening and stretching isometrics with the combination of biofeedback techniques, we were able to precisely and effectively address the root muscles causing the forward head posture and encouraged the repair of poor posture. The results of our study showed promising outcomes in terms of neck ROM, neck disability and pain intensity.

Certain neck range of motion (ROM) movements are frequently affected in forward head posture, particularly neck rotation, neck extension, and neck flexion (19). The head's forward posture may limit these motions and cause stiffness and tightness in the joints and muscles of the neck. The within group analysis of our study showed that both groups had a significant improvement in neck flexion, extension, right rotation, and left rotation ($p < 0.05$). Additionally, both Group A and Group B demonstrated a significant decrease in Neck Disability Index scores ($p < 0.05$), indicating a reduction in neck-related disability, and Numeric Pain Rating Scale scores significantly decreased in both groups ($p < 0.05$).

These findings are supported by previous studies. Erina et al. (2023) found a significant difference in pre-intervention and post-intervention NDI scores using isometric exercise techniques in computer users with forward head posture (20). Zahra et al. (2017) reported significant improvement in neck active ROM and muscle strength following a 4-week postural corrective exercise program using isometric stretching and strengthening in females with forward head posture (21). Jeong et al. (2018) in their systematic review and meta-analysis identified isometric exercises as one of the most effective interventions for improving neck pain, ROM, and disability, and indicated that these exercises help achieve both static and dynamic stabilization (22).

In our study, we made hypothesis regarding which biofeedback technique combined with isometric training is more effective in improving the study's outcomes. The results showed a significant difference between Group A and Group B in post-intervention means of neck ROM for neck flexion, right rotation, and left rotation ($P < 0.05$), while no significant difference was found for neck extension ($p = .56$). The post-intervention means of Neck Disability Index scores also showed significant difference among groups ($p = 0.003$). However, no significant difference was found between groups in pain levels, which may be due to pain being a subjective and complex experience influenced by various factors beyond the interventions studied (23, 24).

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Previous literature supports the effectiveness of biofeedback-guided interventions. Nizamuddin et al. (2013) concluded that pressure biofeedback guided deep cervical flexor training is slightly better than conventional treatment for forward head posture and can be included in rehabilitation programs (25). Kang et al. (2015) also demonstrated the efficacy of pressure biofeedback guided cervical exercises in FHP (41). Kim et al. (2020) found deep cervical flexor training with visual biofeedback guidance to be an effective method for maintaining neck mobility and improving neck pain (26). Chodankar et al. (2022) reported improvements in reaction time and central somatosensory conduction time in participants receiving biofeedback-guided forward head posture corrective exercises compared to non-biofeedback groups (10). Isometric strengthening and stretching exercises are beneficial when paired with both pressure biofeedback and visual biofeedback, and the choice between techniques may be influenced by patient preferences and specific rehabilitation objectives (9).

Conflict of interest: Authors revealed no competing interest.

Funding: No funding was received for this study.

CONCLUSION:

The results of our study reveals that both visual biofeedback and pressure biofeedback were proven to be effective techniques for improving neck range of motion, reducing neck disability, and neck pain. Post-interventional analysis revealed a significant difference between both groups for neck flexion and right and left rotation, while no statistically significant difference was observed in neck extension and pain. Overall, these findings highlight the potential benefits of incorporating visual and pressure biofeedback interventions into rehabilitation programs for patients with symptomatic forward head posture.

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