Title: Comparative Effectiveness of Cervical Stabilisation Exercises and Vertical Oscillatory Pressure Technique in the Management of Patients with Cervical Spondylosis

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ABSTRACT

Background: Mechanical neck pain associated with degenerative cervical spondylosis affects over 330 million individuals globally, representing a significant public health concern. The primary burden of managing this condition falls on functional rehabilitation specialists.

Objective: The study determined the comparative effectiveness of cervical stabilization exercises (CSE) and vertical oscillatory pressure (VOP) in the management of patients with cervical spondylosis.

Methods: The study involved 40 patients with neck pain arising from cervical spondylosis. Informed consent was obtained and participants were assigned the two treatment groups (A-CSE, B-VOP) of twice weekly regimen for six weeks. Treatment effects were assessed on pain intensity, anxiety level, disability index, health related quality of life and cervical range of motion using Visual Analogue Scale, Beck Anxiety Inventory, Neck Disability Index, Short Form-12 questionnaire, and goniometer respectively at baseline, third and sixth weeks. Inferential statistics of Independent t-test, Paired t-test and Repeated Measure ANOVA were used to analyze data. Alpha level was set at $p<0.05$ of significance.

Results: The results showed VOP had significant effect on all variables while CSE also had significant effect on the variables except health-related quality of life ($p = 0.382$). There was significant improvement on the variables except health-related quality of life at both 3 and 6 weeks in the CSE group. There was also significant improvement on the variables at both 3 and 6 weeks in the CSE group except health-related quality of life which only had significant improvement at 6 weeks. There was significant difference on only pain level across the groups at Weeks 3 and Week 6

Conclusion: CSE and VOP were effective in the short-term management of cervical spondylosis. However, VOP should be preferred when improvement on quality of life is desired. VOP may be administered by physiotherapists on patients as part of the rehabilitation protocol to effectively manage neck pain arising from cervical spondylosis.

Keywords: Manipulation, Exercise, Cervical Spondylosis, Neck Pain, VOP

Introduction

Cervical spondylosis or cervical osteoarthritis is a progressive degeneration of the intervertebral disc in the cervical region leading to changes in the surrounding structures especially the bones and the ligament (Peng & Depalma, 2018). It has characteristics of bony outgrowths, nerve root compression, paraesthesia, pain and/or muscle weakness (Ojoawo et al, 2016).

According to population-based researches, by the age of 50, approximately 80–90% of people have disk degeneration (Teraguchi et al, 2014; Brinjikji et al, 2015). A survey of the global burden of low back and neck pain reported that in 2015, more than a third of a billion people worldwide suffered from mechanical neck pain for at least 3 months (Hurwitz et al, 2018), indicating the global health implications of degenerative cervical spondylosis (Vos et al, 2015). Cervical spondylosis is a chronic, developing deterioration of osseocartilaginous components of the cervical spine that is most associated with aging, and disease-modifying agents are not currently available (Theodore, 2020).

One of the most popular forms of treatment for persistent neck discomfort is physical therapy. The majority of neck pain physiotherapy programmes entail using treatments to lessen discomfort and/or stiffness sufficiently to start a neck strengthening and stretching exercise programme (Rob

Dickerman, 2018). Physiotherapy treatment plans can differ from person to person, as can the precise techniques and exercises performed (Rob Dickerman, 2018).

Exercise programmes for managing neck pain differ with regard to duration, frequency, intensity, and mode (Wolsko et al, 2003). Previous studies have shown that isometric exercises and strength training can also have positive effects on neck pain (Cohen, 2015). Neck stabilization exercises, also often referred to as cervical stabilization exercises (CSE) were introduced as a rehabilitation programme to limit pain, maximize function, and prevent further injury in the neck (Dusunceli et al, 2009). It is a method of exercise which, like its counterpart in the lumbar spine, it is designed to improve the natural mechanisms by which the cervical spine maintains a stable, injury-free state. This is accomplished through a series of exercises that are relatively simple with respect to time and equipment, but are physiologically complex (Dusunceli et al, 2009).

It is important to select exercises carefully to avoid worsening the neck pain. One way to know if the neck pain is getting worse is if the symptoms spread away from the neck to the shoulder and/or down the arm (Informed Health, 2022). This can happen during certain exercises or common activities such as driving, reading or using a computer for a prolonged period of time (North American Spine Society, 2012). Spinal stabilization exercises have been used to activate the deep muscles and decrease overactivity of the surface muscles (Stuge et al, 2004). This type of exercise has gained popularity in the treatment of spinal back pain though the applications of the stabilization exercises in low back pain have become common, few randomized clinical trials have investigated the efficacy of cervical and scapulothoracic stabilization exercises for the management of mechanical neck pain (Celenay et al, 2016). Cohen (2015) noted exercise treatment appears to be beneficial in patients with neck pain (Cohen, 2015).

Vertical oscillatory pressure (VOP) is a derivative of manipulative therapy which applies a vertical manipulative gentle thrust on the vertebrae, a technique used for the treatment of back pain. VOP has been reported to be an effective in relieving the pain of patients with neck pain (Egwu et al, 20-7; Ojoawo et al, 2013). Nwuga (2007) noted that most patients who require spinal manual therapy needs only the simple mobilization procedures such as VOP (Nwuga 2007), it was suggested that spinal manual therapy is more effective than conventional physiotherapy in the treatment of mechanical back pain. VOP relieves neck pain without inducing significant myocardial stress in cardiovascular function (Egwu et al, 2003). Ilesanmi et al (2017) noted VOP to be the simplest and an effective spinal mobilization technique in the treatment of neck pain (Ilesanmi et al, 2017).

Some of the interventions used in the management of cervical spondylosis includes CSE (Dusunceli et al, 2009; North American Spine Society, 2012; Celenay et al, 2016) and VOP (Egwu et al, 2003; Egwu et al, 2007; Ojoawo et al, 2013; Ilesanmi et al, 2017). The efficacy of both CSE and VOP techniques have both been tested individually in the management of cervical spondylosis in different studies (Egwu et al, 2003; Dusunceli et al, 2009; Celenay et al, 2016; Ilesanmi et al, 2017). Neck discomfort is the fourth biggest cause of disability, with a prevalence rate of more than 30% on an annual basis (Cohen, 2015). Therefore, this study was aimed at assessing and comparing the effectiveness of Vertical Oscillatory Pressure (VOP) and Cervical Stabilization Exercises (CSE) on disability level, pain intensity level, anxiety level, health related quality of life and the cervical range of motion of the patients with cervical spondylosis.

This study was designed at assess the hypotheses that: there would be no significant improvement in patients' physiological (pain intensity, cervical range of motion) and psychosocial (anxiety level, disability level, health related quality of life) variables when cervical stabilization exercise

is administered to patients with cervical spondylosis; there would be no significant improvement in patients' physiological (pain intensity, cervical range of motion) and psychosocial (anxiety level, disability level, health related quality of life) variables when vertical oscillatory pressure is administered to patients with cervical spondylosis; and there would be no significant difference between the effect of cervical stabilization exercises or vertical oscillatory pressure on patients' physiological (pain intensity, cervical range of motion) and psychosocial (anxiety level, disability level, health related quality of life) variables.

Methods

40 patients were purposively recruited and randomly assigned to two groups using the fishbowl technique from the Outpatient Departments of Physiotherapy and Orthopaedic Surgery & Traumatology, Obafemi Awolowo University Teaching Hospital Complex, Ile-Ife, Nigeria. The sample size for each group was estimated using a formula by Chan (2003) for determining the sample size of the two-sided test of 5% with proportion estimates set at 0.25 and 0.70 based on clinical expectations for the study. There were 20 patients in each study group; Group A – Cervical Stabilization Exercises and Group B – Vertical Oscillatory Pressure.

Ethical approval was obtained from Ethics and Research Committee of the Obafemi Awolowo University Teaching Hospitals' Complex, Ile-Ife, the committee responsible for clearance of research involving human subjects, or patient records at the study sites with protocol number – ERC/2022/11/09. A detailed information document about the study was provided to all participants. Informed consent was sought and obtained from participants in the study for

inclusion. They were also informed that they can withdraw from the study at any stage without prejudice.

Patients undergoing treatment for mechanical neck pain as a result of cervical spondylosis and have been receiving treatment for less than three months before the commencement of the study (non-chronic) at the study site were included. Patients with neck pain secondary to other conditions (including neoplasm, neurological diseases or vascular diseases), radiculopathy presenting neurological deficit, infection or inflammatory arthritis in the cervical spine, those with history of surgery done on the cervical spine as well as patients with associated diagnosis such as osteoporosis.

The study evaluated the physiological (pain intensity, cervical range of motion – flexion, extension, right lateral flexion, and left lateral flexion) and psychosocial (anxiety level, disability level, health related quality of life) variables in patients with neck pain resulting from cervical spondylosis before, during and after six weeks of CSE and VOP intervention. The study also compared the effects of CSE and VOP on the physiological (pain intensity, cervical range of motion) and psychosocial (anxiety level, disability level, health related quality of life) variables in the treatment of patients with neck pain resulting from cervical spondylosis. The study design is experimental and participants were purposively recruited, then randomly assigned into groups using the fishbowl draw technique.

For Group A, each exercise session comprised 5-minute warm-up exercises, 20-minute stabilization exercises, and 5-minute cool-down and stretching exercises, including neck and shoulder girdle muscles. The whole programme was carried out twice weekly for 6 weeks, the cervical bracing technique with the activation of deep neck flexors was performed (Falla et al,

2007). The exercises included workouts using the bracing technique in neurodevelopment stages (supine, prone, quadrupedal, bipedal) for the cervical spine. Participants held the contraction for 10 seconds at each position, with 10 repetitions. Extremity range of motion exercises was conducted while maintaining a stable spine at the specific positions. All exercise repetitions increased progressively from 8 to 12. Cervical isometric exercises were performed directly forward, obliquely, toward right and left, and directly backward by maintaining a stable spine with elastic resistive bands, with 10 repetitions and a holding time of 6 to 10 seconds each. The exercises also included functional training with elastic resistance and exercise balls on unstable surfaces, with 10 repetitions and a holding time of 10 to 15 seconds each (Afolabi et al, 2018). The participants were asked to maintain the positions and contractions during the treatment sessions as much as possible.

For group B, grade III VOP was performed based on the description of Nwuga (2007) and Egwu et al. (2012) on each participant belonging in this group (Nwuga 2007, p. ;Egwu et al, 2012). VOP was administered by placing the two thumb on the spinous process of the already identified vertebra of participants while in prone position, digital pressure is then applied to the identified vertebra then oscillate with grade III mobilization force as described by Snodgrass et al. (2007). Oscillation was repeated every 6 seconds for 60 seconds (that is 10 oscillations) then digital pressure and oscillations was reapplied using the above procedure after 20 seconds rest after which cryotherapy was applied following tissue reaction due to digital pressure. A stop watch was used for timing oscillatory and rest duration; this procedure was repeated for each participant of this group twice weekly for 6 weeks. The magnitude of the transmitted force during procedure was obtained by; Weight of the researcher before treatment – Weight of the researcher during treatment (Ilesanmi et al, 2017), an observer monitored the wight of the researcher when applying VOP while

still sanding on a weighing scale. The weight (force) was derived using the formula; Weight (Newton) = Mass (kilogram) *x* Acceleration due to gravity on earth ($9.8m/s^2$).

Data were collected on pain intensity, anxiety level, disability level, health related quality of life and cervical range of motion (flexion, extension, left lateral flexion and right lateral flexion) using Visual Analogue Scale (VAS), Beck Anxiety Inventory (BAI), Neck Disability Index (NDI), Short Form-12 questionnaire (SF-12) and goniometer respectively at baseline, 3 weeks and 6 weeks of the study from both groups. BAI has an internal consistency of 0.94 and reliability of 0.75, NDI has a test-retest reliability of 0.89 and correlation coefficient of 0.6 with VAS. The reliability of VAS and SF-12 are 0.99 and 0.836 respectively and the goniometer has an intraclass correlation coefficient of 0.822.

The demographic variables of the participants were presented as mean and standard deviation. Repeated Measures Analysis of Variance (ANOVA) was used for comparison of the variables within each group at baseline, three weeks and six weeks. Paired t-test was used to compare variables between the two groups at baseline, 3 weeks and 6 weeks, a significant level of $p<0.05$ was considered. IBM SPSS Statistics 28 was used for the analysis of both descriptive and inferential statistics.

Results

The results showed 18 male (45%) and 22 female (55%) patients with cervical spondylosis were divided equally into two groups. Group A consists of 5 males (12.5%) and 15 females (37.5%) of the population and Group B – VOP 13 males (32.5 %) and 7 females (17.5%) in Table 1.

The physical characteristics of participants and the t-test results showing the differences between the two groups are shown in Table 1. The result showed the age of Group A participants to be

57.20 ± 13.63, while the age of Group B participants is 57.30 ± 15.33. The result showed the weight of Group A participants to be 73.35 ± 9.43, while the weight of Group B participants is 66.55 ± 8.78.

A repeated measure analysis of variance (ANOVA) showed significant effect of CSE on anxiety level, disability level, pain intensity, cervical flexion, cervical extension, cervical left lateral flexion and cervical right lateral flexion range of motion in Table 2. A repeated measure analysis of variance (ANOVA) shows significant effect of VOP on anxiety level, disability level, pain intensity, physical health-related quality of life, cervical flexion, cervical extension, cervical left lateral flexion and cervical right lateral flexion range of motion in Table 3.

Paired T-test comparison of the effects of CSE and VOP showed significant difference in pain intensity at baseline ($p<0.05$) in Table 4. At week 3, the results showed significant difference in pain intensity and cervical flexion range of motion in Table 5. And at the end of the study at week 6, there was significant difference in the effect of pain intensity in Table 6.

Discussion

Cervical spondylosis is a common health challenge and creates a substantial individual, community and financial burden globally as a leading cause of disability worldwide. This study evaluated and compared the physiological (pain intensity, cervical range of motion) and psychosocial (anxiety level, disability level, health related quality of life) variables in patients with neck pain resulting from cervical spondylosis with cervical stabilization exercises and vertical oscillatory pressure as alternative intervention therapies.

Physical characteristics of age, weight, height and Body Mass Index (BMI) of the participants were compared across the group, the result of the study showed significant difference in weight and

BMI and this could be an indication for differences in the effectiveness of the techniques ($P<0.05$). Lin et al (2014) and Xiao et al (2021) noted that increased body weight and BMI is correlated with the decreased improvement in symptom and functioning at end point (Lin et al, 2014; Xiao et al, 2021). Group B participants have significantly lower weight and BMI than Group A participants.

The mean anxiety level, disability level, and pain intensity significantly decreased following six weeks of cervical stabilization exercises. Celenay et al (2016), Gupta et al (2008) and Kuo et al (2020) also reported decrease in the level of disability and pain following stabilization exercises in the management of patients with cervical spondylosis (Gupta et al, 2008; Celenay et al, 2016; and Kuo et al, 2020). Lame et al (2005) provided evidence that depression, anxiety, distress and related emotions are related to pain and disability and also there is a strong impact that pain intensity has on disability and chronic pain that leads to anxiety (Lame et al 2005; Altug et al, 2013). Altug et al (2015) reported in another study that exercise has shown significant impact on the anxiety and stress levels (Altug et al, 2015), this is also similar to another study by Vanshika and Pragya (2012) which concluded that exercise especially lumbar stabilization exercises (LSE) decreases level of depression and anxiety in patients with chronic low back pain (CLBP) (Vanshika & Pragya, 2012).

There was no significant difference in the physical health-related quality of life of the subject who underwent cervical stabilization exercises which is also in contrast to findings by Afolabi et al (2017) in the case of LSE for chronic low back pain (CLBP) patients (Afolabi et al, 2018). Statistically significant improvement was also recorded in all planes of the cervical range of motion (flexion, extension, right lateral flexion, and left lateral flexion), which is in consonance with reports by Gupta et al (2008) and Kuo et al (2020) which made exception for flexion. (Gupta et al, 2008 and Kuo et al, 2020)

The mean anxiety level, disability level, and pain intensity significantly also decreased following six weeks of vertical oscillatory pressure. The effectiveness of VOP on disability level and pain intensity is similar to earlier studies (Afolabi et al, 2017; Ojoawo et al, 2013; Aure et al, 2003; Sharma et al, 2015), which also confirms literature findings which held that pain intensity has direct impact on disability level (Arnstein et al, 1999).

The study found a significant difference in the physical health-related quality of life of the subject who underwent vertical oscillatory pressure which is in contrast to findings by Afolabi et al (2017). Statistically significant improvement was also recorded in all planes of the cervical range of motion (flexion, extension, right lateral flexion, and left lateral flexion) which corroborates findings by Sharma et al (2015) that manual therapy such as posterior anterior central pressure (VOP) has significant effect on spinal range of motion.

The study showed that VOP has significant effect on the physiological (pain intensity, cervical range of motion) and psychosocial (anxiety level, disability level, health related quality of life) variables in patients with neck pain resulting from cervical spondylosis before, during and after six weeks of treatment. The study showed that CSE has significant effect on the physiological (pain intensity, cervical range of motion) and psychosocial (anxiety level, disability level) variables in patients with neck pain resulting from cervical spondylosis before, during and after six weeks of treatment.

Overall, it was found that cervical stabilization exercises (CSE) and vertical oscillatory pressure (VOP) were individually effective and have significant impact on various physiological and psychosocial variables of interest. However, VOP was significant on all the variables while CSE was significant in all except physical health-related quality of life. Therefore, VOP may be

preferred to CSE in the management of patients with cervical spondylosis when improvement on quality of life is desired.

A study on the combination of cervical stabilization exercises (CSE) and vertical oscillatory pressure (VOP) should be conducted to assess the effect of both modalities in the management of cervical spondylosis. The combination of CSE and VOP will be expected to be more effective on all variables than each of them in isolation as reported by Afolabi et al (2018) in the case of lumbar stabilization exercises and VOP in the management of patients with low back pain. VOP could lead to restoration of segmental mobility, modulation of pain at different levels in the CNS and normalization of reflexes while CSE could help to improve posture and enhance neck muscle strength and endurance in addition to pain relief.

A prospective study is recommended to study the long-term effects of cervical stabilization exercises (CSE) and vertical oscillatory pressure (VOP) on anxiety level, disability level, pain intensity, physical health-related quality of life, and cervical range of motion. Prospective studies are essential to understand the long-term benefits or otherwise of treatment modalities. Long-term psychosocial and quality of life variables are underexplored in many studies including this one which focuses on short-term intervention, a prospective study can help fill this critical gap.

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