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IMPACT OF RESONATING FREQUENCIES OF SOUND WAVES ON LOWER BACK PAIN RELATED TO VERTEBRAL MALALIGNMENT

Nimra Batool[1], Mehrun Nisa[1], Faheem Afzal[2], Afzal Hussain[3], Muhammad Saeed Ahmad[4], Saima Batool[1], Youssra Ashgar[1], Asma Munir[1],

1. Department of Physics, The Government Sadiq College Women University Bahawalpur, Punjab, Pakistan. Emails: nimrabatool216@gmail.com, mehr.phy@gscwu.edu.pk, youssraasgher345@gmail.com, saimabatool990099@gmail.com, asmamuniriub@gmail.com,

2. Associate professor, PSRD College of rehabilitation sciences, Lahore, Pakistan Email: faheem.afzal@pcrs.edu.pk

3. Director of IHC hospital and Research Center, Lahore, Pakistan Email: afzalhussain.ihc@gmail.com

4. Department of Computer Science & Information Technology, The Government Sadiq College Women University Bahawalpur, Punjab, Pakistan. Email: drsaeed@gscwu.edu.pk

Corresponding Author: Dr. Mehrun Nisa, Email: mehr.phy@gscwu.edu.pk

Abstract:

Lower back pain is a prevalent global health concern, with the incidence escalating due to an aging and expanding world population. This study aims to evaluate the efficacy of resonating sound waves in alleviating lower back pain associated with vertebral malalignment. A purposive non-probability sampling technique was employed to recruit participants aged 25 to 75 years, experiencing lower back pain linked to vertebral malalignment. The inclusion criteria encompassed mechanical etiologies, such as disc and nerve-related pain, while visible causes like infection, trauma, and tumors (organic causes) were excluded from the study. IBM SPSS and Microsoft Excel were utilized for data entry, graphing, and tabulation. The findings reveal a robust positive trend in reducing pain scores for patients undergoing pulsar treatment ($P < 0.001$). X-ray analyses demonstrated adjustments to disc spacing, facilitating vertebral realignment into a stable position. A comparison of pre- and post-treatment Numerical Pain Rating Scale (NPRS) scores revealed that resonating sound waves significantly improved pain relief in individuals suffering from chronic lower back pain. This study contributes to the growing body of evidence supporting

the potential of resonating sound waves as an effective intervention for alleviating lower back pain associated with vertebral malalignment, thereby addressing a significant global health challenge.

Keywords: Mechanical low back pain, Pulsar treatment, Resonating frequencies, Sound waves, Vertebral malalignment

1. Introduction

Uncontrolled pain is at epidemic proportions. According to studies, the lumbar intervertebral discs are where severe and persistent back pain typically starts[1]. The most common and paralyzing pain is the Low Back Pain (LBP) worldwide. This is largely related with reduced spinal movability, restricted muscle flexibility, and changes in spinal kinematics.[2]. It affects all age groups and people suffering from disability results in lower back pain associated with improper posture of the spine have accelerated by more than 50% since 1990's[3]. High body mass index, oldness, loss of structured physical actions, tiresome activities, or standing for 4 hours or more are risk factors that increase the risk of Lumbosacral pain. Bulging or ruptured disks, muscle or ligament strain, spinal stenosis or arthritis of spine and osteoporosis etc. are the most important causes of lower back pain.[4].

Malalignment is evident in fractures and dislocations, but is rarely considered diagnostically and in this case vertebral deviation in chronic lower backache is the only radiographic sign. vertebral malalignment can be congenital and can be due to physiological movements or radiographic position of the patient[5].

The risk factors for low back pain are many and come from different backgrounds, including physical characteristics, socioeconomic demographics, lifestyle choices, and psychological variables. As a result, they are complex and have many possible causes that linked with an increased prevalence of low back pain[6]. Various treatment options such as invasive treatments range from use of strong medications to surgery[7], which can have poor outcomes[8] and problematic side effects, have been used to adjust the Lower Back Pain.

The question is whether the physicians now have any therapeutic treatment option for the chronic lower back pain to offer to patients who fail both conservative therapy and surgical options[9]. The purpose of this study basically aims to determine the impact of therapeutic sound waves in on pain.

2. Research methodology

The sound transducer of Pulsar device produces a waveform that is applied to cervical vertebra C1. This is because the cervical spine has a greater range of motion; while traversing through spine it causes vibration in the vertebrae and slight stretching of the soft tissues includes blood vessels, muscles, nerves and tendons. This study was carried out in Innovative Health Concepts hospital and research center (IHC&RC), Lahore.

The convenient sampling technique is used to collect the data of 90 patients (25-75 years) with lower back pain associated with vertebral malalignment from IHC&RC, Lahore.

Data was collected with the collaboration of IHC&RC, Lahore with the Government Sadiq College Women University (GSCWU), Bahawalpur and also with the patients. The inclusion criteria were mechanical causes of back pain such as disc and nerve related pain. Visible causes of back pain

such as infection, trauma, and tumors (organic causes) are excluded from the study. IBM SPSS version 26 was used for data analysis, entry and for graph and tabulation. This study is conducted to examine the impact of resonating sound waves will be significant in relieving lower back pain due to the vertebral malalignment. This study will have a clear impact on society as it identifies new non-invasive spinal intervention of lower back pain treatment that also ensures patient's safety.

Pulsar is a treatment device for the spine and upper cervical area. It consists of a controller positioned on top of an impulse delivery mechanism or device head, which is mounted on a moveable armature attach to a fixed stand. The device head allows three-dimensional movement. Positioned at the base of the device head is a stylus that is used to deliver sinusoidal waveforms of various frequencies and intensities, both linearly and rotationally.

Specific algorithms are designed based on the desired waveform input provided to the software. These algorithms generate a corresponding sound file. A low frequency wave ranging from 96 Hz to 101Hz, known as healing wave, is applied to one of the channels (either left or right), while simultaneously a high frequency wave ranging from 198Hz to 202Hz is sending to the other channel.

In pulsar treatment, the spine is exposed to audible range sine wave. the application of low frequency sound wave induces mechanical vibrations that lead repeated stretching and activation of surrounding soft tissues. Additionally, minor reverberations within of the vertebrae occur as a result of this treatment approach.

3. Data Analysis

A quantitative analysis was conducted to determine if there is a significance difference between the pre– and post-treatment effects on patients. Descriptive statistics such as frequencies, means and standard deviation were reported to facilitate comparison of similar data. For the analysis a 't' test was applied. The Paired-sample t-test is a statistical test used to assess whether the severity of initial self-reported low back pain differed after the treatment.

4. Results

In this study, 90 individuals with lower back pain received sound wave therapy. The patients who were considered for the study, comprising males and females of various age groups, weights, and heights that were reported experiencing various levels of pain in the IHC&RC and the ranges of the constant sound wave parameters that are given to the patients with lower back pain are enlisted in table 1. Data obtained were analyzed in IBM SPSS version 26 and after applying paired sample t-test. Mean, standard error, standard deviation values with the significant p-value were computed for all 90 patients presented in table 2. The Post treatment assessments in the paired sample test demonstrated significantly lower self-reported scores for lower back pain ($p<0.05$).

Table 1: *Demographic information of 90 patients are represented in their mean and standard deviation with significant p-values.*

	Male (n=39)	Female (n= 51)	P-Value
Age (years)	40.15±10.70	44.59±13.88	0.348
Height (cm)	169.75±8.99	168±8.93	0.813
Weight (kg)	80.54±10.92	70±9.34	0.008
BMI (kg/m^2)	25.23±1.97	26.88±2.99	0.107

Table 2: paired sample t-test

	Paired difference					t	df	Sig.(2-tailed)
	mean	Std. deviation	Std. Error Mean	95% confidence interval of the difference				
				lower	upper			
NPRS post pain rating	4.03333	1.18855	.21700	3.58952	4.47714	18.587	29	.000

This suggests that the noninvasive resonating sound wave intervention has a significant impact on lower back pain. Figure 2(A) shows the vertebral malalignment but after the resonating sound wave intervention disc spacing has been adjusted showing in figure 2(B). Figure 3 demonstrate the NPRS pain scale ratings before and after the resonating sound wave treatment that illustrates who underwent sound wave treatment had lower LBP score. After comparing pre and post NPRS pain ratings pulsar is a potentially effective treatment alternative for individuals suffering from lower back pain. A mixed waveform of 8Hz-202 Hz resonated throughout the spine, with intensities ranging from 0.3 to 1, mixed frequencies ranging from 8Hz to 202Hz. In order to affect the lumbar region, where they are also applied, sound waves are employed to activate C1.

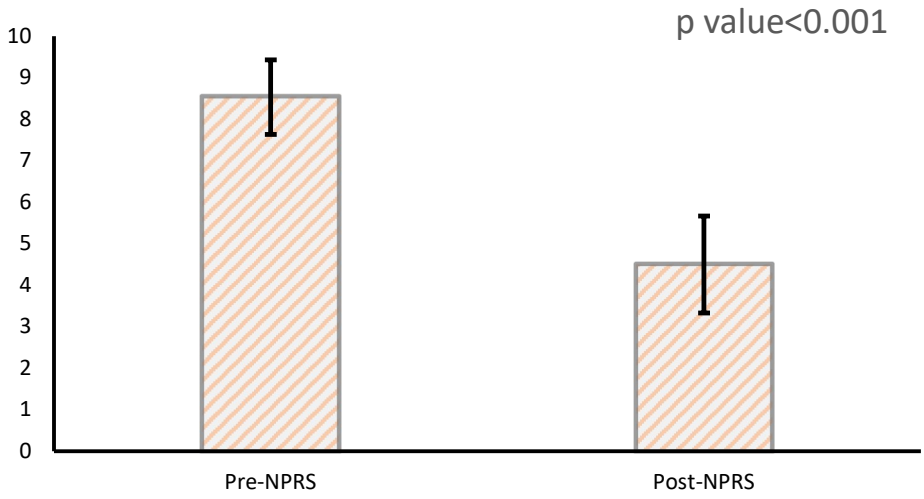

Figure 1 shows mean and standard deviation of numeric pain rating scale (n=90). P value<0.05,P value < 0.01** and P value < 0.001****.*

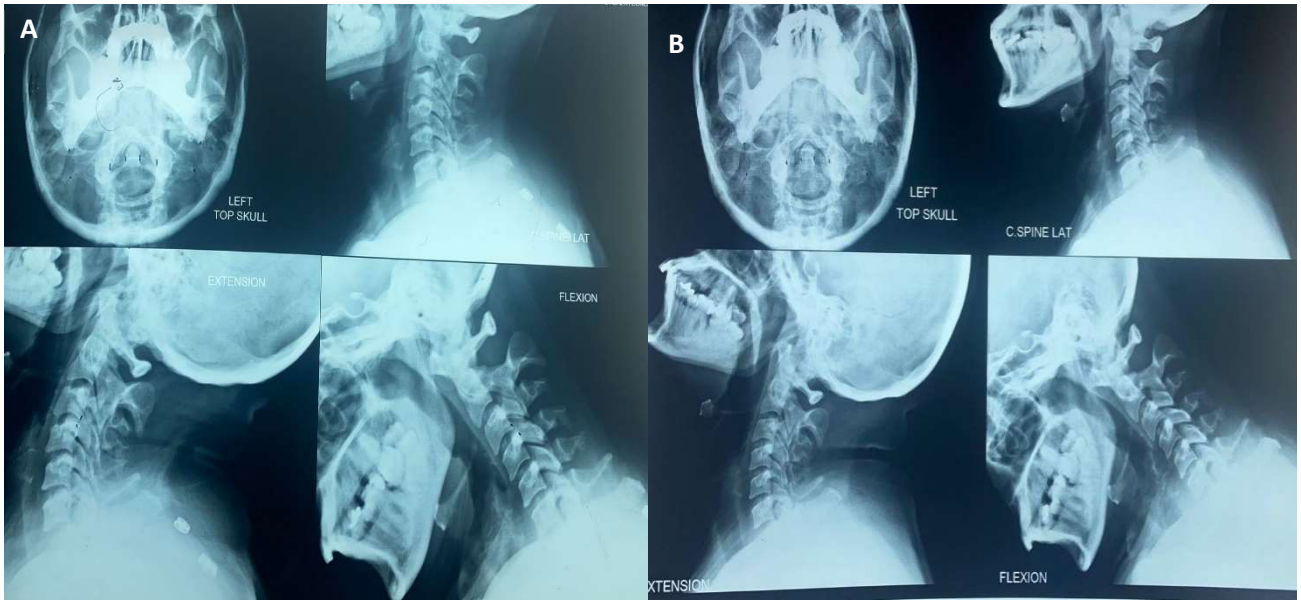

Figure 2 (A) presents Pre-Radiological Assessment and (B) shows post radiological assessment.

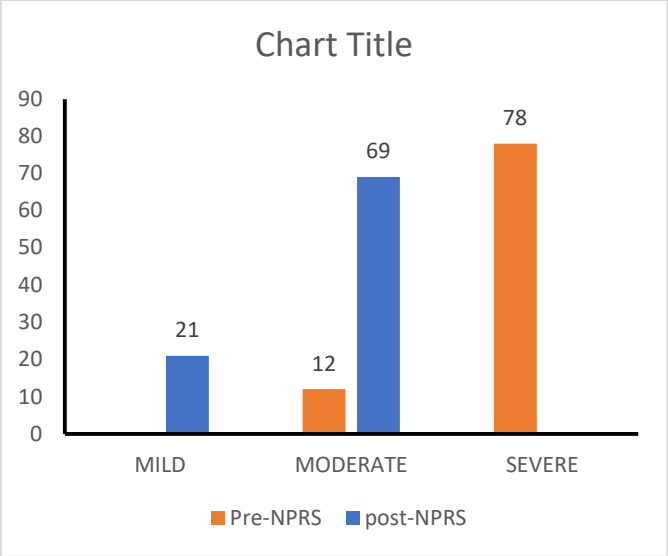

Figure 3 shows the NPRS pain scale ratings before and after the resonating sound wave treatment

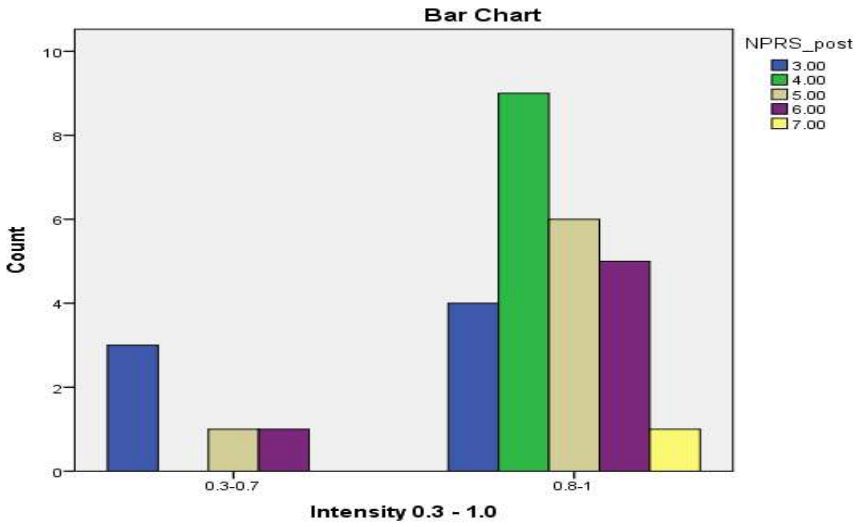

Figure 4 presents impact of intensity of sound wave on patient lower back pain

5. Discussion

The paired sample test revealed significantly decreased self-reported scores for lower back pain ($p<0.05$) in the post-treatment evaluations. This implies that resonant sound wave intervention, which is noninvasive, has a major effect on the discomfort of the back. Vibration may have beneficial or adverse effects [11]. The issue related to managing chronic back pain is a complicated that remains a major source of incapacity and efficiency loss globally [12-14]. Treatment options for chronic back pain can involve a medical, emotional, and physical therapies. In case where conventional treatments fail then there may be a need for a more drastic and permanent surgical procedure as a last resort for eligible patients [15, 16]. However, it is important to consider that surgery on the spine offers no assurance a long-standing relief from symptoms,

satisfaction of the patient or resumed regular activities. Additionally, it is linked with potential problems, under scoring a requirement for less intrusive medical care alternatives[17-19].

One such alternative is pulsar approach, which addresses the need for effective treatment options by utilizing precisely directed sound stimulation to treat patients. The current study have used pulsar to treat neck and low back pain is reliable in the light of the previously released data [10, 20-22].Following the completion of the patient's sessions, improvements were observed nearly no complaints of negative effects, in pain and disability ratings, trunk full range of movement, quality of life, sleep, and work performance. During this study finding demonstrate the significant physical impact that sound waves and rhythmically pulsing spinal activation therapy can have the non-surgical treatment of spinal disorders patients. While the use of sound wave stimulation has received less attention in the literature than repetitively pulsed electrical stimulation, it has demonstrated promising outcomes in the treatment of LBP[10, 23]. To fully comprehend the physiological changes that take place inside the spine and its supporting structure during sound wave therapy, more study is required.

The latest research on the pulsar device has demonstrated that individuals with persistent low back pain had much better pain and functional outcomes[10, 20, 22]. Several patients with chronic back and neck pain subsequently had considerable improvements in their pain ratings and decreased dependence on medication, according to one of the initial studies examining the therapeutic benefits of this device[22]. Therefore, research showed that the waves caused advantageous mechanical modifications in the vertebrae, restoring the normal alignment of the spinal column[20].

Conclusion

In conclusion, managing chronic back pain is complex, often requiring a range of therapies. Surgical interventions are a last resort with no assured long-term relief. The pulsar approach, utilizing precisely directed sound stimulation, emerges as a promising non-surgical alternative. The study shows its reliability, yielding improvements in pain, disability, range of movement, and overall quality of life. Sound wave therapy demonstrates significant potential for treating spinal disorders, necessitating further research. Recent studies on the pulsar device reveal positive outcomes, indicating its effectiveness in reducing pain and medication dependency while inducing beneficial mechanical changes in the vertebrae, restoring spinal alignment. In summary, the pulsar approach offers a promising and less invasive solution for chronic back pain, with ongoing research needed for a comprehensive understanding of its physiological effects.

Conflicts of Interest: The authors declare no conflict of interest.

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