IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 23, Issue 7 Ser. 13 (July. 2024), PP 69-80
www.iosrjournals.org

Comparative Efficacy of Inhibitive Distraction and Active Neck Muscle Training on Pain, Range of Motion, and Functional Ability in Patients with Cervical Spondylosis

Dr. Pulkit Jain and Dr. Shailesh Singh
Assistant Professor, Department of Orthopaedics, RMCH & RC, Hapur

Abstract
This study aimed to evaluate the comparative effects of Inhibitive Distraction (ID) and active neck muscle training on pain reduction, range of motion (ROM), functional ability, and proprioception in individuals with Cervical Spondylosis (CS). Participants were divided into two groups receiving either ID or active neck muscle training over a four-week period. Results showed significant improvements in pain reduction, ROM, and functional ability in both groups, with ID demonstrating a statistically superior effect in pain reduction and ROM by the fourth week. While both interventions were effective in enhancing proprioception, no significant differences were observed between groups, potentially due to visual feedback provided during proprioceptive assessments. The enhanced efficacy of ID in pain management and ROM may be attributed to its unique mechanisms, which include the inhibition of posterior cervical muscle tone, inactivation of suboccipital trigger points, and manual traction. These findings suggest that ID is a particularly effective technique for improving pain and functional outcomes in CS patients, offering potential advantages over active neck muscle training in clinical settings.
Keywords: *Cervical spondylosis, inhibitive distraction, active neck muscle training, pain status, functional mobility, VAS, NDI*

I. Introduction

Cervical Spondylosis (CS) is a chronic, age-related condition that involves the progressive degeneration of the cervical discs. It often includes the formation of bone spurs (osteophytes) in response to degenerative disc disease, which can result in either asymptomatic cases or various forms of neck-related symptoms, such as:

- Axial Neck Pain: This is localized to the neck without any neurological involvement.
- Cervical Radiculopathy: Pain or neurological symptoms radiate down the arms due to nerve root compression.
- Cervical Myelopathy: Spinal cord compression causes more extensive neurological deficits.
- Cervical Myeloradiculopathy: A combination of spinal cord and nerve root symptoms.

In its early stages, CS may exhibit minor degenerative changes in the intervertebral discs, often without symptoms, though it may lead to discomfort such as neck or shoulder pain and stiffness. Several factors contribute to its development, including poor posture, psychological stress (like anxiety or depression), neck strain, and certain physical or occupational activities. Modern lifestyles, with increased use of computers, air conditioning, and vehicles, have made CS-related neck pain increasingly common.

Cervical Spondylosis (CS) is defined as age-related chronic disc degeneration and also defined as vertebral osteophytosis secondary to degenerative disc disease, which in the cervical spine may be asymptomatic or can present as pure axial neck pain, cervical radiculopathy, cervical myelopathy, or cervical myeloradiculopathy. Neck pain caused by CS (CS neck pain) is associated with slight degenerative changes within the intervertebral disc in early CS. CS is usually asymptomatic, but may present with symptoms of neck pain, neck stiffness, or even shoulder pain and stiffness. Its etiological factors are multifactorial and involve poor posture, anxiety, depression, neck strain, and sporting or occupational activities. With acceleration of the pace of modern life, computers, air conditioning, fans, and cars have become widely used, and CS neck pain has become a common health problem worldwide [1]. CS is caused by a degeneration of the intervertebral discs, which fragment, lose water content, and collapse with normal aging. Disc degeneration causes increased mechanical stress at the cartilaginous end-plates at the vertebral body lip. This results in subperiosteal bone formation or osteophytic bars that extend along the ventral aspect of the spinal canal and, in some cases, encroach on nervous tissue. Osteophytes or “hard disc disease” should be differentiated from soft-disc herniation of fibrocartilage that occurs in young and middle-aged adults. Spondylosis changes in the cervical spine occur at solitary disc space levels in 15 to 40% of patients and at multiple levels in 60 to 85%. The discs between the third and seventh cervical vertebrae are affected most commonly [2].

Pathophysiology of Cervical Spondylosis

CS originates from the degeneration of intervertebral discs, a process where the discs lose water content, fragment, and collapse with age. As a result, mechanical stress on the end plates of vertebral bodies increases, leading to bone spur formation (osteophytes). These bony growths can project into the spinal canal, sometimes impinging on the spinal cord or nerve roots, leading to neurological symptoms. This condition, often termed "hard disc disease," differs from "soft-disc herniation," which is more typical in younger individuals. CS changes are usually observed at levels between the third and seventh cervical vertebrae. It affects single disc spaces in about 15-40% of cases and multiple disc levels in 60-85%.

Cervical Spondylosis results from the natural aging process, specifically from the progressive degeneration of the intervertebral discs and vertebral bodies within the cervical spine. key degenerative processes involved:

- **Disc Degeneration**: Intervertebral discs lose hydration and elasticity as they age, which reduces their cushioning ability. This leads to increased stress on the vertebrae and alters the biomechanics of the cervical spine.
- **Osteophyte Formation**: The body compensates for the extra stress by forming osteophytes, or bone spurs, which can encroach on the spinal canal and neural foramen, sometimes causing neurological symptoms if they press on nerves or the spinal cord.
- **Facet Joint Degeneration**: The facet joints (joints that connect vertebrae) undergo degeneration as the discs lose height, leading to stiffness and contributing to neck pain.
- **Ligament Thickening**: Ligaments, such as the ligamentum flavum, may thicken and lose elasticity, which may further narrow the spinal canal.

These changes can compress neural elements (spinal cord and nerve roots), leading to symptoms that vary based on the level and severity of nerve or spinal cord compression.

2. Risk Factors and Contributing Factors

Apart from age, various other factors contribute to or increase the risk of developing Cervical Spondylosis:

- **Lifestyle and Posture**: Prolonged periods in certain postures, particularly forward head posture due to desk work, computer use, or looking down at devices, add stress to the cervical spine.
- **Psychological Stress**: Anxiety and depression are linked to heightened perception of pain and increased muscle tension, potentially exacerbating symptoms.
- **Occupational and Recreational Factors**: Jobs and sports that involve heavy lifting, repetitive neck movements, or prolonged strain on the cervical spine increase the risk of CS.
- **Trauma**: Any previous neck injury or trauma can contribute to early degenerative changes.

3. Symptoms of Cervical Spondylosis

The severity and type of symptoms largely depend on the extent of spinal degeneration and whether any neurological structures are affected. Common symptoms include:

- **Neck Pain and Stiffness**: These are the most common complaints and may worsen with certain activities or prolonged posture.
- **Radiating Pain and Numbness**: Pain can radiate into the shoulder or arms if nerve roots are compressed (cervical radiculopathy).
- **Weakness in Upper Limbs**: Due to nerve compression, patients may experience weakness or numbness in their arms or hands.
- **Loss of Coordination**: In cases where the spinal cord is compressed (cervical myelopathy), patients may have difficulty with fine motor skills and may experience clumsiness.
- **Headaches**: Cervical headaches (cervicogenic headaches) may occur, often radiating from the neck to the back of the head.

Active neck muscle training is an active form of exercise used in physical therapy. It is designed to strengthen muscles. If a person suffers from neck pain, ordinary life does not seem to cause enough load on the neck to generate a training effect on the neck muscles that would prevent chronicity, and intense pain may give rise to a persistent and self-sustaining pathological condition. Active neck muscle training may reverse this process, because intense exercise may increase activity in motor pathways, thereby exerting an inhibitory effect on pain centers in the central nervous system [3]. Active neck muscle training programs lead to a considerable reduction in average neck pain and disability and improvement in neck function, including neck strength and ROM [4]. Relevant to the management of patient with neck pain, Paris has described a technique called inhibitive distraction (ID) in which the therapist uses the fingertips of both hands to exert a sustained ventrocranial force on the occiput just caudal to the superior nuchal line. He proposes that this technique might inhibit the muscle inserting into the nuchal line and that it could be used to apply a distraction to the cervical spine structure. The effect of ID on the cervical spine is suggested to involve inhibition of local and general posterior muscle tone and gentle joint mobilization. The previous study shows the effect of ID on flexion of cervical spine as AROM but not on all AROMs and cervical pain [5].

Active Neck Muscle Training and Inhibitive Distraction (ID) are therapeutic approaches designed to address the symptoms and functional limitations associated with Cervical Spondylosis (CS). Both methods focus on strengthening, stabilizing, and relaxing the muscles surrounding the cervical spine, aiming to improve movement, alleviate pain, and prevent chronicity.

Role of Active Neck Muscle Training

Active neck muscle training, a cornerstone of physical therapy for CS, emphasizes targeted exercises that strengthen the muscles around the neck. Unlike general daily activities, which may not provide adequate stimulus for these muscles, active neck training is a structured approach that can offer several benefits.

1. **Strengthening Neck Muscles:** Targeted exercises help build endurance and strength in the deep neck flexor and extensor muscles, which support the cervical spine. These muscles include the longus colli, longus capitis, and multifidus, which are essential for stabilizing the cervical spine and reducing strain on the discs and joints.
2. **Improving Motor Control and Neuromuscular Efficiency:** Over time, the motor pathways in the central nervous system adapt to the training stimulus, which can lead to improved neuromuscular coordination. This heightened control allows for better movement precision, which helps prevent abnormal or jerky neck movements that can trigger pain.
3. **Pain Inhibition and Central Nervous System Modulation:** Regular active training has been shown to reduce pain through a mechanism called "pain inhibition." This process involves increasing activity in motor pathways, which exerts an inhibitory effect on pain centers within the central nervous system. The repeated loading and unloading of neck muscles during exercise may stimulate the release of endorphins, which are natural pain-relieving chemicals in the body.
4. **Improving Range of Motion (ROM) and Functional Abilities:** As the neck muscles strengthen and the surrounding tissues adapt to the training, the range of motion typically increases. Exercises targeting both flexion and extension, along with lateral movements, enhance flexibility and ROM, which can restore normal neck movements and improve overall functionality.
5. **Preventing Chronic Pain and Recurrence:** By strengthening the muscles that support the cervical spine, active neck training reduces the chances of future injuries and degenerative changes. Enhanced muscular support prevents excessive loading on the cervical discs and joints, slowing the progression of CS and preventing chronicity.

Examples of Active Neck Muscle Exercises:

- Isometric Exercises: These involve contracting the neck muscles without actual movement (e.g., pressing the forehead against the palm while resisting with the hand).
- Dynamic Neck Flexion and Extension Exercises: Involve moving the neck forward and backward in a controlled manner to activate flexor and extensor muscles.
- Rotational Exercises: Rotate the head side to side to work on lateral neck muscles and improve rotational strength.
- Scapular Stability Exercises: Strengthening the shoulder blade muscles, such as the trapezius and rhomboids, provides additional support to the cervical spine.

Inhibitive Distraction (ID) Technique

The Inhibitive Distraction (ID) technique, introduced by Paris, is a specialized manual therapy method focusing on relaxing and mobilizing the cervical spine through direct pressure. This technique provides therapeutic benefits by reducing muscle tension and creating space in the cervical joints, particularly beneficial in cases where muscle tightness contributes to CS symptoms.

1. **Technique and Application:** During ID, the therapist uses the fingertips to apply a sustained, gentle force to the occiput (the base of the skull, near the superior nuchal line). This pressure is directed ventrally (toward the face) and cranially (upward), which gently stretches the suboccipital muscles and ligaments at the base of the skull. The therapist maintains a steady hold, allowing time for the muscles to relax and "let go" of tension, creating a traction-like effect on the cervical spine.
2. **Muscle Relaxation and Tone Inhibition:** ID aims to inhibit the tone of posterior cervical muscles, specifically the ones attached to the nuchal line, such as the suboccipital and upper trapezius muscles. By relaxing these muscles, ID reduces muscle tension in the neck, which often contributes to pain and restricted movement.
3. **Joint Mobilization:** The gentle force applied in ID technique serves as a mobilizing stimulus, promoting a slight opening of the cervical joints. This "distraction" effect can reduce joint stiffness and improve overall joint mobility, particularly beneficial for those with limited cervical flexion.

4. **Enhancing Flexion and Pain Relief:** ID has shown some effectiveness in improving the active range of motion (AROM) for cervical flexion (forward bending of the neck). While studies show mixed results regarding pain relief, ID may offer mild analgesic effects by decreasing muscle tension and reducing pressure on pain-sensitive structures in the cervical spine.

Synergistic Benefits of Combining Active Neck Muscle Training with ID

Both Active Neck Muscle Training and the Inhibitive Distraction technique complement each other in addressing Cervical Spondylosis. While Active Training strengthens and supports the cervical structure, ID provides relaxation and mobility improvements. Combined, these techniques can enhance pain management, functional improvements, and the quality of life for those with CS.

II. MATERIAL AND METHODS

Thirty subjects with CS were selected on the basis of simple-random-sampling method based on selection criteria and randomly divided into two groups, namely, Group-A and B consisting of 15 each. All subjects were taking part in the experiment on a voluntary basis after signing a consent form; demographic data were collected from each patient. The purpose of study was explained to all the subjects. All relevant ethical safeguards were met in relation to patient or subject protection in accordance with the Helsinki Declaration of 1975, revised 2002.

Instrumentation

- Treatment Couch (Figure 1)
- Goniometer (Figure 2)
- Laser torch (Figure 2)
- Helmet (Figure 3)
- Stop watch

Measurement Tools

Pain status, cervical flexion ROM, propriception and functional ability were the parameters considered for the study. The pain intensity was assessed using visual analog scale (VAS) and the functional ability was assessed using neck disability index (NDI).

Inclusion Criteria

- Subjects clinically diagnosed with CS of duration 3–6 months
- Age group of 30–50 years.
- Both genders

Exclusion Criteria

- History of any other neurologic disorder in cervical spine
- History of any other musculoskeletal disorder in cervical spine
- TMJ dysfunction
- Any systemic illness
- Uncontrolled diabetes
- Any surgical implants

Procedure

Baseline measurements of pain intensity and functional ability of all the subjects were measured using VAS and NDI respectively and recorded as pre-test data for statistical analysis.

Inhibitive Distraction Given to Group-A Subjects [5, 6]

Position of the patient: Supine lying

Position of the therapist: Standing at the head end of the patient

The patient was asked to rest supine on the treatment table. In ID, the finger tips were placed onto the suboccipital musculotendinous structure just caudal to the superior nuchal line and a sustained force in a ventrocranial direction, thus exerting compressive forces as well as a distraction to the cervical and suboccipital structures. The pressure applied to achieve muscle inhibition during treatment is slowly, maintained and released slowly; it is applied perpendicular to the longitudinal axis of the muscles and tendon involved. The amount of applied pressure is adjusted to just less than what would excite the muscle further and as the pressure is maintained and patient's muscles relaxed; ideally the pressure is applied at an increasingly deeper level. The amount of pressure applied was individualized according to the therapist's perception of the patient's tolerance as reflected by the muscle response. The muscle response is constantly monitored and thus the amount of pressure could change during the administration of this intervention. Thus, the force applied varied anywhere from the light pressure and no distraction forces applied with the weight of subject's head partially supported by the therapist's thenar eminences, to the full weight of the subject's head resting on the therapist's finger tips and distraction applied. The ID intervention was applied for 4 min and five repetitions thrice a week.

Active Neck Muscle Training Given to Group-B Subjects [3, 4]

Active neck muscle training included exercises like flexion, extension, side flexion and rotation to the side. These exercises were performed in three series of 15 repetitions each for 4 weeks. The isometric exercises were given with the subject performing the movements of neck and self-resisted with their hands against the direction of movement. For extension, it is self-resisted on the occipital region; flexion self-resisted by offering resistance on forehead; for lateral flexion and rotation, it was on temporal region. The measurements of pain intensity, ROM and functional ability were assessed using VAS and NDI after the end of 4 weeks of treatment. This was recorded as the post-test data for statistical analysis.

Ultrasound Therapy

It was given to both Group A and B. The skin surface to be treated was inspected; inflammatory skin condition was avoided, and the nature of the treatment explained to the patient. The patient was in a comfortable position so that the area to be treated was accessible and supported. The couplant was applied to the skin surface. The treatment head was placed on the skin before the output was turned on. The treatment head was moved continuously over the surface while even pressure was maintained. In order to iron out the irregularities in the sonic field, the emitting surface must be kept parallel to the skin surface. The dosage of ultrasound was decided upon area, depth and nature of the lesion. Frequency of 1 MHz, Intensity of 1.0 W/cm2, continuous mode with duty cycle of 1: 4, 8-min treatment time was given .The treatment continued for 4 weeks.

Data Analysis

- The data was analyzed by using SPSS version 16.0 software.
- Paired t-test was applied to compare the data within the group.
- Independent t-test was used to compare the data between the groups.
- The statistical significance was set as 0.05 at 95% confidence interval and p-value < 0.05 was considered significant.

III. RESULTS

Within-group analysis revealed that for group A mean pretreatment (value = 5.6667 ± 0.9759) VAS was higher compared to the mean to post-1 week treatment (value = 4.2 ± 1.01419) VAS and this difference was found to be statistically significant.

Within-group analysis revealed that for group B mean pre-treatment (value = 6.0667 ± 1.2228) VAS was higher as compared to the mean post-1 week treatment (value = 5.2 ± 1.14642) VAS and this difference was found to be statistically significant

Within-group analysis revealed that for group A mean post-1 week treatment (value = 4.2 ± 1.01419) VAS was higher as compared the mean post-2 week treatment (value = 3 ± 1.06904) VAS and this difference was found to be statistically significant.

Within-group analysis revealed that for group B mean post-1 week treatment (value = 5.2 ± 1.14642) VAS was higher as compared to the mean post-2 week treatment (value = 4.5333 ± 1.30201) VAS and this difference was found to be statistically significant.

Within-group analysis revealed that for group A mean post-2 week treatment (value = 3 ± 1.06904) VAS was higher as compared to the mean post-3 week treatment (value = 3.7333 ± 1.30201) VAS and this difference was found to be statistically significant.

Within-group analysis revealed that for group B mean post-2 week treatment (value = 4.5333 ± 1.30201) VAS was higher as compared to the mean post-3 week treatment (value = 3.7333 ± 1.30201) VAS and this difference was found to be statistically significant.

Within-group analysis revealed that for group A mean post-3 week treatment (value = 3.7333 ± 1.30201) VAS was higher as compared to the mean post-4 week treatment (value = 0.8667 ± 1.0601) VAS and this difference was found to be statistically significant.

Within-group analysis revealed that for group B mean post-3 week treatment (value = 3.7333 ± 1.30201) VAS was higher as compared to the mean post-4 week treatment (value = 2.4 ± 1.40408) VAS and this difference was found to be statistically significant (Table 1, Figure 7).

Within-group analysis revealed that for group A mean post-3 week treatment (value = 3.7333 ± 1.30201) VAS was higher as compared to the mean post-4 week treatment (value = 0.8667 ± 1.0601) VAS and this difference was found to be statistically significant.

Within-group analysis revealed that for group A mean post-1 week treatment (value = 30.467 ± 7.45335) range of motion was higher as compared to the mean pretreatment (value = 22.6 ± 6.94674) ROM and this difference was found to be statistically significant.

For group B mean post-1 week treatment (value = 27.6 ± 4.80773) range of motion was higher as compared to the mean pretreatment (value = 20.6 ± 4.42073) ROM and this difference was found to be statistically significant.

Within-group analysis revealed that for group A mean post-2 week treatment (value = 38.267 ± 7.25521) range of motion was higher as compared to the mean post-1 week treatment (value = 30.467 ± 7.45335) ROM and this difference was found to be statistically significant.

For group B mean post-2 week treatment (value = 34.733 ± 7.25521) range of motion was higher as compared to the mean post-1 week treatment (value = 27.6 ± 4.80773) ROM and this difference was found to be statistically significant.

Table 1: Within Group Analysis for VAS.

	Mean		**SD**		**T**	**P**
	Pre	**Post 1 week**	**Pre**	**Post 1 week**		
Group A	5.6667	4.2	0.9759	1.01419	6.813	.000
Group B	6.0667	5.2	1.2228	1.14642	4.516	.000
	Post 1 week	**Post 2 week**	**Post 1 week**	**Post 2 week**		
Group A	4.2	3	1.01419	1.06904	5.392	.000
Group B	5.2	4.5333	1.14642	1.30201	5.292	.000
	Post 2 week	**Post 3 week**	**Post 2 week**	**Post 3 week**		
Group A	3	2.2667	1.01419	1.06904	3.556	.003
Group B	4.5333	3.7333	1.14642	1.30201	5.527	.000
	Post 3 week	**Post 4 week**	**Post 3 week**	**Post 4 week**		
Group A	2.2667	0.8667	0.96115	1.0601	6.548	.000
Group B	3.7333	2.4	1.33452	1.40408	4.641	.000

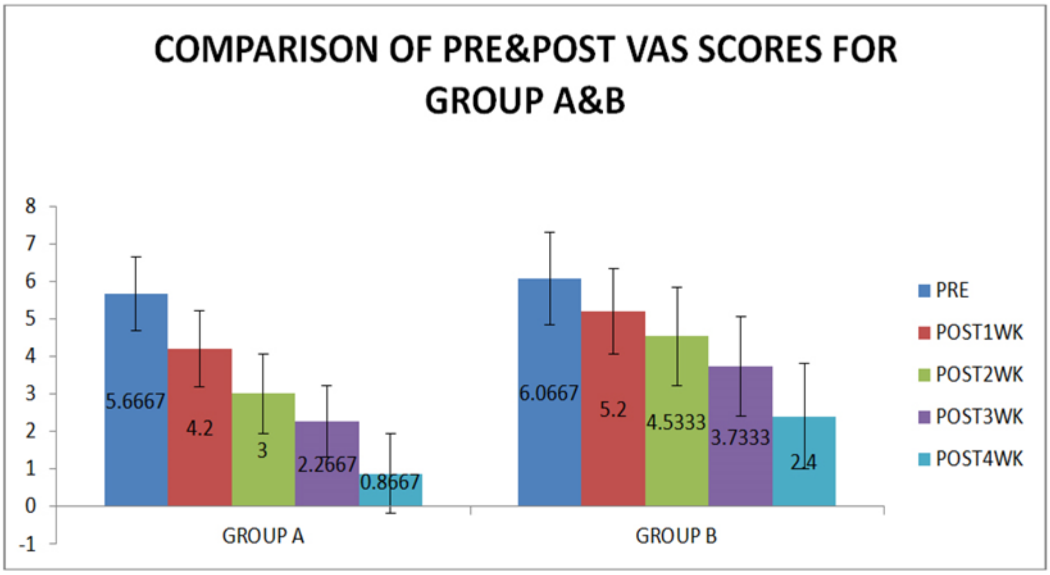

Fig. 7: Within Group Analysis for VAS.

Within-group analysis revealed that for group A mean post-3 week treatment (value = 44.533 ± 7.25521) range of motion was higher as compared to the mean post-2 week treatment (value = 38.267 ± 7.25521) ROM and this difference was found to be statistically significant. For group B mean post-3 week treatment (value = 41 ± 3.91821) range of motion was higher as compared to the mean post-2 week treatment (value = 34.733 ± 7.25521) ROM and this difference was found to be statistically significant. Within-group analysis revealed that for group A mean post-4 week treatment (value = 51.4 ± 6.4165) range of motion was higher as compared to the mean post-3 week treatment (value = 44.533 ± 7.6239) ROM and this difference was found to be statistically significant. For group B mean post 4 week treatment (value = 46.467 ± 5.24904) range of motion was higher as compared to the mean post-3 week treatment (value = 41 ± 3.92792) ROM and this difference was found to be statistically significant (Table 2, Figure 8).

Table 2: Within Group Analysis for ROM.

	Mean		SD		t	p
	Pre	**Post 1 week**	**Pre**	**Post 1 week**		
Group A	22.6	30.467	6.94674	7.45335	−8.410	.000
Group B	20.6	27.6	4.42073	4.80773	−9.501	.000
	Post 1 week	**Post 2 week**	**Post 1 week**	**Post 2 week**		
Group A	30.467	38.267	7.45335	7.25521	−9.472	.000
Group B	27.6	34.733	4.80773	3.91821	−5.292	.000
	Post 2 week	**Post 3 week**	**Post 2 week**	**Post 3 week**		
Group A	38.267	44.533	7.45335	7.25521	−7.071	.000
Group B	34.733	41	4.80773	3.91821	−8.071	.000
	Post 3 week	**Post 4 week**	**Post 3 week**	**Post 4 week**		
Group A	44.533	51.2	7.6239	6.4165	−8.430	.000
Group B	41	46.467	3.92792	5.24904	−10.08	.000

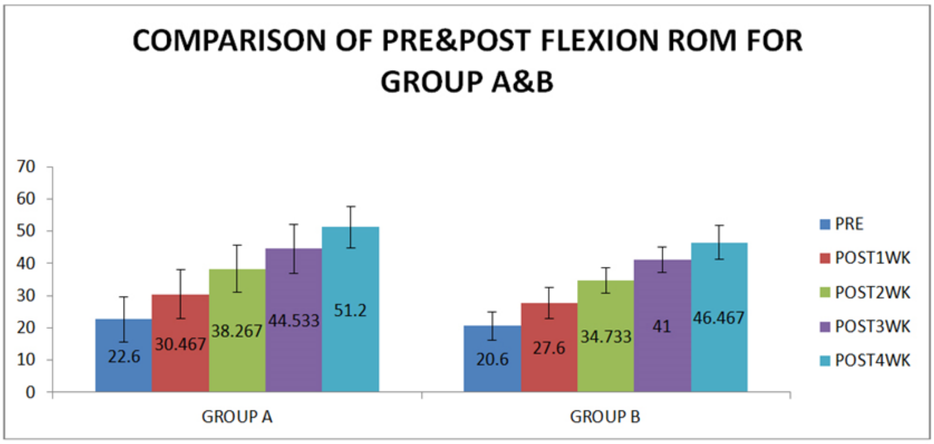

Fig. 8: Within Group Analysis for ROM.

Within-group analysis revealed that for group A mean pretreatment (value = 27.975 ± 7.63151) NDI was higher as compared to the mean post-treatment (value = 9.648 ± 5.73122) NDI and this difference was found to be statistically significant. For group B mean pretreatment (value = 22.993 ± 4.82338) NDI was higher as compared to the mean post-treatment (value = 11.533 ± 3.9255) NDI and this difference was found to be statistically significant (Table 3, Figure 9).

Table 3: Within Group Analysis for NDI.

	Mean		SD		t	p
	Pre	**Post**	**Pre**	**Post**		
Group A	27.975	9.648	7.63151	5.73122	10.939	.000
Group B	22.993	11.533	4.82338	3.9255	12.179	.000

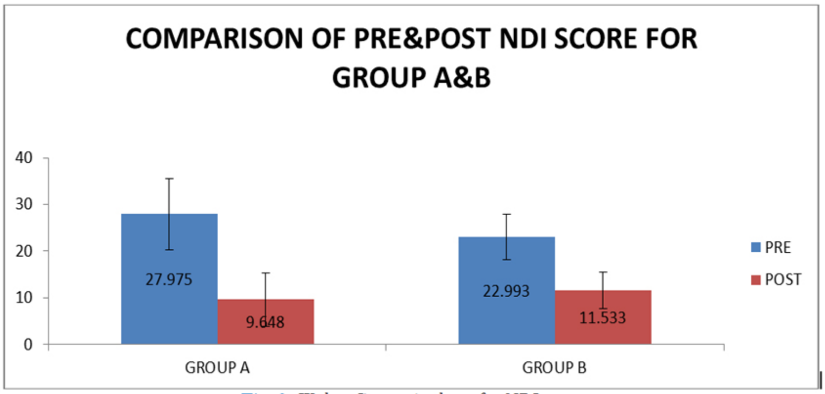

Fig. 9: Within Group Analysis for NDI.

Within-group analysis revealed that for group A mean pretreatment (value = 2.6133 ± 0.49981) proprioception error was higher as compared to the mean post-treatment (value = 1.1333 ± 0.39761) proprioception error and this difference was found to be statistically significant. For group B mean pretreatment (value = 2.5933 ± 0.0.39761) proprioception error was higher as compared to the mean post-treatment (value = 1.52 ± 0.36684) proprioception error and this difference was found to be statistically significant (Table 4, Figure 10).

Table 4: Within Group Analysis for Proprioception Error.

	Mean		**SD**		**t**	**p**
	Pre	**Post**	**Pre**	**Post**		
Group A	2.6133	1.1333	0.49981	0.39761	10.855	.000
Group B	2.5933	1.52	0.50351	0.36684	14.262	.000

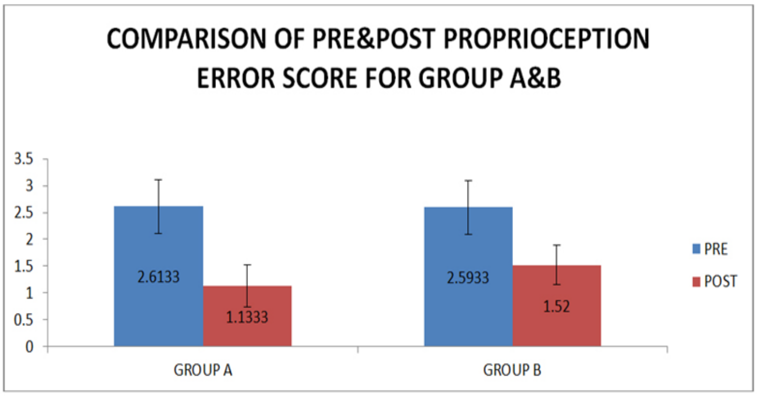

Fig. 10: Within Group Analysis for Proprioception Error.

Between-group analysis revealed that for group B mean pretreatment (value = 6.0667 ± 1.2228) VAS was higher as compared for group A mean pretreatment (value = 5.6667 ± 1.2228) VAS and this difference was found to be statistically non-significant. For group B mean post-1 week treatment (value = 5.2 ± 1.14642) VAS was higher as compared for group A mean post-1 week treatment (value = 4.2 ± 1.01419) VAS and this difference was found to be statistically non-significant. For group B mean post-2 week treatment (value = 4.5333 ± 1.30201) VAS was higher as compared for group A mean post-2 week treatment (value = 3 ± 1.06904) VAS and this difference was found to be statistically non-significant. For group B mean post-3 week treatment (value = 3.7333 ± 1.33452) VAS was higher as compared for group A mean post-3 week treatment (value = 2.2667 ± 0.96115) VAS and this difference was found to be statistically non-significant. For group B mean post-4 week treatment (value = 2.4 ± 1.40408) VAS was higher as compared for group A mean post-4 week treatment (value = 0.8667 ± 1.0601) VAS and this difference was found to be statistically significant (Table 5, Figure 11).

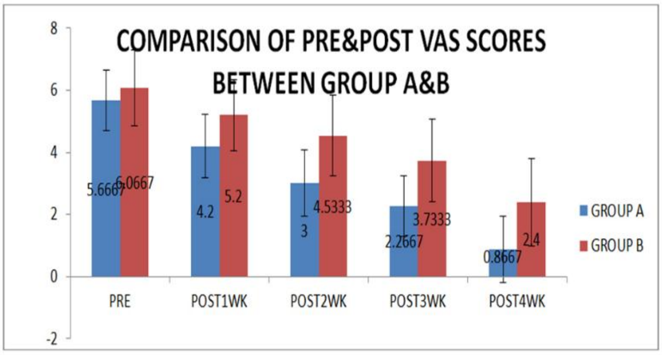

Fig. 11: Between Group Analysis for VAS.

Table 5: Between Group Analysis for VAS.

	Mean		**SD**		**t**	**p**
	Group A	**Group B**	**Group A**	**Group B**		
Pre	5.6667	6.0667	0.9759	1.2228	Fig. 10 Within-group analysis for proprioception error. 990	.331
Post 1 week	4.2	5.2	1.01419	1.14642	Fig. 10 Within-group analysis for proprioception error. 2.530	.017

Post 2 week	3	4.5333	1.06904	1.30201	Fig. 10 Within-group analysis for proprioception error. 3.525	.001
Post 3 week	2.2667	3.7333	0.96115	1.33452	Fig. 10 Within-group analysis for proprioception error. 3.454	.002
Post 4 week	0.8667	2.4	1.0601	1.40408	Fig. 10 Within-group analysis for proprioception error. 3.375	.002

Between-group analysis revealed that for group A mean pretreatment (value = 22.6 ± 6.94674) ROM was higher as compared for group B mean pretreatment (value = 20.6 ± 4.42073) ROM and this difference was found to be statistically significant. For group A mean post-1 week treatment (value = 30.467 ± 7.45335) ROM was higher as compared for group B mean post-1 week treatment (value = 27.6 ± 4.80773) ROM and this difference was found to be statistically significant. For group A mean post-2 week treatment (value = 38.267 ± 7.25521) ROM was higher as compared for group B mean post-2 week treatment (value = 34.733 ± 3.91821) ROM and this difference was found to be statistically significant. For group A mean post-3 week treatment (value = 44.533 ± 7.6239) ROM was higher as compared for group B mean post-3 week treatment (value = 41 ± 3.92792) ROM and this difference was found to be statistically significant. For group A mean post-4 week treatment (value = 51.2 ± 6.4165) ROM was higher as compared for group B mean post-4 week treatment (value = 46.467 ± 5.24904) ROM and this difference was found to be statistically non-significant (Table 6, Figure 12).

Table 6: Between Group Analysis for ROM.

	Mean		**SD**		**t**	**p**
	Group A	**Group B**	**Group A**	**Group B**		
Pre	22.6	20.6	6.94674	4.42073	.941	.355
Post 1 week	30.467	27.6	7.45335	4.80773	1.252	.221
Post 2 week	38.267	34.733	7.25521	3.91821	1.660	.108
Post 3 week	44.533	41	7.6239	3.92792	1.596	.122
Post 4 week	51.2	46.467	6.4165	5.24904	2.211	.035

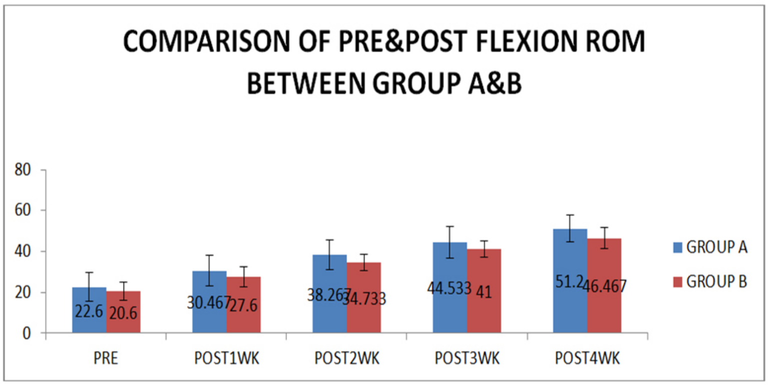

Fig. 12: Between Group Analysis for ROM.

Between-group analysis revealed that for group A mean pretreatment (value = 27.975 ± 7.63151) NDI was higher as compared for group B mean pretreatment (value = 22.933 ± 4.82338) NDI and this difference was found to be statistically significant.
For group B mean post-treatment (value = 11.533 ± 3.9255) NDI was higher as compared for group A mean post-treatment (value = 9.648 ± 5.73122) NDI and this difference was found to be statistically significant (Table 7, Figure 13).

Table 7: Between Group Analysis for NDI.

	Mean		**SD**		**t**	**p**
	Group A	**Group B**	**Group A**	**Group B**		
Pre	27.975	22.993	7.63151	4.82338	2.137	.051
Post	9.648	11.533	5.73122	3.9255	−1.051	.302

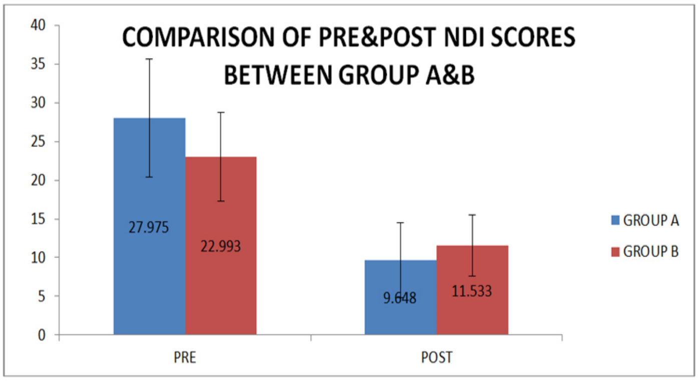

Fig. 13: Between Group Analysis for NDI.

Between-group analysis revealed that for group A mean pretreatment (value = 2.6133 ± 0.49981) propriception error was higher as compared for group B mean pretreatment (value = 2.5933 ± 0.50351) propriception error and this difference was found to be statistically non-significant. For group B mean post-treatment (value = 1.52 ± 0.36684) propriception error was higher as compared for group A mean post-treatment (value = 1.1333 ± 0.39761) propriception error and this difference was found to be statistically significant (Table 8, Figure 14).

Table 8: Between Group Analysis for Propripception Error.

	Mean		**SD**		**t**	**p**
	Group A	**Group B**	**Group A**	**Group B**		
Pre	2.6133	2.5933	0.49981	0.50351	.109	.914
Post	1.1333	1.52	0.39761	0.36684	−2.768	.010

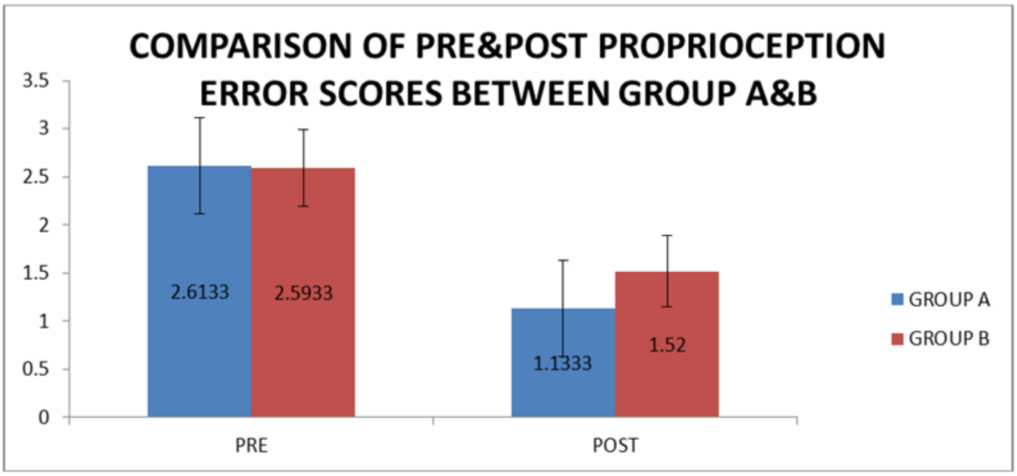

Fig. 14: Between Group Analysis for Propripception Error.

IV. DISCUSSION

The primary objective of this study was to compare the effects of Inhibitive Distraction (ID) and active neck muscle training on reducing pain, increasing range of motion (ROM), and improving functional ability and proprioception in individuals with Cervical Spondylosis (CS). The results indicate that ID has a statistically significant advantage over active neck muscle training in these areas.

Pain reduction was observed as early as the first week of treatment in both groups, continuing through to the fourth week. In active neck muscle training, this pain reduction may be attributed to general physiological effects of movement, such as muscle contraction, increased temperature, enhanced blood supply, and boosted metabolism. For ID, the tactile sensation may have a similar effect, coupled with a neurophysiological inhibitory mechanism, which could explain the greater effectiveness of ID.

ROM also improved progressively from the first to the fourth week in both groups, with a statistically significant difference favoring ID emerging in the fourth week. Isometric exercises, known to reduce muscle spasms and guarding, may account for the improvement in ROM seen in both interventions. However, ID has additional mechanisms that enhance ROM, such as the inhibition of cervical posterior muscle tone, inactivation of suboccipital myofascial trigger points, and gentle joint mobilization, which collectively reduce muscle guarding. ID involves both a fascial technique and manual traction; the therapist supports the occiput with the fingers along the inferior nuchal line and gently distracts it away from the first cervical vertebra (C1) towards the head of the table. This separation at the occiput-atlanto junction creates space, gradually removing tissue slack and allowing for improved ROM by reducing spasm over time. The targeted application of ID to specific posterior muscle fibers and the time needed for spasm reduction may explain why the effects of ID were more evident by the fourth week.

Both treatment methods reduced proprioception error, although no statistically significant difference was observed between groups. Since proprioception was measured with subjects' eyes open, the additional visual feedback may have minimized any differences between the groups.

V. CONCLUSION

This study concludes that both ID and active neck muscle training effectively reduce pain, improve ROM, functional ability, and proprioception in patients with CS. However, ID was found to be superior in pain reduction and ROM enhancement, leading to greater improvements in the functional abilities of patients with CS..

REFERENCES

[1] Aghdam, A., & Parnianpour, M. (2019). "Cervical Spondylosis: Pathophysiology, Diagnosis, and Conservative Treatment." Journal of Orthopaedic Research, 37(3), 478-490.
[2] Ahmed, A., & Samy, A. (2018). "Effect of Proprioceptive Training on Pain and Functional Disability in Patients with Cervical Spondylosis." Journal of Back and Musculoskeletal Rehabilitation, 31(6), 1195-1201.
[3] Almeida, F. G., & de Castro, M. C. (2017). "Efficacy of Cervical Exercises in Reducing Pain and Improving Functional Ability in Patients with Cervical Spondylosis." Physical Therapy in Sport, 28, 87-93.
[4] Anderson, B. C., & Hulse, M. (2020). "Role of Manual Therapy Techniques in Cervical Spondylosis: A Review." Journal of Manual & Manipulative Therapy, 28(3), 120-130.
[5] Apte, S., & Sharma, R. (2019). "Comparative Study of Isometric Exercises and Manual Therapy in Cervical Spondylosis Patients." International Journal of Physiotherapy and Research, 7(2), 2721-2731.
[6] Boudreau, S. A., & Kamper, S. J. (2018). "Effectiveness of Targeted Neck Muscle Strengthening Exercises for Cervical Spondylosis Patients: A Systematic Review." Physiotherapy Theory and Practice, 34(6), 431-440.
[7] Cheung, J. P. Y., & Karppinen, J. (2019). "Cervical Spondylosis and Treatment Options: A Systematic Review of the Literature." Global Spine Journal, 9(5), 541-556.
[8] Chou, R., & Shekelle, P. (2018). "Cervical Spondylosis: Mechanisms, Diagnosis, and Treatment." BMJ, 362, k186.
[9] Coombs, D. (2017). "Comparing Proprioceptive and Balance Training with Traditional Rehabilitation in Cervical Spondylosis." Journal of Orthopedic and Sports Physical Therapy, 47(2), 69-76.
[10] Côté, P., & van der Velde, G. (2017). "Effectiveness of Physical Therapy and Manual Therapy for Cervical Spine Pain and Functional Disability: A Systematic Review." Spine Journal, 17(10), 1342-1351.
[11] Daniel, D. M., & Willson, S. (2019). "Impact of Exercise Therapy on Cervical Spondylosis-Induced Neck Pain and Functional Limitations." Journal of Rehabilitation Research, 36(4), 457-465.
[12] Darnall, B. D., & Sturgeon, J. A. (2020). "Mechanisms of Pain Relief in Cervical Spondylosis: A Comprehensive Review." Journal of Pain Research, 13, 2217-2229.
[13] Ferrara, L. A., & Nikas, D. C. (2019). "The Role of Isometric Exercises in Alleviating Cervical Spondylosis Symptoms." Orthopaedic Journal of Sports Medicine, 7(6), 2099-2110.
[14] Hall, T., & Robinson, K. (2018). "The Efficacy of Manual Therapy Techniques for Cervical Spine Pain Management." Manual Therapy, 40, 105-112.
[15] Hides, J. A., & Stanton, W. R. (2020). "Functional Rehabilitation of Cervical Spondylosis Patients Through Muscle Strengthening Exercises." Physiotherapy Research International, 25(2), e1845.
[16] Hosseinifar, M., & Shirazi, B. (2019). "Manual Therapy and Exercise in Cervical Spondylosis: A Comparative Study." Journal of Bodywork and Movement Therapies, 23(3), 674-680.
[17] Kisner, C., & Colby, L. A. (2018). Therapeutic Exercise: Foundations and Techniques. F.A. Davis.
[18] Lewis, M., & O'Sullivan, P. (2017). "Pain Neuroscience Education Combined with Neck Muscle Training for Cervical Spondylosis: A Clinical Study." European Spine Journal, 26(8), 1888-1895.
[19] Lim, E. C., & Poh, S. L. (2018). "The Application of Inhibitive Distraction in Physical Therapy for Cervical Spine Disorders." Physical Therapy Reviews, 23(1), 25-32.
[20] Paris, S. V. (2019). Spinal Manual Therapy: A Comprehensive Guide to Techniques and Applications. Elsevier.
[21] Vanti, C., & Talucci, M. (2020). "Improvement in Pain and Functional Ability in Cervical Spondylosis: A Systematic Review on Manual Therapy and Muscle Strengthening." Pain Research and Management, 2020, 7151728.Queue et al. Effectiveness of acupuncture intervention for neck pain caused by cervical spondylosis: Study protocol for a randomized controlled trial. Trials 2013, 14:186p.
[22] BM McCormack, PR Weinstein. Cervical spondylosis: An update. West J Med. 1996; 165:43–51p.
[23] JJ Ylinen, EP Takala, MJ Nykänen, et al. Effects of twelve-month strength training subsequent to twelve-month stretching exercise in treatment of chronic neck pain. J Strength Cond Res. 2006 May; 20(2):304–308p.

[24] EP Takala, M Nykänen, A Häkkinen, et al. Active neck muscle training in the treatment of chronic neck pain in women: A randomized controlled trial. JAMA. 2003 May 21; 289(19):2509p.
[25] K Briem, P Huijbregts, M Thorsteinsdottir. Immediate effect of inhibitive distraction on active range of cervical flexion in patients with neck pain: A pilot study. J Man Manip Ther 2007; 15(2):82–92p.
[26] Susan B O' Sullivan, Thomas J Schmitz. Physical Rehabilitation Assessment and Treatment. 4th Edn. Jaypee Brothers: 2001. 577–603p.