EFFECTIVENESS OF MICROCURRENTS ON CERVICAL PAIN AND RANGE OF MOTION

Abbreviations

NP- Neck Pain

MENS- Microcurrent Neuromuscular Stimulation

TENS- Transcutaneous Electrcal Nerves Stimulation

MCT- Microcurrent Therapy

CROM- Cervical Range of Motion

IETP- Isometric Exercise Training Program

DOMS- Delayed Onset of Muscle Soreness

VAS- Verbal Analogue Scale

NDI- Neck Disability Index

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Cervical pain more commonly known as Neck pain (NP) is a common musculoskeletal pain disorder,[1, 2] with two-third of the population having cervical pain at some point in their lives[3]. Cervical pain affects about 330 million people globally as of 2010 (4.9% of the population). It is more common in women (5.7%) than men (3.9%). It is second most common to low back pain.[4] Sore neck has been a common problem among a large section of today`s population.

The factors contributing to increasing cervical pain are modern sedentary lifestyle, prolonged sitting and incorrect, fixed or constrained working postures due to desk jobs, use of more gadgets, inactive living and long working hours. This will bring to mechanical disorders of the cervical spine structures leading to muscular tightness in both the neck and upper back, and pinching of the nerves emanating from the cervical vertebrae.[5] Joint or muscle problems in the neck causes neck pain, upper back or upper extremity pain. It is usually diagnosed by physical examination, special orthopedic tests, X-rays, and MRI.[6]

The common symptoms of localized or radicular pain are tenderness, spasm, associated with functional disability. The main symptom is pain. The sensation of soreness comprises increased muscle tension in the back of the neck, palpable neck stiffness, reduced neck movement and vegetative disturbances in the region of the head and the upper extremities (headache, dizziness, fatigue).[8] Cervical pain disorders affect both physical and psychological function and can have negative impact on everyday life activities in terms of limiting functional mobility, thus reducing the quality of life.[9] Cervical pain and its associated disability are a tremendous financial burden to most industrialized nations.[7]

Cervical pain can be managed by conservative means including, medication, interventional pain management techniques, physical therapy and surgery. Physical therapy plays an important role in the conservative management of cervical pain.[10] The conservative physical therapy management includes; stabilization exercises, flexibility, muscle strengthening, mobilization, manipulation, mechanical traction procedures, and electrotherapy.[11]
Various electrotherapy modalities have been used for reducing pain and increasing cervical range of motion like TENS, ultrasound, short wave diathermy.

Microcurrent electrical neuromuscular stimulation (MENS) is a sub-sensory modality that employs current intensities between 1 and 600μA. It uses current in the micro ampere range, 1000 times less than that of TENS and below sensation threshold. The pulse width, or length of time that the current is delivered with a micro current device is much longer than previous technologies. A typical micro current pulse is about 0.5 seconds, which is 2500 times longer than the pulse in a typical TENS unit and a good micro current unit has approximately ten times better the electronic circuitry.

Reports on the effectiveness of microcurrent therapy (MCT) in the management of pain are promising and, as such, MCT may offer a new non-pharmacologic approach which, to knowledge, has not been applied to cervical pain.

Frequency **S**pecific **M**icrocurrent is a machine that transmits micro currents (millionths of an Ampere) to specific tissue parts. Studies have demonstrated that the body uses these frequencies naturally when repairing and growing its new cells (increases ATP by 500%). Microcurrent therapy, which is used from one to usually 600 uA clinically, is the modality of choice for increased tissue healing. Other effects are decreased inflammation, edema, wound healing and increased physical endurance in sports by increasing the creation of adenosine triphosphate (ATP) and proteins that facilitate healing. [1]

Literature Review will be mentioned in order:

- Cervical Pain
- Microcurrents and its use in Rehabilitation
- Summary

CERVICAL PAIN:

Cervical pain is a common disorder characterized by pain, ache or soreness experienced in a region between the inferior margin of the occiput and the first thoracic vertabra.[12]

Mechanical neck pain is one of the most common neck disorders. The source of pain may arise from many structures within the cervical spine and can develop into chronic pain.[13] Mechanical neck pain has often been defined as pain in the area between the neck and shoulder regions, where neck movement or palpation of the cervical region could provoke symptoms.[14]

PHYSIOLOGY OF CERVICAL PAIN:

Cervical pain may arise due to bad postural, muscular tightness in both the neck and upper back, and pinching of the nerves emanating from the cervical vertebrae.[16] Joints or muscles problems in the neck causes neck pain, upper back or upper extremity. It is usually diagnosed by physical examination, special orthopedic tests, X-rays, and MRI.[15]

Sore neck has been a common problem among a large section of today`s population. The factors contributing to this issue include the modern lifestyle, prolonged sitting and incorrect, fixed or constrained working postures. The root of these difficulties is found in the mechanical disorders of the cervical spine structures, poor body posture and jerky body movements.[17]

Since majority of the population today is sitting for longer periods and as aging progresses, kyphosis in the thoracic vertebra has been increasing[18]; this result' s in rounded shoulders and a decrease in thoracic cavity and vital lung capacity[19]. In addition, this slouched posture puts the upper and lower cervical spine into a relative tension state while forwardly inclining the lower part of the cervical spine[9]. A sustained forward-bending posture in the cervical spine could increase the load around the tissues near the neck[20], as well as the activities of muscles near the neck; additionally, the load increase in the assistant muscles and joints becomes a main cause of chronic pain near the neck and shoulder areas[21].

Neck pain can be managed by conservative means including, medication interventional pain management techniques, and surgery. Physical therapy is an important component of conservative management of neck pain and post surgical rehabilitation after neck surgeries.[22]

The conservative physical therapy management includes; muscle strengthening, flexibility, and stabilization exercises, mobilization, manipulation, -mechanical traction procedures and electrotherapy.[23]

Treatment for Cervical Pain:

Massage and exercise are excellent for improving muscle activity and flexibility. The combination of massage and home exercise treatment programs helps to ensure continuous improvement of patient symptoms, hence reducing the pain.[24, 25]

A study conducted by Rungthip P, Thavatchai S, et all suggest that both single-level and multiple-level thoracic manipulation improve neck disability, pain levels, and Cervical Range of Motion(CROM) at 24-hour and 1-week follow-up in patients with Chronic Mechanical Neck Pain (CMNP).[14]

Patients with non-specific neck pain treated with sustained natural apophyseal glides (SNAGs) manual physical therapy techniques and followed by Isometric Exercise Training Program (IETP) -was more effective in reduction of pain and enhancement of function, as compared to those patients treated with SNAGs manual physical therapy techniques alone.[23]

Proper physical therapy program can help the patients with Cervical Syndrome and neck pain return to their normal everyday activities, improve their quality of life, as well as reduce the absence from work.[17]

Acupuncture is found to be more beneficial relative to sham acupuncture [28-31] or sham laser or TENS [32-35] and a wait list or no treatment [36] for pain reduction in the short term in patients with chronic mechanical neck disorder.

Intermittent traction when compared to no treatment or placebo [37, 38] for chronic mechanical neck disorder, neck disorder with radiculopathy or degenerative changes showed reduced pain in the short term.

Laser (830nm or 904nm) was shown to be better than placebo [39-43] for chronic neck pain, in reducing pain and improving function, global perceived effect and quality of life immediately post treatment and at intermediate (approximately six months) follow-up.

Continuous ultrasound was better than a control immediately post treatment and in the short term [44, 45] for myofascial pain. High-powered pain threshold with the probe placed over the trigger point and held motionless was more beneficial than conventional ultrasound [45] for myofascial pain immediately post treatment.

Effect of TENS on Cervical Pain:

There was no benefit when TENS was compared to placebo [46] for reducing pain in patients with chronic mechanical neck disorder immediately post treatment. TENS didn't have any effect when combined to other treatments (infrared, hotpack/exercise, collar/exercise/analgesic, and standard physiotherapy of ice/home exercise/advice)[48, 49,50, 51] for various disorder types and various follow-up periods in very small trials. There was no difference when TENS was compared to manual therapy[51, 52] or ultrasound [47] for reducing subacute/chronic neck pain immediately post treatment. Also, when different parameters of TENS were compared to each other the results were similar for pain at short term follow-up. [53]

MICROCURRENTS:

Frequency Specific Microcurrent as the name suggests sends microcurrents to the designated tissue parts of the body. It has been clinically proven that the body is able to use these currents for repairing and growing its new cells. Thus Microcurrent becomes the modality of choice where tissue healing is required as it can increase ATP by 500%, using the currents from 1 to 600µA.[54]

Microcurrent stimulation plays a role in restoring cells or facilitating healing by increasing the creation of adenosine triphosphate (ATP) and proteins, and curing wounds through the supply of electric energy at the cell level, which restores the potential of the cell membrane to normal potential[55]. In recent years, a number of studies of microcurrent stimulation have been performed for in a wide range of conditions such as fracture and fatigue recovery, and various diseases involving cancers and diabetic nerve damage[56,57,58,59]. In particular, microcurrent stimulation is known to be effective for cumulative fatigue recovery, reducing pain, inflammation, increasing muscle tone and enhance wound healing. There are studies done to prove effectiveness of Microcurrents in many conditions.

A study conducted by T.El-Husseini, et all suggest that Microcurrent led to better pain control, with a markedly lower requirement for tramadol as compared to the control group. Improved pain control was accompanied by a better healing of the wound and a lower drain volume. There were neither adverse effects nor a need to discontinue Microcurrent therapy. [60]

Effects of Microcurrent on Delayed Onset of Muscle Soreness(DOMS):

Jeong-Woo Lee, Ji-Sun Kang, et all found that difference of interelectrode distance has no influence on VAS pain and the RIII reflex of DOMS. Although there were no significant differences in RIII amplitude, they suspect that it may be influenced by current parameters such as frequency and intensity.[61]

The parameters selected for the experiment, indicated that Microcurrent stimulation was not effective in reducing pain and loss of range of motion associated with DOMS.[62]

Study conducted by Da-Haeng Kang, Jae-Keun Jeon suggested that microcurrent stimulation was effective for recovery from cumulative muscle fatigue of the erector spinae, while TENS had no effect.[63]

Jeffrey and Elizabeth conducted a study, which stated that the effectiveness of low-volt, microamperage stimulation alone for the treatment of perceived pain and muscle function has not been established.[64]

A two-center retrospective study demonstrated a 45.4% faster, and more robust healing of wounds with the use of the Microcurrent Therapy, when compared to Standard Wound Treatment in a rehabilitation center environment. This translates into improved patient care, and potentially significant cost savings. Economic benefits for the use of Microcurrent Therapy compared to other wound care methods were planned for future research.[65]

AIM:

To study the effectiveness of Microcurrents on Cervical Pain and Range of Motion.

OBJECTIVES:

- To check the effectiveness of Microcurrents on Cervical Pain.
- To check the effectiveness of Microcurrents on Cervical Range of Motion.

Study design: Experimental Study Design

Study population: Patients with cervical pain

Type of sampling : convenience sampling

Sample size: 14 subjects

Duration of the project: 6 months

Site of research work : Physiotherapy outpatient centre in a tertiary care center

Inclusion criteria:

Patients in the age group of 18-35 years of either gender.

- Patients with chronic cervical pain and restricted range of motion.

Exclusion criteria:

Presence of any of the following

- Motor deficits
- Spondylosis
- Tumor
- Fracture
- Metabolic diseases
- Rheumatoid arthritis
- Osteoporosis
- Any prior cervical or thoracic surgery
- CNS involvement

PROCEDURE:

An ethical committee approval was taken before starting the study. Patients who came to the Physiotherapy outpatient centre were initially screened for the inclusion and exclusion criteria.

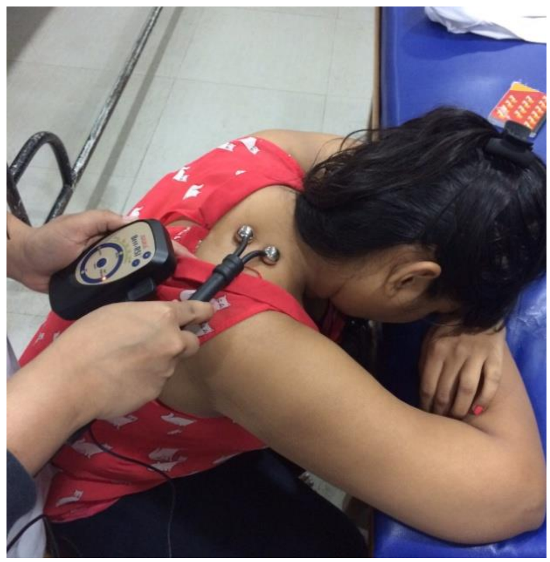
They were explained about the need of the study, the way in which the study would be performed and an informed consent was taken from them. They were allocated to either of the groups receiving either Microcurrents and Isometric cervical exercises or only Isometric cervical exercises by lottery method.

Patients were evaluated for cervical range of motion, VAS and NDI before starting with the treatment and were re-evaluated on the 5^{th} day.

Intervention

One group was given Microcurrents and cervical isometric exercises and the other group was given only cervical isometric exercises.

- Microcurrents was given for ten minutes followed by cervical isometric exercises. Before giving microcurrents the patients' were asked the exact pain area and a Y-Probe of the machine was used to give the currents over the painful area. Microcurrent was given in the sitting position with the head resting on the arms over the pillow.



- Isometric exercises were given in supine and side lying positions respectively. Each exercises was done for ten repetitions each.

Patients were asked to continue the same isometric exercises in both the group as a home programme. Ergonomic advice was given to the patients.

Outcome Measures

Pain measurement:

Patients are asked verbally the pain perceived on verbal analogue scale (VAS) ranging from 0-10.

Range of motion measurement:

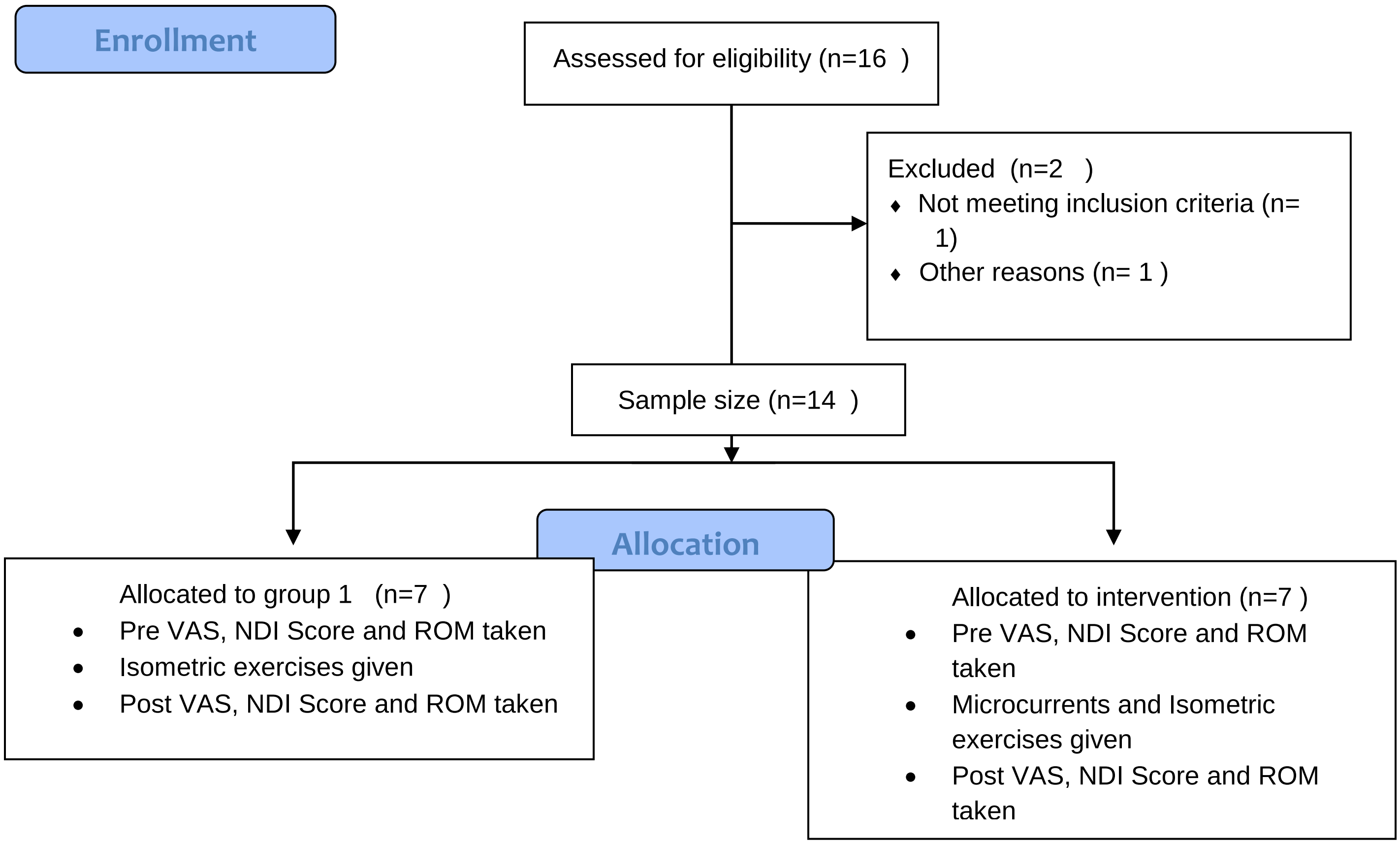
An Inclinometer was used to measure cervical flexion, extension, right lateral flexion, left lateral flexion, right rotation and left rotation were measured. It has a valid and a moderate to good reliability for measuring cervical spine range of motion.

NDI Scale:

Patients were individually scored on the the neck disability index scale and the total score for the same was calculated.

The pain in VAS, NDI Scale and the range of motion in degrees using an inclinometer was re measured on the 5th day post treatment.

CONSORT Flow Diagram[77]



Data analysis:

The data was analysed using SPSS version19.0.

Normality was analyzed using Shapiro Wilk Test. Since the data did not follow normality, between the groups Mann Whitney T Test was used. Within the group Wilcoxon Signed Rank Test was used setting the level of significance at $p \leq 0.05$

16 patients complaining of neck pain were evaluated according to the inclusion and exclusion criteria out of which14 subjects were enrolled in the study after taking their written informed consent.

Table 1: Characteristics of Subjects in each group at baseline

	Microcurrents Group	Control Group	p value
AGE (years)*	33.14±7.4	32.86±6.543	0.949
GENDER M(F)ǂ	3(4)	2(5)	0.57
Range of Motion			
Flexion	50 (15)	60(7)	0.109
Extension	45(20)	55(10)	0.383
Right Rotation	55(15)	64(5)	0.128
Left Rotation	50(15)	60(5)	0.038
Right Flexion	20(5)	19(2)	0.209
Left Flexion	15(13)	18(7)	0.62
Neck Disability Index	28(4)	30(4)	0.38
VAS	6(2)	7(1)	0.383

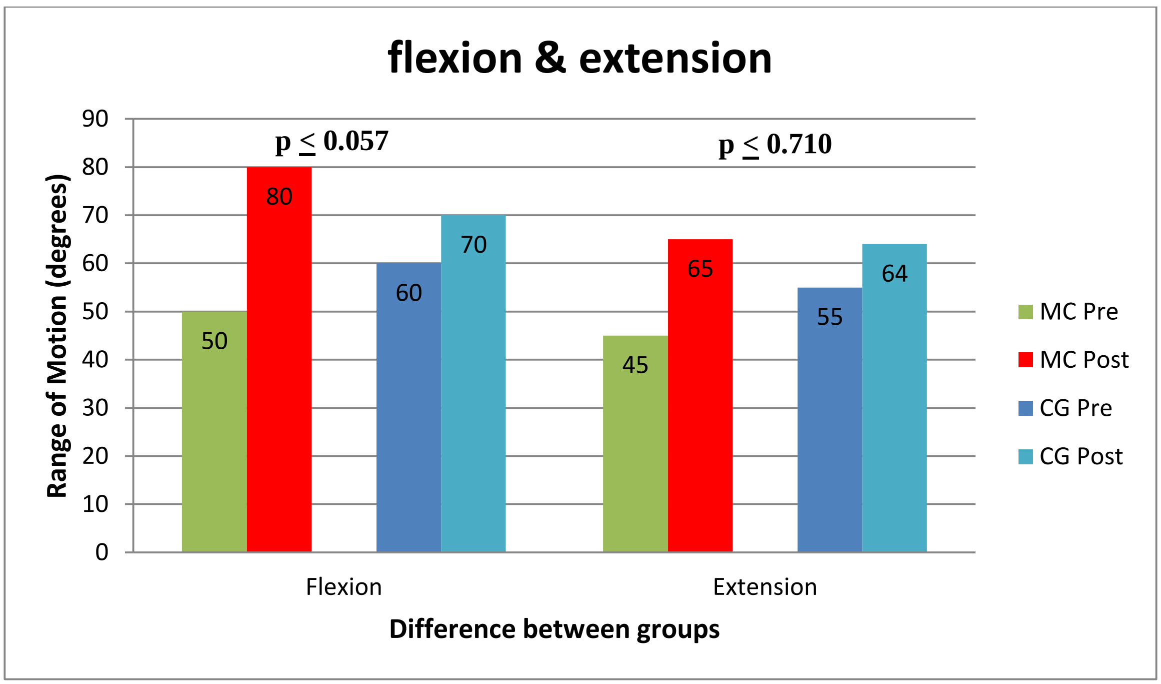
*Student's t test; ǂ Chi Square Test

Range of Motion

Table 2: Range of Motion between the groups.

	Microcurrents Group		Control Group		p Value
	Pre	Post	Pre	Post	
Flexion	50(15)	80(10)	60(7)	70(13)	0.057
Extension	45(20)	65(5)	55(10)	64(6)	0.710

Graph 1: Difference between groups in flexion and extension



Flexion

There is non significant statistical difference observed in flexion between the groups ($p \leq 0.057$). However 10º improvement in range in the groups receiving microcurrents compared to the control is clinically significant.

Within the group analysis showed statistical difference between pre and post observation of interventions in both groups ($p \leq 0.017$)

Extension

There was no statistical difference observed in extension between the two groups ($p \leq 0.710$).

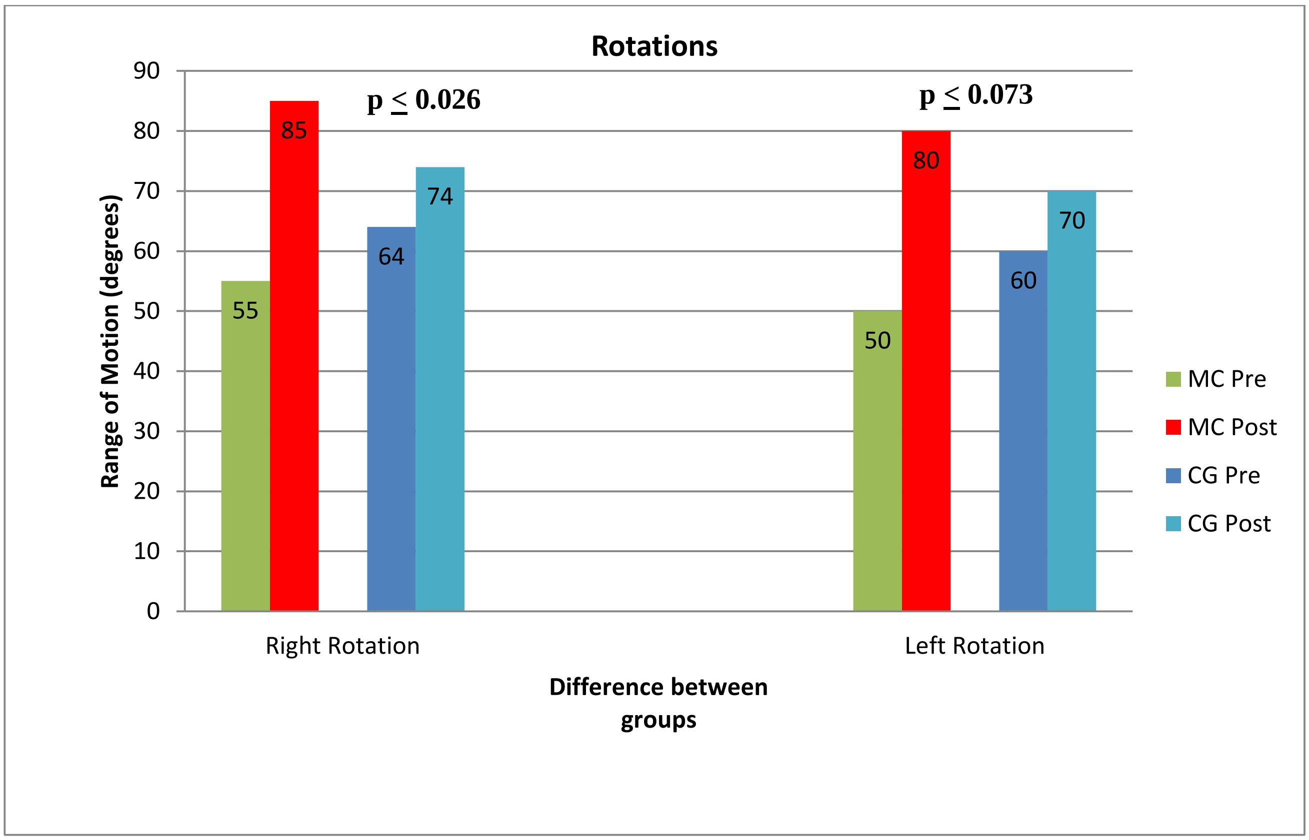
Within group analysis showed statistical difference between pre and post observation of interventions in both the groups ($p \leq 0.01$)

Rotations

Table 3: Median and IQR for the ROM in Right Rotation and Left Rotation in Experimental and Controlled Groups Before (Pre) and After (Post) Treatment.

	Microcurrent group		Control group		P Value
	Pre	Post	Pre	Post	
Right Rotation	55(15)	85(15)	64(5)	74(5)	0.026
Left Rotation	50(15)*	80(20)	60(5)*	70(10)	0.073

Graph 2: Difference between groups in right and left rotation



Right Rotation

There is statistical and clinical significant difference observed in right rotation in the group receiving microcurrents when compared to the control group.($p \leq 0.026$)

Within group analysis showed statistical difference between pre and post observation of interventions in both the groups ($p \leq 0.01$)

Left Rotation

There was no statistical difference observed in left rotation between the two groups ($p \leq 0.073$). However a 10º increase between the post values of the two groups is clinically significant

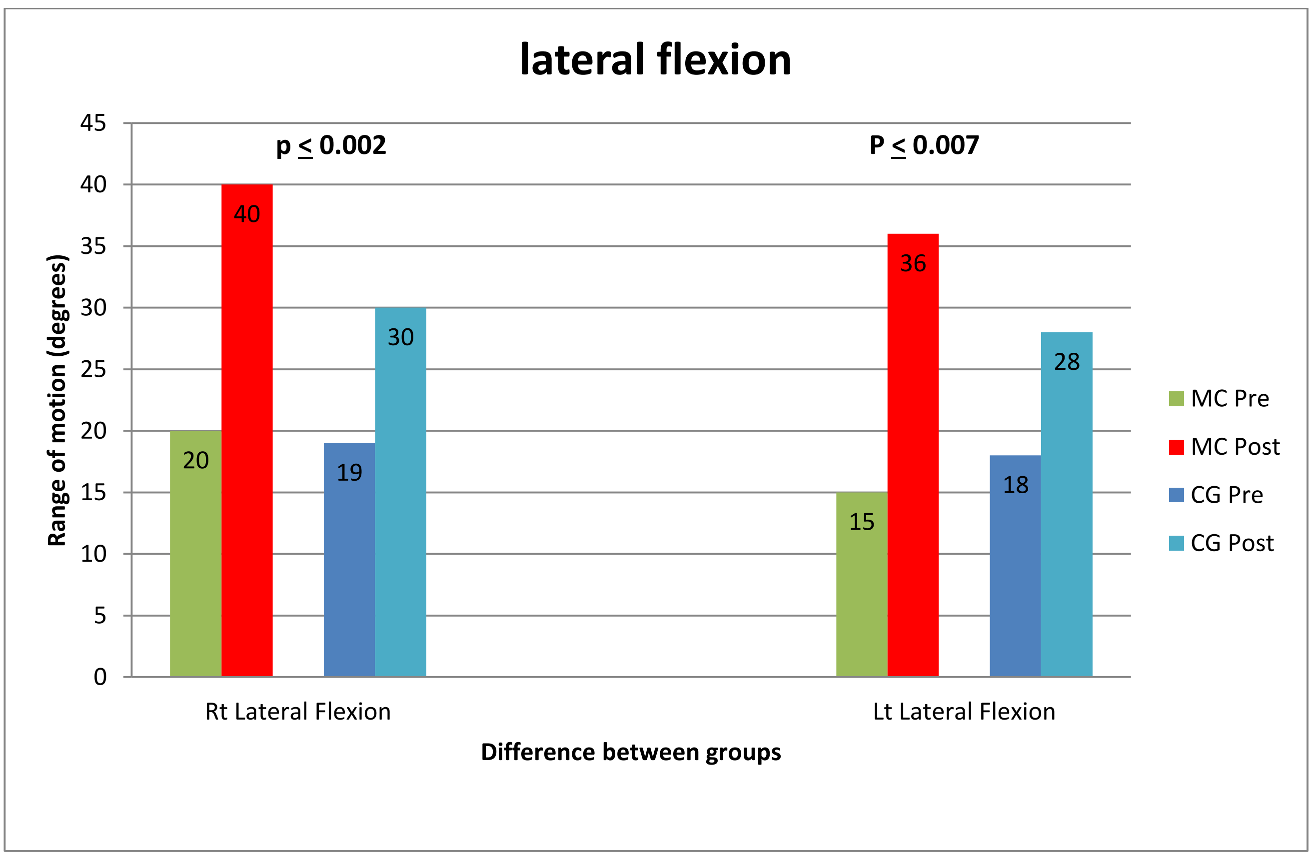
Within group analysis showed statistical difference between pre and post observation of interventions in both the groups ($p \leq 0.01$)

Lateral Flexion

Table 4: Median and IQR for the ROM in Right Lateral Flexion and Left Lateral Flexion in Experimental and Controlled Groups Before (Pre) and After (Post) Treatment.

	Microcurrent Group		Control Group		P Value
	Pre	Post	Pre	Post	
Right Lateral Flexion	20(5)	40(5)	19(5)	30(6)	0.002
Left Lateral Flexion	15(13)	36(12)	18(7)	28(5)	0.007

Graph 3: Difference between groups in right and left flexion



Right Lateral Flexion

There is significant difference observed in right lateral flexion between the groups ($p \leq 0.002$)

Within group analysis showed statistical difference between pre and post observation of interventions in both the groups ($p \leq 0.01$)

Left Lateral Flexion

There is significant difference observed in left lateral flexion between the group ($p \leq 0.007$)

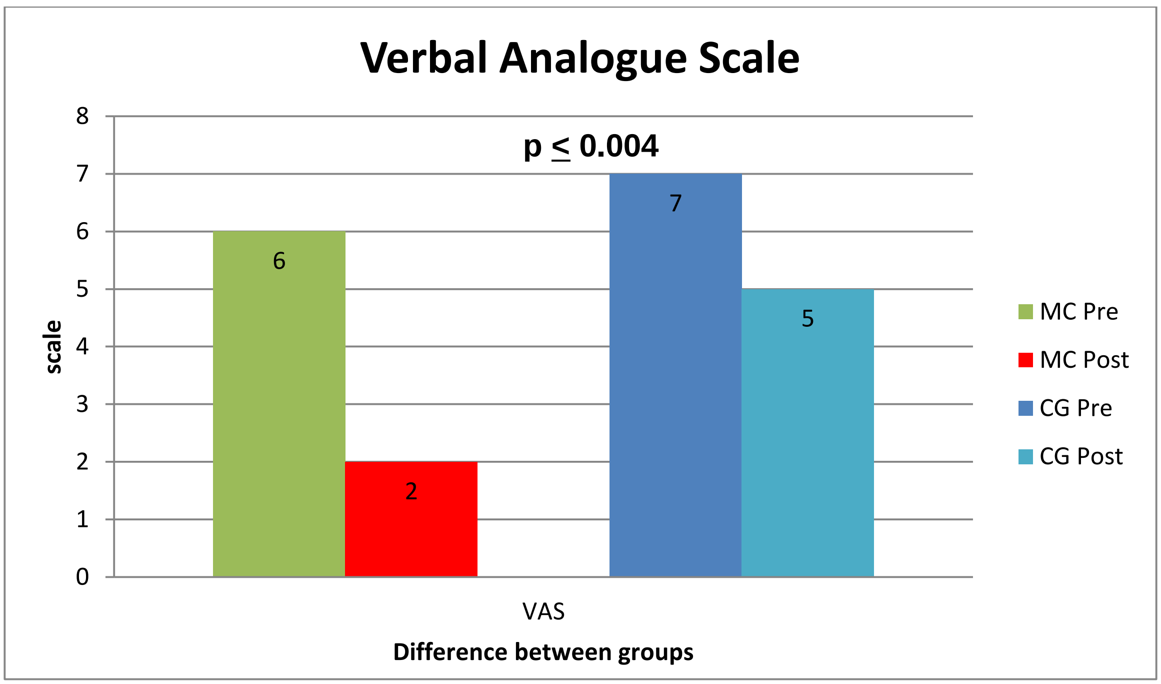
Within group analysis showed statistical difference between pre and post observation of interventions in both the groups ($p \leq 0.01$)

Verbal Analogue Scale

Table 5: Median and IQR for VAS in Experimental and Controlled Groups Before (Pre) and After (Post) Treatment.

	Microcurrent Group	Control Group	p Value
Pre	6 (2)	7 (1)	
Post	2 (4)	5 (1)	0.004
p Value	0.017	0.015	

Graph 4: Difference between groups in VAS



VAS

There is significant difference observed in VAS between the group ($p \leq 0.004$)

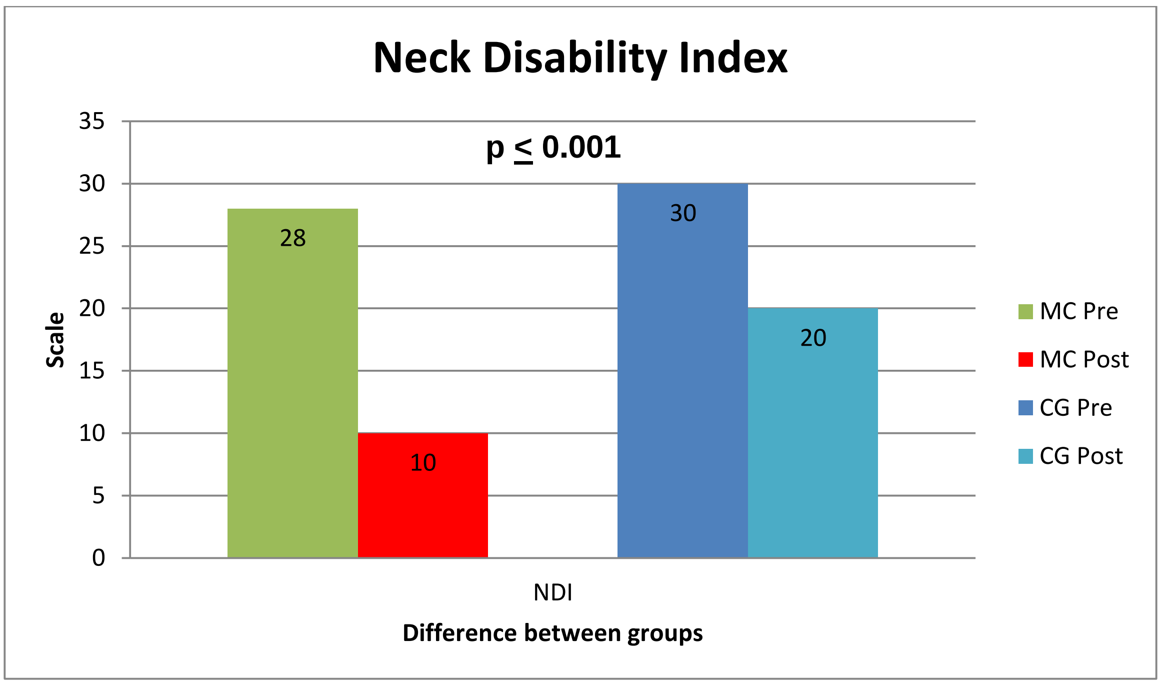
Within group analysis showed statistical difference between pre and post observation of interventions in both the groups ($p \leq 0.01$)

Neck Disability Index

Table 6: Median and IQR for NDI in Experimental and Controlled Groups Before (Pre) and After (Post) Treatment.

	Microcurrent Group	Control Group	p Value
Pre	28 (4)	30 (4)	
Post	10 (9)	20 (7)	0.001
p Value	0.016	0.018	

Graph 5: Difference between groups in Neck Disability Index



NDI

There is significant difference observed in NDI between the group ($p \leq 0.001$)

Within group analysis showed statistical difference between pre and post observation of interventions in both the groups ($p \leq 0.01$)

The objective of the study was to investigate the effect of Microcurrents on cervical range of motion, neck disability score (NDI) and pain evaluated by verbal analogue scale (VAS). The study revealed that there was significant difference in the range of motion, functional ability and pain post 5 days of Microcurrents and isometric exercises.

Neck Disability Index

This study showed that Microcurrents along with isometric exercises effectively improved patients' daily activity functions. There is significant improvement in the neck disability scores in intergroup as well as intragroup which received Microcurrents along with isometric exercises. A reduction in the maximal pain intensity effectively improved the patients' daily activity functions.

A study done by Yuan-Chi Chan et al, stated similar results such as the one obtained that is the short- term effects of self-massage combined with home exercise on pain, daily activity, and autonomic function in patients with myofascial pain dysfunction syndrome, which stated that treatment with physical modalities plus combination of self-massage and home exercise is more effective than the physical modalities treatment alone. It also has a significant functional improvement in neck disability scale and patient-specific functional scales.[73]

VAS

The difference in the VAS scores for pain levels also showed significant change after 5 days of Microcurrents and isometric exercises.VAS was lower in patients' receiving microcurrents and isometric exercises than patients' in who received only isometric exercises.

Studies theorized by T. El-Husseini et al, suggested an improvement in pain control and decrease in the VAS score accompanied by better healing of wound and lower drain volume by using Microcurrents on skin patches for post-operative pain control in total knee arthroplasty.[72]

Cervical Range of Motion

The cervical flexion range showed a significant increase in the experimental group as compared to the control group.

The right rotation range improved notably as compared to the left rotation in inter-group analysis. Intra- group analysis showed improvement in the rotation ranges of both the groups. Right and left lateral Flexion showed significant clinical improvement in the experimental group on the fifth day of treatment when compared with the Control Group which received only Isometric Exercises.

There was a non-significant difference in extension cervical range of motion between the microcurrent group and control group. However there is a future scope of study for the same.

Driban theorized that the healing of the tissue involves two endogenous sources of electromagnetic energy: strain generated potential and bioelectric currents or potentials. Bioelectric currents work on tissues with unequally distributed ions within the extracellular and intracellular fluid. Occurrence of any cell membrane tear such as a muscle strain or spasm causes an inward flow of positive ions and outflow of negative ions because of the chemical gradient. Once this membrane seals transient electrical properties remain altered throughout the duration of healing till homeostasis is restored.[73]

Microcurrents has been successfully used to enhance soft tissue healing and to treat fracture nonunion .[66,67] Substances that increase electrical field, such as prostaglandin E_2, enhance the wound healing rate and increase cell division.[68,69] Electrical fields stimulate secretion of growth factor [69]. Low mA current stimulates adenosine triphosphate production [68]. It is discovered in another study that microcurrent stimulates dermal fibroblasts and U937 cells to secrete transforming growth factor-β_1, a major regulator of cell-mediated inflammation and tissue regeneration[70]. Hence this study is to prove that microcurrents can be used to decrease pain n improve range of motion in patients with cervical pain.

Major sign of cervical pain seen is muscle spasm commonly due to trigger points in the underlying muscle. Trigger points are postulated to increase the metabolic activity of the muscle by sustained depolarization of the motor end plate causing a sustained contraction due to increased free calcium ions. These free calcium ions in the sarcomere initiate the release of algogenic substances hence leading to sensitization of autonomic and sensory nerve endings.[71] Microcurrent therapy is theoretically designed to mimic the bioelectrical system of the body and re-establish homeostasis and normalcy with rapid return to function.[74]

Their result is similar to that of our present study in which muscle fatigue in the right and left erector spinae was reduced significantly. Microcurrent stimulation can induce cell responses in damaged tissues through bioelectricity thereby assisting with the healing of tissues. It can also facilitate endogenous bioelectric current which would reduce resistance in the damaged portion, and promote conduction of bioelectric current assisting with the recovery of homeostasis of the human body. That is, microcurrent enhances electrical and chemical processes, which assist the healing process, returning damaged muscle tissues to a normal state[75]. Reduction of the median frequency value indicates a reduction in muscle fatigue, [76,77] and muscle tone and microcurrent stimulation is more effective for the recovery of muscle fatigue and muscle tone than only taking a rest. The microcurrent therapy increased collagen formation speed in the recovery of damaged cells more than in the TENS therapy, which is why the microcurrent stimulation had a more positive effect on muscle fatigue and muscle tone.

This study proves that microcurrents can be use effectively in reduction of pain and muscle spasm, however the effects of microcurrents should be studied in further by comparing it to other pain relieving modalities and also to study a longer carry over effect.

Microcurrents along with isometric cervical exercises have shown significant changes in the VAS and NDI score and also in improving the cervical range of motion. It has shown improvement in a day's time, this holds great impact in terms of absenteeism and in the reduction of time in pain thereby improving function.

Microcurrents can be advocated as a modality of choice for pain relief.

Study design: experimental study design

Background: Cervical pain is a common problem, with two-thirds of the population having neck pain at some point in their lives. Neck pain, although felt in the neck, can be caused by numerous other spinal problems. Neck pain may arise due to, muscular tightness on both the sides of the neck and upper back or pinching of the nerves emanating from the cervical vertebrae. The factors contributing to increasing cervical pain are modern sedentary lifestyle, prolonged sitting and incorrect, fixed or constrained working postures. Microcurrent therapy, which is used from 1μA to usually 600 uA clinically, is the modality of choice for increased tissue healing, reducing pain, inflammation and tightness.

Objective: To check the effectiveness of Microcurrents on cervical pain and range of motion.

Procedure: Screening of the patients for inclusion criteria was done and an informed consent was taken. 14 subjects were divided into two groups. Patients pre VAS NDI score and ROM was measured using an inclinometer. The experimental group was given microcurrents for 10 minutes followed by isometric exercises and the control group was given only isometric exercises. The patients were re-evaluated for VAS, NDI and range of motion on the 5^{th} day.

Results and conclusion: The values of VAS, NDI and ROM in the experimental group and control group were analyzed using Mann Whitney T Test unpaired and in comparison of the two groups showed that Microcurrents showed clinical significance in reducing VAS and NDI score and improving the ranges. Microcurrents assist with the recovery of homeostasis of the human body hence, it can be advocated as a modality for pain relief.

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