EFFECTIVENESS OF INSTRUMENT ASSISTED SOFT TISSUE MOBILISATION TECHNIQUE ON CERVICOGENIC HEADACHE IN SMARTPHONE ADDICTED COLLEGE STUDENTS: A PILOT STUDY

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ABSTRACT

Background and purpose: Cervicogenic Headache (CeH), classified as secondary headache is one of the most emerging clinical conditions in the 21st century involving predominantly upper cervical segments and adjacent soft tissue structures. Postural malorientation and muscle imbalance (weakness and tightness) of the neck closely related to myofascial trigger points (MTrPs) formation, especially smartphone user college students, that produces CeH. Instrument Assisted Soft Tissue Mobilization (IASTM) technique aids physiotherapist to localize TrPs precisely and treat conditions effectively even at the deeper structures of the body without enhancing fatigue of the clinician's hand.

Objectives: The purpose of this study was to evaluate the effectiveness of IASTM on myofascial syndrome (taut-bands and TrPs) and its correlation with pain and disabilities associated with CeH when applied along with exercises.

Subjects and Methods: 10 participants of college students 4 males and 6 females (mean 25 ± SD 4.02) were included in the study after maturing all inclusion and exclusion criteria. All participants received treatment of Infrared radiation, followed by IASTM application using Graston® tool and exercise protocol, 3 sessions every other day per week for 2 weeks. Outcome measures were pain pressure algometer (PPT) and Headache Disability Index (HDI), measured at baseline and after 6 sessions of treatment.

Results: Data analysis revealed statistically significant improvement after 6 sessions of intervention in all outcome parameters ($p < 0.05$).

Conclusion: This study concludes that IASTM is an effective intervention for the treatment of MTrPs and headache disabilities associated with prolonged smartphone user college students.

Keywords: Cervicogenic Headache, Trigger points, Smartphone, IASTM.

INTRODUCTION:

Headaches are one of the major and prevalent health disorders in the present world. More than 90% of the population had a history of headache once in a lifetime.[1] Cervicogenic headache (CeH) is classified as secondary headache by the International Headache Society (IHS) and presentation of 'Pain' originated from the dorsal neck region involving various muscular, osseous, articular and neurogenic structures, referred to the head affecting fronto-temporal area and eye, where the pain persists originally with episodes of solitary attacks, exacerbations that last from a few hours to many days.[2,3] 0.Sjsastad et al studied unique clinical features of CeH and recognised by Cervicogenic Headache International Study Group (CGHISG) that are headache felt unilateral (or side dominant) headache or hemi cranial pain without any side shift, which is chronic in nature, headache triggered by neck movement, sustained awkward head positioning, external pressure over the upper cervical or occipital region, restriction of range of motion in the neck, ipsilateral neck, shoulder or arm pain, headache pain characteristics include- moderate to severe non-throbbing pain usually starting in the neck, episodes of varying duration, or fluctuating, continuous pain adjunct with associated signs and symptoms such as: nausea, phonophobia and photophobia, dizziness, ipsilateral blurred vision, difficulties on swallowing, ipsilateral oedema mostly in the periocular area.[4]

CeH involves specific joint segments and muscles and can be secondary to traumatic neck injuries (like whiplash), external pressure over nerve and nerve root in the upper three cervical segments. Literature supports that dysfunction of the C2-3 zygapophysial joints, C2-C3 and C3-C4 discs or facet joints along with dysfunction of the atlantoaxial (C1-2) and atlantooccipital (C0-C1) are significantly contributing to this condition.[5] Myofascial trigger points (MTrPs) are the hyperirritable palpable nodule often associated with pain referral, precipitated by subsequent weakness and tightness of specific muscles in a particular pattern leads to CeH.[6] This presentation mimics increased uses of smartphones in everyday activities (minimum 4hrs) especially in the age group of college students (18-28 yrs.) and subsequent mal-positioning of head and neck while using smartphone ultimately produce CeH significantly.[7]

Among all headaches (primary and secondary) tension-type headache (TTH) being most common affecting near about 38%, migraine type of headache affects 10%, where chronic daily headache has a prevalence of 3% of the worldwide population. [8,9] Prevalence rate of TTH and migraine is 29.7% and 15.9% respectively with female preponderance, female: male= 1.7:1.2 for migraine and TTH, respectively.[10] A recent study performed in the Karnataka state of India demonstrated that 63.9% of the population was affected by headache about 25.2% of people were suffering from migraine and 35.1% of people were affected

by TTH, where the females are more prevalent than males irrespective of types of headache disorders.[11] CeH ranges from 0.4% to 4.1% of the global population, by essentially affecting females two to four times than males and accounts for 15% to 20% of all chronic and recurrent headaches.[12,13] In India, a study of college students aged between 18 years to 30 years suggested that it is prevalent in15.6% of the population with frequent headache and 1.7% of the general population respectively.[14] Another study performed on medical students in Pakistan with a mean age group of 24.01 ± 2.6 years demonstrated that 41.4% of students suffered from CeH.[15]

CeH manifests unique and complex pathophysiology having a typical onset of the pain from the posterior aspect of the neck as it oriented with rich nociceptive innervation and pain generating structures (e.g., muscles, zygapophysial joints, intervertebral discs, ligaments and the skin) that are triggered easily.[16] The commonest mechanism for the CeH is the trigeminocervical nucleus that involves convergence at pars caudalis sub part between cervical and trigeminal afferents, nociceptive afferents from the C1, C2, and C3 spinal nerves converge onto second-order neurons that also simultaneously receives afferents stimulus from the ophthalmic (first) division of the trigeminal nerve via the trigeminal nerve spinal tract and this convergence allows for upper cervical pain to be referred to the parietal, frontal, orbital and occipital, auricular regions of the head innervated by and trigeminal and cervical nerves respectively.[17]

Numerous researches have been performed for the symptomatic management of CeH includes pharmacological, anaesthetic and surgical interventions but of short-term efficacy.[18,19] Physical therapies have shown to be reliable, by several studies through multi-directional approaches, including manual therapies like joint mobilization and spinal manipulative therapy, trigger point (TrP) therapy therapeutic exercise includes cranio-cervical flexion (CCF) exercise, various dynamic neck and upper quarter strengthening exercises, sensorimotor training exercises at the final stage of a rehabilitation program, stretching of tight muscles such as upper trapezius, sternocleidomastoid (SCM), levator scapulae, suboccipitals, pectoralis major and minor, muscle energy technique used to decrease symptoms of CeH.[20-22] Electrotherapies like T.E.N.S, electrical muscle stimulation, Low-level laser therapy and cryotherapy along with Cognitive behavioural therapy, psychotherapy, biofeedback, relaxation techniques are intensively used as an adjunct therapy for advanced management of the intense pain associated with CeH.[18,20,23,24]

Instrumented Assisted Soft Tissue Mobilization or IASTM is one the most advance and promising techniques to treat various pathological conditions of soft tissue (e.g., myofascial adhesions or restrictions, scar tissue adhesions, thickenings, ridges, fibrotic nodules, crystalline deposits) by implementing a mobilizing effect, pain alleviation, improvement of function and range of motion (ROM).[25] IASTM using Graston® tool is a specially designed instrument that provides deeper penetration, precise localization of the target tissue while reducing imposed stress on the therapist's hands.[26]

Several researchers have demonstrated that application of IASTM by appropriate pressure and shear force, produces a localized micro-trauma to the targeted soft tissue, producing capillary and microvascular haemorrhage, which reinitiates the body's inflammation process by releasing removing the scar tissue, releasing adhesions and facial restrictions, linearly IASTM increases blood, nutrient supply and fibroblasts migration to the injured area, these process facilitates extracellular matrix-like collagen synthesis, organization, deposition, realignment and maturation through elevation of fibronectin level and ultimately facilitate in the repair process and healing.[27]

Previous studies have shown that IASTM effectively increases the ROM of various joints (e.g., glenohumeral, hip, knee and ankle), recovery of altered soft tissue function following tendon injuries and reduce pain in various musculoskeletal conditions (e.g., costochondritis, trigger thumb, mayo fascial syndromes, chronic low back pain, plantar fasciitis.[28-30] The purpose of the study was to evaluate the effectiveness of IASTM on the myofascial syndrome (taut bands and trigger points) and disabilities in daily smartphone user college students having CeH when applied with exercises.

MATERIAL AND METHODS:

This study was conducted at the Nopany Institute of Health Care Studies (NIHS), Kolkata, India. Approval of Institutional Ethical Committee (IEC) was taken before commencement of the study. The study employed a pilot design. To be eligible participants had to mature all inclusion criteria like: College students between the age groups of 18 to 30 years of both genders using smartphone minimum of 4 hours/day, complaint of unilateral headache for the past 3 months at least once per week, presence of active TrP over SCM or descending fiber of trapezius or suboccipitalis muscle, either anyone or two or even three of the mentioned muscles; positive cervical flexion-rotation test (FRT) with restriction greater than 6°-10°, major CeH diagnostic criteria recognised by CHISG & IHS. Participants were excluded if any other nonspecific head and neck pain (localised and radiating), history of any recent surgery of the cervical spine, participants are continuing other physiotherapeutic or rehabilitative treatments for headaches or have received any physiotherapy or chiropractic treatment in between the past 3 months, any nonspecific condition with sensory dysfunction, pregnancy and other nonspecific conditions preventing physical loading, history of recent weight loss, patients are under any medical intervention for pain and headache, subjects are not willing to take treatment or any adverse reactions while taking treatment.

Written consent of all participants was taken prior to the intervention. 14 College students between the age groups of 18 to 30 years and daily users of smartphones minimum of 4 hours were involved initially in this study as per their basic complaints of unilateral head and neck pain through convenience sampling. Thereafter, through a primary assessment out of 14 participants by maturing all the above-mentioned inclusion and exclusion criteria, 10 participants of both genders were recruited in the study. FRT had shown to be reliable and valid in determining upper cervical joint dysfunction (C_1-C_2) of patients with CeH (sensitivity 91%, specificity 90%).[31] This test is defined as positive for the CeH patient where the estimated range is reduced by more than 6°-10° from the anticipated normal range of 44°.[32,33]

Outcome measures:

Pain sensitivity was measured by Pain Pressure Algometer and β version of headache disability inventory or Headache Disability Index (HDI) was used to assess the disabilities of CeH at baseline and after 6 sessions (3 sessions per week for 2 weeks on alternate basis) of intervention. Subjects had to report when the feeling of pressure first changes into pain, during gradual pressure application through algometer by the therapist, perpendicular to the TrPs such as the superior insertions of the SCM and trapezius muscle, over of insertion the suboccipitalis muscle on the symptomatic side. The mean of 3 trials for each location was recorded by 30-second resting interval to avoid error and used for statistical analysis. The instrument was calibrated prior

to intervention. The reliability of algometry has been found high (intraclass correlation coefficient, 0.91; 95% confidence interval [CI], 0.82-0.97) and the rate of the instrument should be constant at an approximate rate of 1 $kgcm^{-2}s^{-1}$ or 10 Ns^{-1}.[34,35] To assess disability status associated with the quality-of-life burden, psychological and emotional aspects of CeH 25 Questions in β version of headache disability inventory divided into functional and emotional subpart. Participants were asked to answer questions by saying Yes, Sometimes and No and scored 4 points, 2 points, 0 points respectively. A total score of 10-28 is considered to indicate mild disability; 30-48 is moderate disability; 50-68 is severe disability; 72 or more is complete disability where the possible lowest score is 0 while the highest score is 100 (25×4=100). This scale had shown significant reliability (95% CI) to evaluate the quality of life, functional capabilities, ADL and the impact of headache on daily living of the headache population.[36,37]

INTERVENTIONS:

All the participants were received superficial heat by utilizing Infra-red radiation (IRR) for 15 minutes followed by IASTM using tools over Mtrps of the length of targeted muscles (SCM, descending fiber of trapezius, suboccipitalis muscles) in a multidirectional stroking fashion applied to the skin at 30°- 60° for 5 minutes. Participants were in a comfortable position during treatment. IASTM was administered by a certified practitioner who was trained of using the same over patients (Fig 1). Emollient (anti-allergic) was applied to prevent skin irritation prior to Graston® application. Each session included 1minute of sweeping (longitudinal strokes performed parallel to the muscle fibers similar to an effleurage stroke), 1minute of swivel (pivoting/rotating back & forth similar to manual compression with oscillations) directly over the Mtrps, 2 minutes of fanning (one end of the instrument was held in place & the other end moved through a semi-circular pattern similar to petrissage) and concluded with 1min of sweeping. Graston® tool was washed in alcohol-based sanitizer before and after every treatment session and all norms of COVID-19 precautions were maintained. Mtrps were marked with a 1×1 cm piece of tape/under wrap to confirm consistency of subsequent treatments.

Thereafter, participants were asked to perform CCF exercises in supine lying using feedback from an air-filled pressure sensor (Stabilizer™, Chattanooga Group Inc., Chattanooga, TN) placed behind the neck. The subjects were first taught to perform a slow and controlled cranio-cervical flexion action and trained to hold progressively, from a baseline of 20 mmHg, participants attempt to visually target pressures of 22, 24, 26, 28 and 30 mmHg and to hold the position steady for 10 seconds as per ability for 3 sets of 5 repetitions. A 10-second rest was allowed between each set. Thereafter, dynamic strengthening exercises of shoulders and upper extremities for 1 set of 15 repetitions. The exercise protocol ended with gentle stretching exercises administered by the therapist to the tight structures of the neck (including the SCM, upper trapezius etc) shoulder blades for 10 sets of 3 repetitions. All participants had received 3 sessions per week for 2 weeks on an alternate basis. All the participants were advised to perform some freehand exercises (e.g.; isometric exercises for neck, chin tuck exercises etc.) at least a series of 15 repetitions daily and aerobic exercises for 30 minutes at home at least 3 times a week.

Statistical analysis:

The primary analysis consisted of the use of descriptive statistics for calculating mean and standard deviation. Student t test was used to compare the difference between pre-intervention and 2 weeks post-intervention period. It was used to compare the difference in pain pressure threshold and cervical ROM.

The level of significance was set at $p<0.05$ and the analysis was performed using SPSS version 19.

RESULTS:

The HDI score and PPT were measured at the baseline and after the completion of 2 weeks of treatment. The data collected was analysed using student t test. 10 participants were included in this study within the age group of 18 to 30 with a mean age group of 25± 4.02 (mean ± SD). The Pre-Post mean changes of HDI score for all participants was 31.40 ± 8.99 (mean ± SD) (Fig-02). HDI score for female and male participants were 30.33 ± 11.05 and 33.00 ± 5.77 respectively (Table-01). The Pre-Post mean changes of PPT values for all participants was 15.10 ±5.19 (Fig-03). PPT values for female and male participants were 16.50±5.39 and 13.00±4.76 respectively (Table-02). TrP was prevalent on both sides of the participant's upper trapezius (Rt and Lt). Mean changes of HDI score, among the Lt. side TrPs were 34.40 ± 5.36 and for the Rt. Side TrPs were 28.40±11.43 (Table-01). Mean changes of PPT score over Lt. and Rt. side upper trapezius's TrPs were 17.80±5.26 and 12.40±3.84 respectively (Table-02).

DISCUSSION:

CeH is chronic or recurring in nature and occurs due to musculoskeletal dysfunction of the Cervical spine. A study concluded that pain and stiffness in the neck or base of the head can refer to any part of the head that may be one-sided or two-sided. The main cause of CeH as described by Simon et al.[38] (2002) due to the presence of an active TrP as a hyperirritable spot associated with a taut band of a skeletal muscle that is painful on compression, palpation or stretch.

A study concluded that the prevalence of CeH is as high 20%. Another Danish study also concluded 30% of male and 65% of female also have an active MTrP. Several studies have concluded the occurrence of CeH due to mainly increased amount of smartphone users. The average duration of smartphone users these days are as high as 4.1 hours a day to a maximum of 5.4 hours. These in turn lead to musculoskeletal disorders such as upper cross syndrome or decreased cervical lordosis and resultant active TrP formation over cervical muscles and leads to pain.

In our study, the mean age group of all the participants were 25 ± 4.02 years as this is the main age group where most of the college students spend more than 4 hours. Researches on students showed that students try to ignore their symptoms by considering them usual or part of fatigue. It has also been found that students try to treat their symptoms on their own by using different medicines that are known to them instead of seeking medical help from a specialized doctor. As students in universities are more prone to develop headaches than the general population due to their academic life. Factors responsible for causing headaches include; emotional stress along with incomplete sleep and taking food supplements that are harmful to health like caffeine or some other substances that increase alertness/awakening and have energizing effects on the body.

The treatment of this CeH and TrPs owns several procedures including upper cervical mobilization, stretching and theraband strengthen exercises. On the other hand, IASTM proves its efficacy over several other conditions where there is a presence of active TrPs. A study conducted by Launder K et al.[39] (2014) in the year 2014 found the efficacy of IASTM to improve posterior shoulder ROM. So, in our study, we also used IASTM to see its efficacy over taut band and TrPs which thought to cause CeH.

Significant changes have found in PPT and HDI score among all the participants. Several studies have proved its efficacy over trigger point therapy and thus our results support the same. Application of IASTM is theorized to stimulate connective tissue remodelling through resorption of excessive fibrosis, along with inducing repair and regeneration of collagen secondary to fibroblast recruitment. In turn, this may result in a breakdown of scar tissue, the release of adhesions, and improvement in fascial restrictions.

A study conducted by Vardiman et al.[40] (2014) indicated that IASTM applied using the correct pressure and treatment angle did not cause muscle damage or initiate an inflammatory response in healthy tissue.

The prevalence of CeH in females is about 4 times more than in males. As CeHs are much more common in females than males, other factors which may trigger like: menstruation and levels of different hormones, should also be considered for finding their effect upon CEH. Poor posture is also an important cause of CeHs as it was found that CeHs have more prevalence in those patients who present with forward head posture. Forward head posture alters the biomechanics of the neck and loads the neck with greater stress. The results also supported by another study which concluded that the differences in neck posture, pronounced levels of muscle tenderness and the presence of MTrPs were observed in subjects with CeH group but not in a no headache control group. IASTM aims to treat such kinds of muscle tenderness which act as a primary cause of having CeH.

CONCLUSION: This study concludes that IASTM is an effective intervention for the treatment of MTrPs and disability associated with CeH in prolonged smartphone user college students

LIMITATIONS: Our primary limitation from this study was the sample size as we only included 10 individuals for our intervention. A larger sample size thus indicated for future reference. In this study, we did not include any control group. So further study with an active control group is indicated. We were unable to do the follow-up assessment also for the long-term beneficial effects. Thus, a study with long term efficacy is also can be recommended as a future reference.

ACKNOWLEDGEMENT: We would like to express our sincere thanks to all the faculty members, MPT students of NIHS and our family for their constant support during the preparation of the manuscript.

CONFLICT OF INTEREST: None.

FUNDINGS: Self.

CONTRIBUTION OF AUTHORS: All the authors have contributed actively to different components of the study such as: designing, data collection, interventions, statistical analysis, manuscript preparation and reviewing the manuscript.

Fig 01: Application of IASTM techniques over MTrPs for CeH.

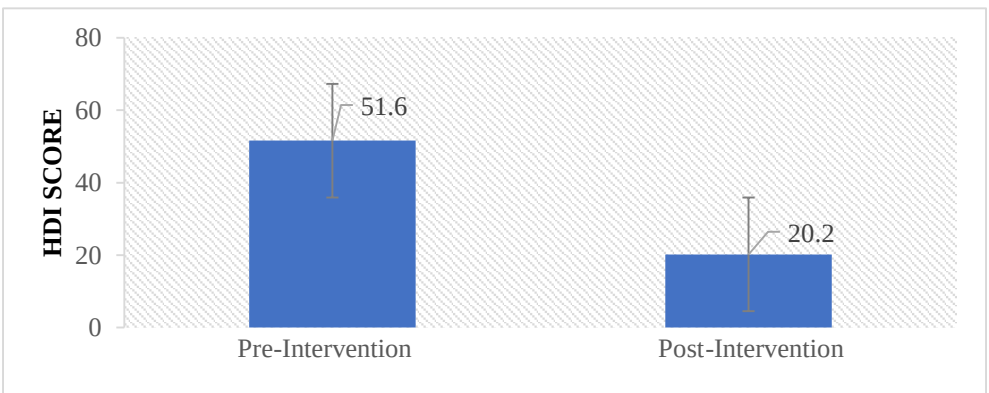

Figure 02: Pre and Post Intervention comparison of HDI for participants

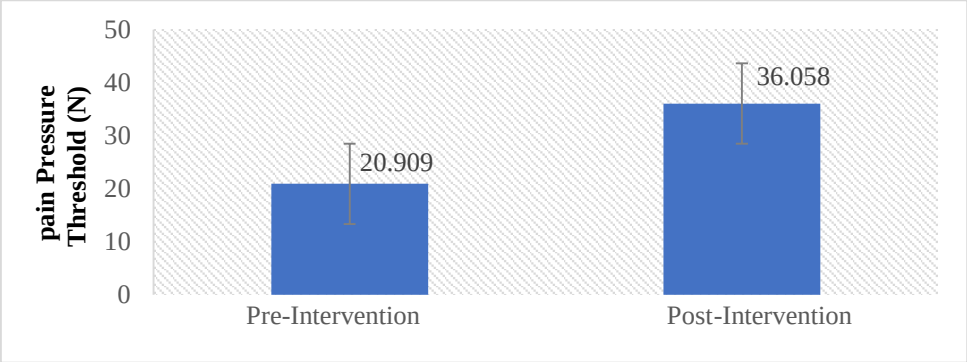

Figure 03: Pre and Post Intervention comparison of PPT for participants.

Table 1: Pre and post treatment HDI Score

	N	Mean Changes	Std. Dev	t	df	P
HDI for all	10	31.40	8.99	11.03	9	<0.05
HDI score for Female Participants	6	30.33	11.05	11.05	5	<0.05
HDI score for Male participants	4	33.00	5.77	11.43	3	<0.05
HDI score for Lt side TrPs	5	34.40	5.36	14.33	4	<0.05
HDI score for Rt. Side TrPs	5	28.40	11.43	5.55	4	<0.05

Table 2: Pre and post treatment PPT Score

	N	Mean changes	Std. Dev	t	df	P
PPT for all Participants	10	15.10	5.19	9.19	9	<0.05
PPT score for Feale Participants	6	16.50	5.39	7.49	5	<0.05
PPT score for Male participants	4	13.00	4.76	5.46	3	<0.05
PPT score for Lt side TrPs	5	17.80	5.26	7.56	4	<0.05
PPT score for Rt. Side TrPs	5	12.40	3.84	7.20	4	<0.05

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