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Effectiveness Of Mulligan Manual Therapy In Improving Headache Frequency And Intensity In Patients With Cervicogenic Headache: A Systematic Review

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Abstract
Background: The Cervicogenic Headache (CGH) is rampant musculoskeletal ailment caused by postural dysfunction of cervical spine. Different cervical spine anatomic structures may be the source of the etiology of CGH. Mulligan Manual Therapy (MMT) is thought to be beneficial in improving neck pain and headaches however the existing literature lacks evidence to strengthen the results produced by MMT, hence this systematic review is done to investigate the effects of same on various indicators of Cervical Spine health and Headache frequency and intensity.
Methods: The studies were included in the present review were constrained to English Language only with study design as Randomized Controlled Trial (RCT) published between 2019- 2024 with atleast one intervention as Mulligan Manual therapy (MMT) compared with other therapeutic interventions like traditional treatment (TT), strengthening exercises, stretching or if various MMT interventions compared with themselves. Database searches were conducted using MEDLINE, PubMed, Scopus, Web of Science (WoS), and Cochrane. Data extraction was done based on eligibility criteria and risk of bias assessment using PEDRO scale for the included studies was done using the following keywords: "Cervicogenic headache and mulligan therapy", "Cervicogenic headache and manual therapy", "Cervicogenic headache and physical therapy", "Cervicogenic headache and mulligan or manual therapy", "Cervicogenic headache and SNAGs and/or NAGs", "Headache and mulligan therapy", "Headache and manual therapy", "Headache and mulligan therapy or physical therapy". The systematic review has been registered in INPLASY with the registration number INPLASY202510045.
Results & Conclusion: 5 studies out of 1575 articles after abstract screening were included for which effects were studied on various parameters like headache frequency, intensity, cervical disability, range of motion (ROM), psychological parameters like depression and anxiety, cervical muscle performance which were diversified across the included studies. The findings of present review reveals the role of MMT in improving symptoms of headache in CEH patients with reduction in neck disability, improved cervical muscle performance, lordosis angle, ROM, psychological functioning, hence emerging as one of the most beneficial approach in treatment of headaches of cervical origin.
Keywords: *Cervicogenic Headache, Mulligan Manual therapy, SNAG*

INTRODUCTION

Headache of cervicogenic origin (CGH) is a headache of secondary type in healthcare, caused by disorders of the soft tissues, discs, or bones of the cervical spine. Congregation theory states that CGH is a type of pain, caused by injury in the tissues having innervation by the high cervical. These lesions result in afferent, harmful sensory signals from the higher cervical nerves that are connected to the affected structures [1, 2]. Reduced range of motion (ROM) and ipsilateral widespread shoulder and arm pain may be associated with a lateralized, non-throbbing headache that originates from a nociceptive source in the cervical spine. Neck pain and discomfort are also associated with CGH, possibly due to hypersensitivity of neck afferents caused by continuous degenerative changes in the cervical musculoskeletal system [3, 4]. CGH have been estimated to affect 1%, 2.5%, 3.5%, or 0.1% of the general population, and among those who suffer from agonizing headaches, the prevalence can increase to 17.5%. The prevalence of post-whiplash headache in patients might reach 53% [5, 6, 7]. According to a research conducted in 2011, 47% of people worldwide experience headaches, with 15-20% of those CGH. According to epidemiological studies, headaches and neck pain are more common together. Females experienced higher headaches of all kinds, particularly migraine (17.0% against 8.6%) and H15+ (6.0% versus 2.9%). CGHs afflict women four times as frequently as they do men [8, 9].

The etiology of CGH may originate from many anatomical features of the cervical spine. The headache is most likely caused by the afferents of the trigeminal and upper three cervical spinal nerves merging in the second-order neurons in the trigemino-cervical nucleus of the upper cervical spinal cord [10, 11, 12]. The area may become more sensitive if there has been neck trauma, whiplash, strain, or persistent spasms in the muscles of the skull, neck, or shoulders, much like the allodynia seen in late chronic migraines. Individuals who are more susceptible to more severe pain have a lower pain threshold. Early diagnosis and therapy intervention are crucial because of this. The ICHD-3 criteria for diagnosing CGH consist of:

a. Any kind of headache that fulfils the criterion 3.

b. Indication of a lesion or condition in the cervical region or soft tissues of the cervical spine that may result in a headache, either clinically or by imaging:

1. The development of headache is correlated with the lesion's appearance or the commencement of the cervical problem.
2. Together with the improvement or resolution of the neck lesion or disease, the headache is greatly benefitted or gone away.
3. Provocative actions can considerably exacerbate the headache, and cervical ROM is diminished.
4. After a cervical structure or its nerve supply is blocked for diagnostic purposes, the headache goes away.

c. Not more appropriate for a different ICHD-3 diagnosis [13].

Imaging tests like X- rays, computed tomography (CT) scan and Magnetic resonance imaging (MRIs) can be used to look for injuries to cervical spine which can result in headache. Manual examination can also supplement in diagnosis of CGH which directs to assessment of mobility of cervical spine [14].

Dysfunctions of the upper cervical zygapophyseal (facet) joints (especially C0–C1, C1–C2, and C2–C3) lead to abnormal loading, capsular stretch, and chemical irritation of joint mechanoreceptors and nociceptors. In response to injury or dysfunction, the body may release inflammatory mediators (like prostaglandins and bradykinin) that can irritate the nociceptors (pain receptors) in the joint capsule and surrounding tissues. Excess nociceptive discharge converges on the trigeminocervical nucleus in the brainstem, producing referred pain to the head and facial regions. Overactivity and spasm of suboccipital and upper trapezius muscles alter cervical posture, increasing sustained strain on joint capsules and muscle fibers. Persistent muscle tension promotes local ischemia and release of algesic biochemicals, sensitizing peripheral nociceptors. Dysfunctional cervical joints send distorted proprioceptive signals to the central nervous system (CNS), disrupting head–neck coordination and postural reflexes. Impaired kinesthetic feedback leads to maladaptive muscle recruitment patterns, perpetuating cervical stiffness and headache [2].

The management of CGH involves physical therapy interventions as primary management including manual therapy techniques like Mulligan, Maitland Mobilization, Muscle Energy Technique, other interventions like stretching, strengthening and Myofascial Release. Other management areas include pharmacological interventions like NSAID's, muscle relaxants, antiepileptic, antidepressants and nerve blockers [15, 16]. The physical therapy interventions like Mulligan manual therapy (MMT) have been proven to produce significant improvements in headache frequency and intensity better in comparison to other interventions but the conclusions have not been fortified which leads to the lack of evidence regarding the various techniques of MMT. This systematic review focuses on extensive research of randomized controlled trials (RCTs) assessing impact of MMT in comparison to other interventions which will refurbish and strengthen the evidence related to MMT effects on CGH. Sustained glides and simultaneous active movement stimulate large diameter mechanoreceptors (Aβ fibers) in the joint capsule and ligaments. According to the gate-control theory, increased Aβ afference inhibits transmission of nociceptive signals (Aδ and C fibers) at the dorsal horn and trigeminocervical nucleus.

METHODOLOGY

Registration

The PRISMA also known as Preferred Reporting Items for Systematic Reviews and Meta-Analyses, criteria was followed in this systematic review of RCT. With registration number INPLASY202510045, the protocol is listed on the International site of Registered Systematic Review and Meta-analysis Protocols (INPLASY) site.

Study eligibility

The articles examined in this analysis were limited to English-language publications and had a RCT design. They were published between 2019 and 2024. Only when at least one MMT intervention—such as Upper Cervical Traction, Sustained Natural Apophyseal Glide (SNAGs), or NAG (Natural Apophyseal Glide)—was compared to other therapeutic interventions—such as conventional treatment, strengthening exercises, or stretching—or when multiple MMT interventions were compared to one another were the studies included. Studies without a control group, duplicate studies, or patient populations with neurological symptoms were not included in the current analysis, nor were research for which full text publications were not available.

Search Strategies and Study Selection

Searches were conducted across MEDLINE, PubMed, Scopus, Web of Science (WoS), Cochrane using the search: "Cervicogenic headache and mulligan therapy", "Cervicogenic headache and manual therapy", "Cervicogenic headache and physical therapy", "Cervicogenic headache and mulligan or manual therapy", "Cervicogenic headache and SNAGs and/or NAGs", "Headache and mulligan therapy", "Headache and manual therapy", "Headache and mulligan therapy or physical therapy". A thorough manual search was carried out for the reference lists of systematic reviews related to Manual therapy and Physical Therapy for neck pain and CGH published between 2019 and 2024.

Data Extraction

The data gathered for the included trials after abstract screening and full text reading, comprised the author's name and year, study title, study type, duration, population, and specified intervention for each study group along with dosage and duration of the sessions for the MMT group and other comparator groups. The extracted data was examined, assessed for risk of bias and was tabulated with the details for each study. Although 5 RCTs were selected for this systematic review but the studies substantially differ in population, intervention and outcomes.

Risk of Bias Assessment

The studies falling in eligibility criteria for review were assessed for risk of bias using PEDRO (https://pedro.org.au/) The Physiotherapy Evidence Database uses an 11-point rating system based on the methodology and findings of each individual study (Table 2). The studies were titled as "Poor", "Fair", "Good", " Excellent" according to the respective scores – "0-3", "4-5", "6-8", "9-10". The criteria 1 is demarketed in "Yes" or "No", hence not scored [17].

RESULTS

Search outcomes

Out of 2681 studies that were selected after title screening, abstract screening was done for 1575 studies. 171 studies were selected for retriveal out of which only 146 studies were assessed for eligibility criteria and finally 5 studies were selected for inclusion based upon the above mentioned criteria (Figure 1).

Study Characteristics

Setting of studies

The treatment duration varied between 1- 2 weeks in 4 out of 5 studies. In study done by Jin et al. performed the interventions, i.e., Health promotion and Mulligan Mobilization for 10 days while Nambi et al. in 2022 investigated and compared the effects of massage and MMT given for 4 weeks for which follow up was taken at 8 week and 6 months [18,19]. A study conducted by Deniz and colleagues compared the conventional protocol with the Mulligan SNAG technique over a period of two weeks. Khalil et al. conducted another study to compare the effects of Mulligan Upper Cervical Manual Traction (MUCMT) and traditional treatment (TT) over a period of one week [20, 21]. A study compared headache SNAG, C1-C2 SNAG and Combined therapy for CGH patients and assessed the effects pre and post one session of treatment [22](Table 2).

Protocols

4 out of 5 studies included used Mulligan SNAGs on C2 spinous process in which ventral gliding in upward and superior direction was performed by therapist [18,19,20,22], however the intervention was compared to various techniques which are as follows: Jin and colleagues compared it to health promotion for 10 days, while MMT was given for 3 repetitions in each sessions for 10 days, Nambi and colleagues assessed and contrasted MMT with Spinal Manipulation Therapy and massage therapy with circular kneading in neck muscles [18,19]. In an another study done by Deniz et al., they compared MMT (for 3 days/ week, alternatively for 2 weeks) to conventional protocol including Ultrasound, Transcutaneous

Electrical Nerve Stimulation (TENS), exercise for 5 consecutive days for 2 weeks, 20 minutes hot pack application, ultrasound on both cervical region for 5 minutes each.

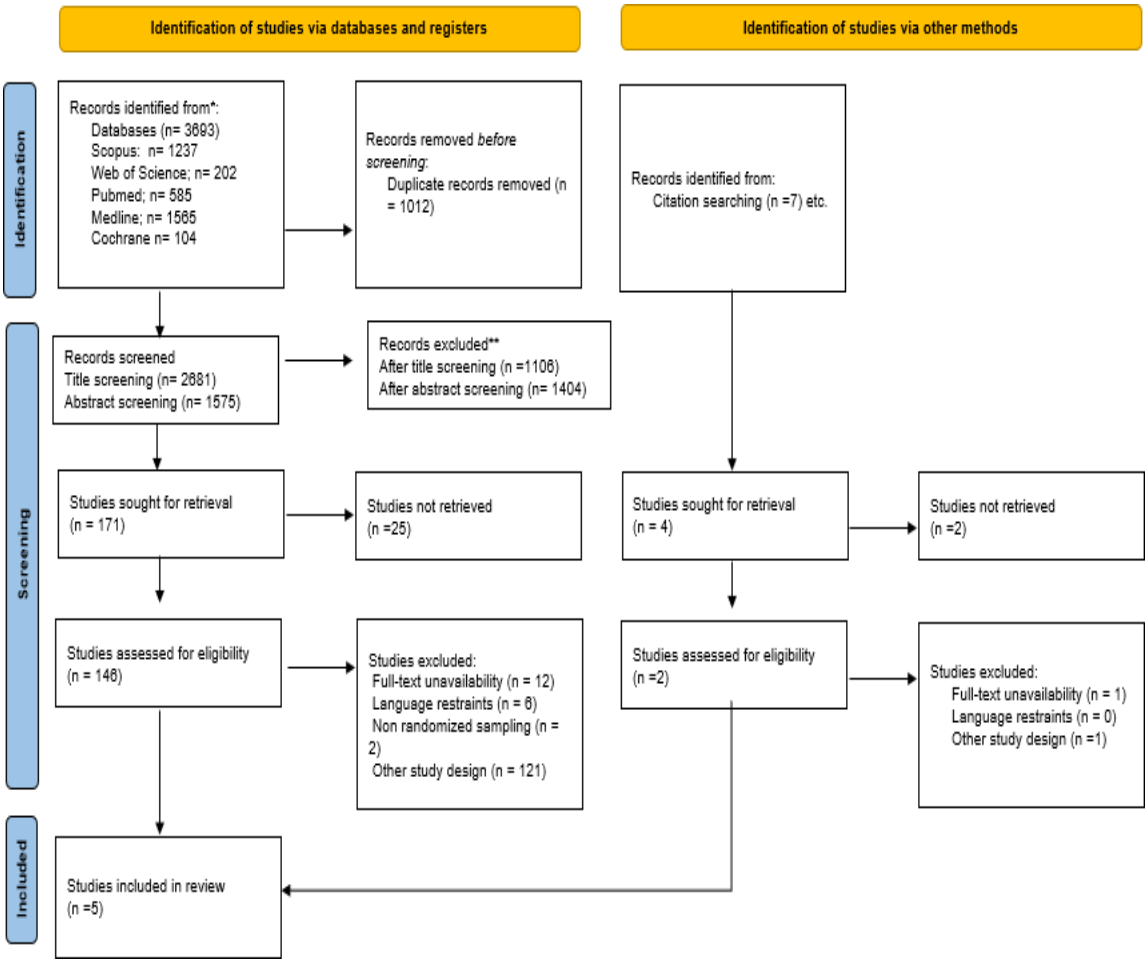

Figure 1: PRISMA 2020 flow diagram which included searches of databases, registers and other sources Mohamed et al compared C1-C2 and Headache SNAG and combination of both with each other dosage of 10 repetitions; 10 seconds hold, 30 seconds rest in between and 5 repetitionsonly for Group C [20, 22]. However, Khalil and associates compared the upper cervical traction for 10 seconds; 10 repetitions in addition to TENS of frequency 2- 200 Hz, 2 channels, 10-250 microseconds pulse duration, 0-100 mA power range, Exercises for deep cervical flexor strengthening for 10 seconds hold, 10 second relax, 10 repetitions for 1week with only exercises, ultrasound, TENS of similar dosage in other group [21].

Outcome Measure

Pain Outcomes: Headache Frequency and Intensity

All the investigations assessed the effect of interventions on Headache intensity, 3 studies measured the intensity of pain using Visual Analog Scale (VAS) [18, 19, 20], while one study assessed it using Numeric Pain Rating Scale (NPRS) [21], Mohamed et al. measured headache intensity in association with effects of headache on social and cognitive functioning using HIT-6 (Headache Impact Test) [22]. Headache frequency was assessed in 2 studies, Nambi and colleagues measured it in number of days of occurrence of headaches per week for 4 weeks while Khalil et al. measured it in number per week [19, 21]. Headache frequency and intensity were assessed to measure the differences in severity of headache.

Functional Outcomes: Cervical Disability and ROM

4 trials investigated the treatment effects on ability of patients to perform activities using Neck Disability Index (NDI) [19, 20, 21, 22]. Nambi and colleagues, Mohamed and colleagues in addition to NDI used HIT-6 to assess the CGH disability [19, 22].

ROM for cervical spine rotation, flexion and extension was measured using goniometer in one study [20], while Flexion Rotation test was performed to check rotation in 3 studies to check for rotation ROM [19,21,22].

Psychological Outcomes: Other outcome measures

Hamilton Anxiety Scale (HAMA) and Hamilton Depression Scale (HAMD) was utilized by Jin et al. to assess the impact of CEG on psychological state of patient while Beck Depression Scale was used by Deniz et al. to assess the depression levels pre and post treatment in patients with CEG [18,20].Jin also measured Regional Homogenity using MRI to assess the correlations with VAS, HAMA and HAMD [18]. Pain Pressure Threshold for cervical region was also measured using digital algometer by Nambi and colleagues to conclude regarding the effects of treatment for CGH on cervical musculature [19]. Cervical Lordosis angle and cervical performance test were recorded by Deniz and associates to evaluate and determine cervical posture and muscle strength of cervical flexors, extensors [20]. DHI also known as Dizziness Handicap Inventory was used by Mohamed et al. to investigate effect of dizziness on quality of life in patients with CGH [22].

Table 2: Intervention Description

Author, year	Type of Research	Sample Size	Disease	Indicators of change	Results
Jin et al., 2023[18]	RCT	N= 40 MMT Group = 20, Health Promotion Group = 20	CGH	CGH pain intensity (VAS), CGH emotion (HAMA, HAMD), Regional Homogeneity	CGH VAS, HAMA, HAMD scores were significantly improved at the end of 10 sessions for MMT group when compared to Health Promotion Group , regional homogeneity revealed negative correlation with VAS.
Nambi et al., 2022[19]	RCT	N= 84 MMT Group = 28 SMT Group = 28 CMT Group = 28	Chronic CGH	CGH frequency, CGH pain intensity (VAS), CGH disability, Neck pain intensity, Neck pain frequency, NDI, FRT, PPT	After 4 weeks intervention CGH frequency (no./ week) was improved in MMT group when compared to SMT and CMT group, similar results at 8 week and 6 month were observed. For other variables no significant differences were observed in 3 groups at 4 week, 8 week, 6 months assessment.
Deniz et al., 2022[20]	RCT	N = 40 Classical Physical Therapy Group = 20 MMT Group = 20	Cervicogenic headache	Cervical lordosis angle, ROM, Cervical Performance test, VAS (Headache intensity), NDI, Beck Depression Scale	VAS scores, Lateral Rotation ROM values and cervical performance tests revealed significant improvements in MMT group when compared to classical physical therapy Group. NDI and Beck Depression Scale scores significantly reduced for both the groups in post test assessment with more reduction in MMT group.
Khalil et al., 2019[21]	RCT	N = 30, MUCMT Group = 15	CGH	Headache frequency, intensity (NPRS),	Between the group analysis for all the variables at 1 week and after 1 week of 3

		TT Group = 15		duration, NDI, Upper Cervical ROM (FRT),	months follow up revealed significant improvements in both the group with profound improvements in MUCMT group when compared to TT group, however, more substantial differences in results were observed in follow up assessment and post treatment when compared to post treatment and pre treatment assessments.
Mohamed et al., 2019[22]	RCT	N = 48 Group A (Headache SNAG) = 16 Group B (SNAG C1-C2)= 16 Group C (Combined) = 16	CGH	Headache intensity, NDI, DHI, HIT- 6, Cervical ROM (FRT)	The outcomes was significantly better in all three groups, however Group C variables indicated highest change when compared to pre treatment values but the values of DHI was comparable in Group B and C.

CGH = Cervicogenic Headache, HAMA= Hamilton Anxiety Scale, HAMD= Hamilton Depression Scale, MMT = Mulligan Manual Therapy, SMT = Spinal Manipulation Therapy, CMT = Conventional Massage Therapy, NDI= Neck Disability Index, FRT = Flexion Rotation Test, PPT = Pain Pressure Threshold, ROM = Range of Motion, MUCMT= Mulligan Upper Cervical Manual Traction, TT = Traditional Treatment, NPRS= Numeric Pain Rating Scale, SNAG= Sustained Natural Apophyseal Glide, DHI = Dizziness Handicap Inventory, HIT = 6- item Headache Impact Test

Table 1: Study characteristics

Author, year	**Description (intervention)**	**Duration of session & Dosage**
Jin et al., 2023[18]	MMT Group - Thrust along with compressive force, patient was asked to do cervical lordosis maneuver. - Postero anterior thrust in upward and anterior direction was applied with patient rotating head to same side Health Promotion Group - Group health education sessions covered topics like the definition of CGH, the main causes of illnesses, daily preventive measures, lifestyle choices, and dietary advice, as well as how to avoid extreme stress, exposure to cold and wind, and extended use of electronics.	MMT Group - 3 repetitions, 10 sessions - 3 repetitions, 10 sessions
Nambi et al., 2022[19]	MMT Group - MMT SNAG on C2 in ventral and upward direction was performed, with overpressure at the end of Cervical Rotation ROM	MMT Group - 10 repetitions; 3 glides/ second, 4 weeks

	SMT Group - Pre manipulation rotation of 30-45^0 on side away from pain, followed by HVLAT on affected side CMT Group - Circular kneading along each cervical vertebrae level on levator scapula, sternocleidomastoid, scalene, and upper trapezius muscles from insertion to origin. - Cervical rotation to the opposite side was used to do circular kneading in the longissimus capitis, splenius capitis, semispinalis capitis, and suboccipital muscles.	SMT Group - At the site of dysfunction, 4 weeks CMT Group - 15 minutes, 4 weeks - 3 repitions, 4 weeks
Deniz et al., 2022[20]	Group 1 - Conventional Therapy- US, TENS, Hotpack on cervical region and isometric exercises Group 2 - Mulligan Mobilization- SNAG over C2 and traction in upper cervical region	Group 1 - Exercises- 5 consecutive days for 2 weeks - 20 minutes hot pack application - US- 5 min right and 5 min left - TENS – 50 Hz, 100 microseconds transition time. Group 2 - 3 days/ week; alternatively, 2 weeks
Khalil et al., 2019[21]	Group A - MUCMT in supine with neck neutral - TT- Hot pack, TENS, Deep Cervical Flexor Strengthening Group B - TT- Hotpack, TENS, Deep Cervical Flexor Strengthening	Group A - 10 seconds; 10 repetitions - TENS – 2- 200 Hz, 2 channels, 10-250 microseconds pulse duration, 0-100 mA power range - Exs- 10 seconds hold, 10 second relax, 10 repetitions, 1week Group B - TENS – 2- 200 Hz, 2 channels, 10-250 microseconds pulse duration, 0-100 mA power range - Exs- 10 seconds hold, 10 second relax, 10 repetitions, 1 week
Mohamed et al., 2019[22]	Group A - Headache SNAG on C2 spinous process with ventral gliding Group B - Rotation SNAG technique C1-C2 was performed, ventral gliding over transverse process of C1. Group C - Combination of both the above techniques	Group A - 10 repetitions; 10 seconds hold, half minute rest within. Group B - 10 repetitions; 10 seconds hold, 30 seconds rest in between Group C - 5 repetitions**;** 10 seconds hold, 30 seconds rest in between

CGH = Cervicogenic Headache, MMT = Mulligan Manual Therapy, ROM = Range of Motion, SMT = Spinal Manipulation Therapy, CMT = Conventional Massage Therapy, HVLAT = High- Velocity Low-Amplitude Thrust, SNAG= Sustained Natural Apophyseal Glide.

Risk of Bias Scores

The studies included in present review majorly reported "Good" quality for methodological assessment. Studies done by Mohamed, Deniz and Jin reported score of "6", "7" and "9" respectively [22,20,18]. The other two studies were scored "8" on 10 on PEDRO quality

Table 3: Risk of Bias Assessment for methodological Quality using PEDRO

Authors, year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Quality**
Jin et al., 2023[18]	Yes	1	1	1	1	0	1	1	1	1	1	Excellent
Nambi et al., 2022[19]	Yes	1	1	1	0	0	1	1	1	1	1	Good
Deniz et al., 2022[20]	Yes	1	1	1	0	0	0	1	1	1	1	Good
Khalil et al., 2019[21]	Yes	1	1	1	0	0	1	1	1	1	1	Good
Mohamed et al., 2019[22]	Yes	1	0	1	0	0	0	1	1	1	1	Good

Figure 2: Cochrane Risk of Bias Assessment for included studies (Analysis is respective to the order of studies mentioned in Table 3)

Intervention Outcomes

Jin et al. concluded that CGH VAS, HAMA, HAMD scores were significantly revamped at the end of 10 sessions for MMT group when compared to health promotion group in agreement with results given by Deniz et al. indicating substantial improvements in VAS scores, Lateral Rotation ROM, NDI and Beck Depression Scale values and cervical performance tests in MMT group when compared to classical physical therapy group. regional homogeneity of left frontal gyrus was found to be positively correlated to VAS and HAMD [18,20]. In a study by Nambi et al., it was concluded that after 4 weeks intervention CGH frequency (number/week) was improved in MMT group when compared to SMT and CMT group, similar results at 8 weeks and 6 months were observed, other variables unveiled significant differences in pre and post test values for all the groups but no relevant in between the group differences were observed [19]. Khalil et al. when compared MUCMT to TT found profound improvements in scores for all parameters with better outcomes in MUCMT group [21]. The outcomes were better in group which underwent both headache SNAG and C1-C2 rotation SNAG when compared to individual treatment group in trial done in 2019 [22].

DISCUSSION

Main findings

The current systematic review determined the impact of MMT on frequency and intensity of headache, cervical disability, ROM and concluded significant improvements in all the included studies for all indicators of change which is attributed to the fact that areas of the midbrain's periaqueductal gray may be responsible for activating and mediating the descending inhibitory pain mechanism. Physiological alterations during mobilization, such as elevated skin temperature and blood circulation, can help lessen discomfort and improve range of motion[23]. In one study, combined therapy was concluded to superior to C1- C2 SNAG and headache SNAG alone which is due to the combined effect of both the interventions possibly resulting indirect activation of cervical facet joint mechanoreceptors that, in line with the gate control theory, reduce discomfort [22, 24, 25].

Headache Frequency, Intensity and Cervical ROM

Cervical traction and C2 SNAGs had better effects than exercise interventions and conventional protocols, possibly due to their greater localization and specificity to the facet joints of the upper cervical region, where dysfunction often increases. This led to a reduction in pain intensity and an improvement in functional level. Additionally, in four studies, the MMT groups' upper cervical rotation ROM was better than that of other groups, reflecting the underlying pathology of CGH, specifically the limited upper cervical ROM, which was documented by Hall et al. and Page et al. as a valid reason for CGH [26, 27].

Psychological Status

The analysis of regional homogeneity to assess local brain activity done by Jin et al. found left frontal lobe activity to be reduced in MRI in CGH patients which is due to the ideology of chronic pain resulting in modulation of chemicals and hence alteration of pain perception resulting in cognitive and emotional stress in patients with CGH, which however was found to be improved as VAS and HAMD scores reduced in both the groups with Mulligan manoeuvre being superior in outcomes, indicating positive effects. Blood flow to middle temporal gyrus was also found to be decreased after treatment of CGH, which responsible for depression, anxiety, hence indicating positive effects of various interventions which induce central sensitization and concludes that CGH have a substantial impact in causing psychological stress [18, 28, 29, 30].

Beck Depression Scale also evaluated reduced depression in study done by Deniz et al. in both the groups in conjugation with similar outcomes in a study done to analyze effects that botulinum toxin type A has on treatment of depression in CGH patients by Karataset al. with similar outcomes suggesting reduced depression due to reduction in pain intensity [31].

Dizziness

Mohammed et al., concluded reduced dizziness with Mulligan SNAG manoeuvre to cervical spine justified by hypothesis that dizziness could be a cause of dysfunction of cervical mechanoreceptors and deep musculature, abnormal proprioceptor activation affecting their input to vestibular nucleus and hence creating imbalance in vestibular organs which gets resolved once the correction of malpositioning is done, which is core principle for MMT [32, 33, 34].

Cervical Lordosis and Cervical Performance

According to Deniz et al., neck traction combined with cervical extension exercise is an effective way to restore the normal lordosis angle, as discussed by Fortner. They also found that cervical performance increased and the cervical lordosis angle decreased, which may be caused by kyphosis in CGH or a decrease in cervical lordosis [35].

Limitations

This systematic review is written for studies which were published in English language only, with variation in interventions to which MMT was compared. Furthermore, the duration of the treatment varied significantly in all the studies which can be studied further. PROSPERO registration was not obtained for this systematic review.

Future Scopes and implications

Future Implications can focus on investigations which compare various manual therapy techniques to mulligan therapy which will concise the report and strengthen the evidence. Also the treatment duration can be more specific when intervention given is manual therapy.

CONCLUSION

This review concluded positive implications of MMT on headache intensity, frequency, however very few studies with small sample size have been conducted but the comparator groups included conventional protocols along with manipulative therapy groups included conventional protocols along with manipulative therapy, health promotion intervention which gives a direction to clinicians to use the MMT, health promotion intervention which gives a direction to clinicians to use the MMT in cases of CGH in addition to protocols or individual SNAGs based upon the necessity to accelerate the protocols.

Ethical approval statement

Ethical approval from specific board was not applicable for the current review, however the registration was done with PROSPERO, international prospective for registration of systematic reviews to ensure the transparency of the study.

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