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DRY NEEDLING AS AN ALTERNATIVE PHYSICAL THERAPY TREATMENT FOR PATIENTS WITH CERVICOGENIC HEADACHES: A SYSTEMATIC REVIEW

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ABSTRACT

Background: There has been an increase in prevalence in cervicogenic headaches (CGH) which is commonly accompanied by neck pain, decreased cervical range of motion (ROM), and other symptoms related to neck movement.

Purpose: The objective of this systematic review was to compare manipulation/mobilization versus dry needling (DN) to determine which treatment is most effective in improving pain intensity, ROM, and frequency in individuals with CGH.

Methods: Current literature was retrieved from a search using Pubmed and EBSCO (Medline) databases. The following keywords were used to guide searches: “cervicogenic” “headache” “neck pain” “dry needling” “manipulation” “mobilization” “manual therapy”. After filtering, 10 studies met inclusion and exclusion criteria such as treatment via manipulation/mobilization or dry needling, diagnosis of CGH, no other treatments or headache diagnoses were the focus of the study, or outcome measures not aligned with our purpose. All studies were appraised by 2 raters using the PEDro scale, and PRISMA guidelines were followed.

Results: Of the 1,406 identified studies, 10 randomized control trials were eligible for review. Only 7 studies met our threshold for quality on the Pedro scale (≥ 5). Two studies of good quality and one of fair quality suggested that DN was an effective treatment; two studies of good quality suggested that manipulation was significantly better than placebo and mobilization; one good quality study suggested that mobilizations worked significantly better than placebo but had a small effect size; and one good quality study suggested that manipulation combined with DN was significantly effective as treatment. Positive treatment benefits for DN were evident immediately after treatment and persisted for up to 6 months, whereas manipulation was evident immediately and for up to 3 months due to the length of the study. The analysis of the data revealed that DN and manipulations significantly improved headache frequency, intensity, and cervical range of motion. However, more research is necessary to establish if a single treatment is sufficient or whether a mix of treatments is more effective.

Conclusion: This systematic review found both dry needling and manual therapy techniques as effective treatment methods when treating individuals with cervicogenic headaches. However, due to limited research directly comparing the two treatment methods no treatment is found to be superior than the other for improving pain intensity, cervical ROM, and frequency in patients with cervicogenic headaches.

BACKGROUND

Headaches are becoming more prevalent and have been recorded to affect 47% of the population. Cervicogenic headaches(CGH) alone are known to affect 22-25% of the adult population.[1] CGH are classified as secondary headaches due to originating from other musculoskeletal issues such as whiplash disorders, sustained postures, hypertonicity of head and neck muscles, and upper cervical hypomobility.[2] The diagnostic criteria for CGH include: the onset of headaches is equal to the onset of cervical disorders, headaches relieved with the treatment of cervical disorders, decreased cervical motion causing a provocation of headaches, and disappearance of headache symptoms following diagnostic blockage to the cervical structure of interest (although diagnostic blockade was not required to be included in our review).[3] The interventions presented in the literature are aimed at treating the primary musculoskeletal deficits mentioned above, but no single therapy plan stands out as being superior to the others. Manipulation and mobilization are commonly researched treatments for CGH, however, research on dry needling and its effects on CGH is limited. From this point on, unless specifically mentioned on their own, mobilization and manipulation shall be referred to as manual therapy. Dry needling (DN) is a growing treatment method for many types of conditions and research needs to continue to determine its efficacy.

According to the clinical practice guidelines (CPG) published in 2017, the treatments best suited for CGH are C1-2 self-sustained natural apophyseal glide, cervical manual therapy, thoracic manipulation, and strengthening.[4] Dry needling was not studied in the CPG for the CGH classification but demonstrates promising results.

DN is an emerging treatment with the capacity to decrease pain, muscle tension, and dysfunction which aids in improving the patient's quality of life.[5,6] Recent evidence demonstrates DN as an effective treatment for reducing pain and increasing pressure pain threshold (PPT) in patients with chronic neck pain (CNP) and low back pain (LBP).[7,8] Although CNP cannot be attributed to a specific cause, it is associated with potential damage to cervical structures, similar to those of CGH. In the systematic review done by Rodriguez et al. DN used on trigger points was shown to increase ROM, and PPT, as well as decrease pain and disability at 3 and 6 months. LBP presents with similarities to CGH such as pain, stiffness, and the presence of myofascial trigger points. In the study by Matin-Corrales, DN used on gluteal trigger points was shown to decrease pain and increase PPT that lasted up to 3 months.[7,8] Due to these similar musculoskeletal impairments associated with CNP, LBP, and CGH, the benefits associated with dry needling may be transferable in the treatment of CGH.

The effects of manual therapy for the treatment of CGH have been extensively studied; however, few studies compare manual therapy to dry needling. Therefore, the objective of this systematic review was to compare manual therapy to DN to determine which treatment is most effective in improving pain intensity, cervical ROM, and frequency in individuals with CGH.

METHODS

Data Sources and Searches

A systematic search of current published literature was performed in the following databases: Pubmed and EBSCO (Medline). The following terms were used alone or in combination: "cervicogenic" "headache" "neck pain" "dry needling" "manipulation"

"mobilization" and "manual therapy". Boolean operators "AND" and "OR" were used to narrow the results. The PRISMA guidelines, including the checklist and 2020 flow diagram, were utilized to direct our systematic review and search process.

Study Selection

The following criteria were used to include studies: Diagnosis of CGH via Sjaastad or International Headache Society (IHS) guidelines, and treatment of CGH with manipulations, mobilizations, DN, or a combination of these.[2] The following criteria were used to exclude studies: Other types of headaches were the focus of the study, different treatments were used, and outcome measures were not focused on pain intensity, range of motion (ROM), and/or pain frequency/duration. There was also a limit of 10 years for the publication date of the research studies included.

Data Extraction and Quality Assessment

The PEDro scale was used to determine the methodological quality of clinical trials and the scoring was graded as 0-3 are considered "poor", 4-5 "fair", 6-8 "good", and 9-10 "excellent".[9] The PEDro scale was scored by two investigators and compared to the score that was provided on the PEDro website to check the reliability of the measure. The PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analyses) guidelines were followed including, the checklist and 2020 flow diagram.[10] An intraclass correlation coefficient (ICC) analysis was performed to determine the reliability of the PEDro scoring, using Excel functions.[11]

Data Synthesis and Analysis

The articles were then manually evaluated, and essential information was pulled out and summarized.

Figure 1 - PRISMA 2020 Flow Diagram.

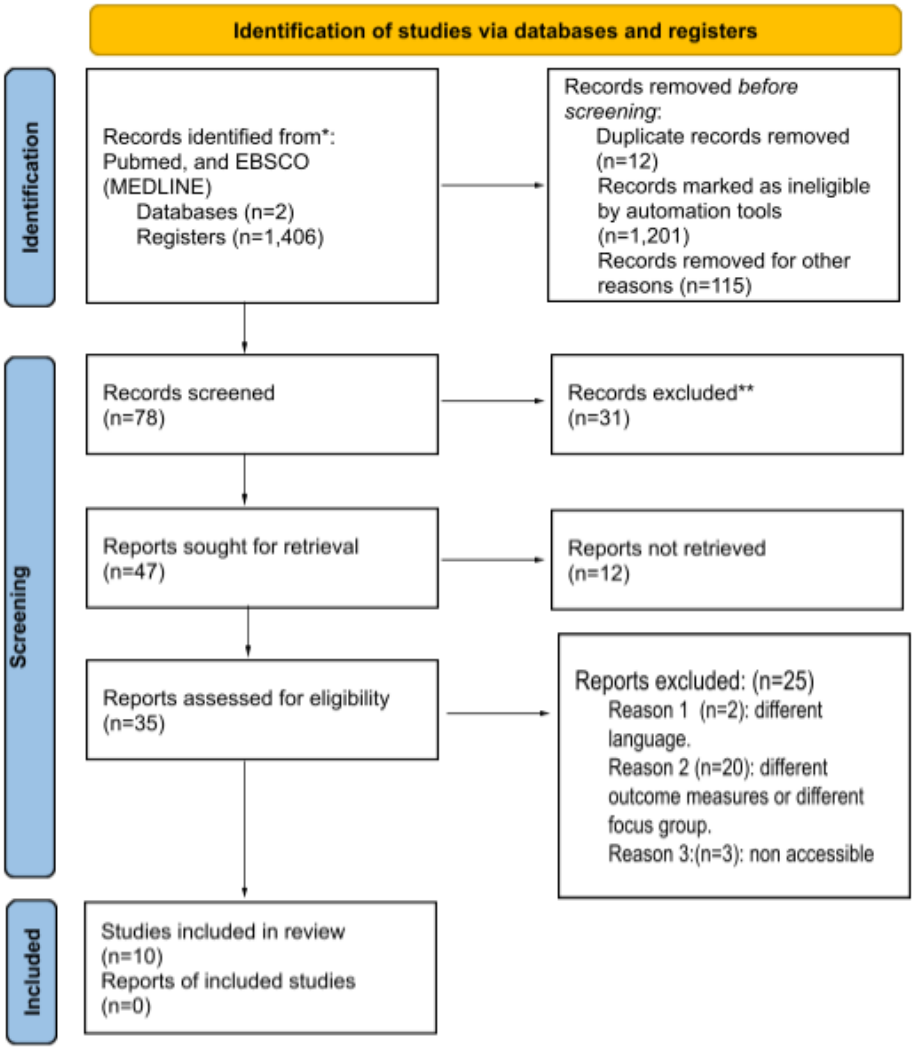

Figure 1. PRISMA 2009 flow diagram. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; RCT, randomized controlled trial.

Figure 2 - PEDro Scale Table.

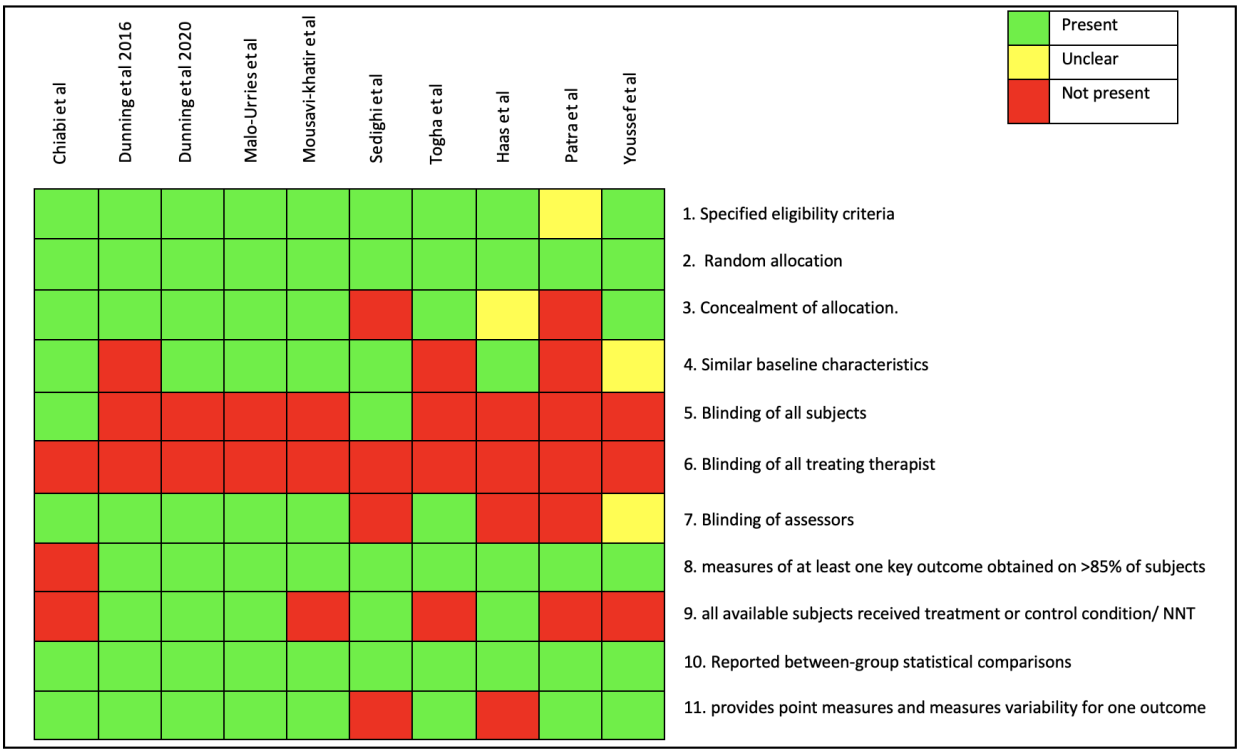

Figure 2. ICC was determined by using Excel functions and only articles 1-7 were compared due to missing scores from the PEDro website. The ICC was determined to be .83 which is labeled as good reliability. PEDro scores of 0-3 are considered 'poor', 4-5 'fair', 6-8 'good', and 9-10 'excellent'.

Table 1 - Article Summary.

Study	Intervention /Exposure	Comparator	Outcomes	Main Findings
Mousavi-Khatir 2021 RCT n=69	**DN (n=23)** • conventional PT + 4 sessions of DN on the cervical muscles **Placebo DN (n=23)** • conventional PT + 4 sessions of SDN at a point away from the trigger point	**Control Group (n=23)** • conventional PT • 15 session (3/wk) of TENS, infrared, and US in cervical spine AND neck exercise program including craniocervical flexion	**Primary:** • HI (NPRS) • HF (days in past week) **Secondary:** • ND (NDI, iranian version) • deep cervical flexor performance (CCFT) • ROM (goni, flex, ext, L/R rot)	**HI (NPRS)** • Decreased significantly in DN vs sham and control groups after treatment and during all follow-ups. **HF** • Reduced in all groups with no significance between groups **ROM** • Higher cervical ROM in DN vs sham and control groups.
Dunning et al 2020 RCT n=142	**Thrust spinal manip + DN (n=74)** • DN: 8-12 needles including 6-8 occipito-cervical points, 1 distal point in ipsilateral hand, and up to 5 oculos frontotemporal points based on TrP • 1-2x/wk for 4 wks	**Nonthrust spinal mob + exercise (n=68)** • C1-C2 or T1-T2 mobilization + periscapular & craniocervical flexion exercises • 1-2x/wk for 4 wks	**Primary:** • HI (NPRS) • Measured at baseline, 4wks, and 3 months (MCID=2.5) **Secondary: HF, HD, ND** • NDI (MCID=7.5) • Medication intake • Global rating of change (GRC)	**HI (NPRS)** • SM+DN had significantly greater reductions in HI at 4 wks and 3 mo. **HF** • Better in the SM+DN group at 4 wks and large for at 3 mo
Malo-urries et al 2017 RCT n=82	**Upper cervical translatoric spinal mobilization (n=41)** • 30 min treatment session 30-sec series of TSM • No pain reported during intervention	**Control group (n=41)** • no intervention, remained supine for 30 min	**Primary** • Cervical mobility • Cervical pain pressure threshold **Secondary** • HI (VAS)	**ROM** • Significant increase in general CROM was observed immediately after the intervention • Effect size was .2 (classified as small in this study) • Control group had significant reduction only in flexion and total ROM **HI (VAS)** • Immediately after UC-TSM HI was significantly lower. Between group effect size: large • Control group increased from 1.58 to 2.02.

Chaibi et al 2017 RCT n=19	**SMT (n=4)** • Chiropractic, the Gonstead method	**Sham manipulation & Control (n=4 each)** • continued usual management with no manual therapy	**Primary** • HF • HD • HI • Headache index	**HF** • HA frequency in SMT and sham decreased across the follow ups leading to 12 months • Headache index improved in the SMT group at all time points, while sham improved at 6 and 12 month follow up • Control group remained unchanged during the whole study period
Sedighi et al 2017 RCT n=30	**DDN (n=15)** • Into the upper trapezius and suboccipitals • One 15 min treatment session	**SDN (n=15)** • Inserted into subcutaneous trigger points • One 15 min treatment session	**Primary** • Muscle tenderness (0-4 scale) • Neck ROM (0-4 scale) • Headache Index	**HF, ROM,& HI** • DDN and SDN may be effective for reducing headache index [HI x HF (amount of days)], trigger point tenderness, and for increasing FRI and active CROM in individuals with active TrP in upper traps and Suboccipitals • Headache index in both groups significantly improved immediately after and after 1 week but the difference between groups was not significant

Dunning et al 2016 RCT n=110	**Cervical and thoracic manipulation (n=58)** • R and L C1-2 articulations • Bilateral T1-2 articulations • 6-8 treatment sessions	**Mobilization and exercise (n=52)** • R and L C1-2 articulations • Bilateral T1-2 articulations • 6-8 treatment sessions	**Primary:** • HI (NPRS) **Secondary - HF, HD, ND** • NDI • Medication intake • Global rating of change (GRC)	**HF & HI** • Manipulation group had significantly greater reductions in HI, ND, HF, HD, and medication intake
Togha et al 2020 RCT n=29	**Treatment groups** • DN (n=10) • ischemic compression (IC) (n=9) 4 treatment sessions within 8 days with one-day intervals between each treatment session	**Control Group (n=10)** • no treatment	**Primary** • HI • HD • HF • MTrP elastic modulus • MTrP area • pressure pain threshold (PPT)	**HF &HI** • In both DN and IC groups, a significant improvement was found in the HI, HD, HF, PPT, and MTrP area but no significant difference between groups

RESULTS

A total of 1,406 studies were identified through a web database search. Twelve studies were removed once duplicates were identified, 1,201 were removed via automation tools, and 115 were removed for various reasons leaving 78 articles for screening. After reviewing abstracts and titles, 35 articles were screened. Upon a more

detailed review of interventions only 10 studies met the criteria and were eligible for full-text review. Three studies were excluded due to not meeting an average PEDro score of at least 5.3. The remaining 7 seven studies addressed our research question, were of higher quality, and were included in our synthesis of information. Three of the included studies investigated DN as the primary treatment, one investigated mobilizations alone, one investigated manipulations alone, and the last two compared two or more of the interventions to each other.

What are the effects of DN on pain as compared to other physical therapy (PT) treatments?

Out of the seven studies examined, four investigated the effects of DN, while the other three investigated other types of treatment methods currently in use to manage CGH.

Dunning 2016 et al. assessed the effects of two intervention groups that either included manipulation or mobilization with exercise, with a total of 110 individuals who were diagnosed with CGH in accordance with criteria established by the Cervicogenic Headache International Study Group. Group one received high-velocity low-amplitude thrust manipulation to C1-2 and T1-2 segments while group two received unilateral grade 4 mobilizations to C1-2 and T1-2 segments. The findings of the study showed a statistically significant improvement (p <0.001) in the numerical pain rating scale (NPRS) score when using C1-2 & T1-2 manipulations, compared to mobilizations of the same areas.[12] It was also stated that the number needed to treat (NNT) was four in favor of manipulations. It is important to note that the physical therapists were allowed to address other spinal vertebrae that were found to be affected, individualizing the

treatment, and increasing the likelihood that the source of impairment was addressed in each patient. Another study by Malo-Urries et al., compared mobilizations to a control group that remained supine for 30 minutes with forty-one participants in each group. Their results showed a statistically significant decrease in pain intensity ($p<0.05$) in the mobilization group compared to the control group. However, the minimal clinically important difference (MCID) was not reached and change was only .5 on the visual analog scale (VAS) meaning mobilization had limited effects on headache intensity.[13] On the other hand, Chaibi et al. investigated the effectiveness of 3 different treatments including spinal manipulations, sham manipulation in an area away from dysfunction, and a control group receiving their usual pharmacological management with no manipulations. The results showed a significant decrease in NPRS in both the manipulation group and the sham group, but not in the control group. These results show that the placebo effect cannot be accurately taken out of the equation, meaning there is only small clinical relevance with these results.[14]

Mousavai-Khatir et al. researched a total of sixty-nine participants diagnosed with CGH, using established criteria via Sjaastad & Fredriksen, which were randomly allocated to three different groups. The three groups included a control group consisting of conventional PT treatment only versus conventional PT plus DN versus conventional PT plus sham DN. Conventional physical therapy consisted of transcutaneous electrical nerve stimulation, infrared, and ultrasound therapy all in the cervical spine.[15] This study found that PT combined with DN decreased NPRS scores significantly ($p<0.001$) and displayed a large effect size in comparison to the two other groups. Additionally, Togha et al. studied the effects of 2 sole intervention groups including ischemic compression

and dry needling compared to a control group of no treatment. They found a significant improvement in VAS scores in the DN group when compared to the control group, but there was no significant difference between DN and ischemic compression. However, the results were only measured after two weeks, and no long-term effects were studied.[16] Lastly, a study by Dunning 2021 et al. investigated the combination of DN and manipulation compared to a combination of mobilization and exercise, using a total of 142 subjects who had been diagnosed with CGH using the standards set out by the Cervicogenic Headache International Study Group. The results showed that manipulation plus DN had statistically greater reductions in NPRS scores at one and three months (p<0.001).[1]

Sedighi et al. took a different approach and looked at the headache index which consists of headache intensity multiplied by days with headache (headache frequency). They classified individuals with CGH based on Sjaastad and Frediksen classification. This study divided thirty patients into two groups; one received deep DN into the upper trap and suboccipital muscles, and the other received superficial DN into subcutaneous trigger points as a control. The authors found a significant reduction in headache index in both DDN and SDN groups (p<0.05) immediately after and 1-week post-treatment. However, the difference between groups was not significant.

What are the effects of DN on Cervical ROM as compared to other PT treatments?

Two articles looked at the effect of DN on the general cervical range of motion consisting of cervical flexion, extension, lateral flexion, and rotation. Mousavi-Khatir et al. found a significant increase in cervical ROM of all planes in participants with CGH who received DN versus sham DN and PT alone groups (p <0.001) at all follow-up

periods of 1, 3, and 6 months.[15] All ROM taken into account had a large effect size (d<0.14).[15] Sedighi et al. showed that deep DN had a greater improvement of cervical ROM (p<0.001) when compared to superficial DN at baseline, immediately after, and 1-week post-treatment. However, both methods of dry needling into trigger points resulted in significant improvement of ROM.[18]

Malo-Urries et al. assessed the effects of two intervention groups that either included mobilizations or no treatment, with a total of 82 individuals who were diagnosed with CGH in accordance with criteria established by Sjaastad and Fredriksen. Upper cervical mobilizations were given to group one, while group two received no care other than lying supine for the full duration of the treatment (30 minutes). The findings of the study showed an immediate significant increase in all cervical ROM after a 30-minute session of upper cervical translatoric spinal mobilizations (p =0.002).[13] However, the effect size of the pre-and post-test was small (d<0.02), and was determined that it had not reached the minimal detectable change.[13]

What are the effects of DN on headache frequency as compared to other PT treatments?

Five of the studies examined used headache frequency (HF) as a stand-alone variable (not combined to create a headache index) and were included in our statistical analysis. Mousavi-Khatir et al. found that DN significantly decreased headache frequency (p<0.001) from baseline to 6 months, however, there was no significant difference found when comparing the DN group to sham DN or control group (p=0.048).[15] Togha et al. also found a significant decrease in headache frequency with DN, but no significant difference from the ischemic compression group (p=1.0).[16]

Although both dry needling and ischemic compression did have a significant decrease in headache frequency when compared to the control group (p<0.001).[16]

According to Dunning 2016 et al., manipulation significantly decreased headache frequency at 1 week, 1 month, and 3 months when compared to the mobilization plus exercise group (p<0.001).[12] Contrarily, Chaibi et al. found that headache frequency significantly decreased in both the manipulation group and sham manipulation groups, with no between-group significance.[14] Dunning 2021 et al. study investigated a combination of manipulation and DN and found a significant decrease in the frequency of headaches when compared to mobilization plus exercise (p<0.001).[17]

Another study looked at HF with a different approach. Sedighi et al. as mentioned above, looked at the headache index which consists of headache intensity multiplied by days with headache (headache frequency). They found a significant reduction in headache index in both DDN and SDN groups (p<0.05) immediately after and 1-week post-treatment but no significant difference between groups. Again, it is unknown how much improvement was contributed to each HI and HF.

DISCUSSION

This systematic study sought to investigate whether dry needling, as opposed to other forms of treatment, is more effective at reducing pain severity, range of motion, and frequency in CGH patients. The articles included in this systematic review fell within good quality evidence according to the PEDro appraisal tool, although these classifications have yet to be validated.[9] According to the results of our systematic review, dry needling has been shown to significantly reduce headache intensity and frequency as well as enhance cervical range of motion.[15, 16, 18] Similar benefits were

seen with manipulations used as a CGH treatment.[12-14] Although dry needling and manipulations are both recommended in the papers as viable treatments for CGH patients, there is currently insufficient data to determine which technique is more beneficial.

When comparing the effects of dry needling to ischemic compression there was no significant difference in effect on outcome measures between the two treatments.[16] This could be due to the similarity in the mechanisms of action for these treatments. Ischemic compression causes ischemia by restricting blood flow; as a result, after compression is relieved, a rush of blood returns to the trigger point, clearing away waste materials and enabling the injured tissue to begin healing.[19] Blood flow is impacted by dry needling as well; micro-damaging the trigger point increases blood flow to the damaged tissues. Additionally, it has been proposed that dry needling has an impact on metabolic mediators, which are involved in healing.[20] Although ischemic compression is effective when targeting superficial muscles, dry needling may be more effective when targeting deeper muscles.[16]

To our knowledge, this is the first comprehensive study comparing the effectiveness of manual therapy and dry needling for the treatment of CGH. Recent research points to a potential benefit of dry needling in the management of CGH. There are currently few studies indicating the effectiveness of dry needling on particular diagnoses because it is still a relatively newer method of therapy. As a result, more studies could be released in the near future. Further study is necessary due to the knowledge gap and lack of agreement over the best strategy to treat CGH, including

whether or not to combine several treatments or if one treatment approach achieves satisfactory outcomes.

Clinical Implications

A prominent feature of CGH is ROM limitations, and although no studies were comparing DN and manual therapy and its effect on cervical ROM, the effect sizes in the individual studies show that there is a stronger relationship between DN and cervical ROM versus a weak relationship with mobilization and cervical ROM.[13, 15, 18] This suggests that DN is the more effective PT treatment for CGH in relation to targeting cervical ROM.

When determining whether or not DN would be something to consider in patients in the clinic it is important to note that all participants in DN studies had a presence of active trigger points in at least one of the muscles surrounding the neck.[15, 16,17,18] Whether electrical stimulation was present or not, benefits were observed. Conversely, Dunning 2021 et al. found that for every 4 CGH patients treated with manipulations as opposed to mobilizations, 1 patient showed a significant reduction in headache intensity.[12]

Limitations

The main limitation of our review may be the insufficient research comparing DN to manual therapy and DN as a standalone treatment. This could be due to DN being a new emerging trend and the lack of long-term studies being conducted or published leaving our recommended purpose statement vague. The heterogeneous techniques targeted during treatment in our selected research were another drawback; this further reduces the efficacy of utilizing DN as the exclusive method of treatment.

Due to the nature of the interventions, blinding subjects and treating therapists in the studies was not possible. This could lead to potential bias for treating therapists and a placebo for participants.

CONCLUSION

According to the published literature, both DN and manipulation have been shown to be more effective on all studied outcome measures when compared to mobilizations. Additionally, there is evidence that DN and manipulation are effective when used separately, but there is no evidence to compare group differences. As a result, there is no proof that either DN or manipulation is superior to each other as a stand-alone treatment. Both DN and manipulation are viable options for treating patients with CGH so other factors such as patient preference and response to treatment should take precedence when deciding which treatment to use. Additionally, it should be noted that DN and manipulation combined were effective in treating symptoms and ROM deficits, and that combination of these two approaches should be taken into account when treating patients with CGH. By understanding the benefits of each treatment, therapists can create a more thorough plan of care when treating patients with cervicogenic headaches in consideration of the findings of this study.

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