International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 24, No. 6, p. 170-177, 2024

INNSPUB
RESEARCH PAPER OPEN ACCESS

Rehabbing migraine: A pilot study on multimodal physiotherapy for pain, strength, disability, posture, and quality of life

Saurabh Kumar*[1], M. Ejaz Hussain[2], Sonia Pawaria[3]

[1]*Faculty of Physiotherapy, SGT University, Gurugram Haryana, India*

[2]*Faculty of Allied Health Sciences, SGT University, Gurugram Haryana, India*

[3]*Department of Physiotherapy, Gurugram University, Gurugram Haryana, India*

Key words: Migraine, Allodynia, Posture, Migraine disability, Quality of life

http://dx.doi.org/10.12692/ijb/24.6.170-177 Article published on June 11, 2024

Abstract

Migraine is a severe headache that causes throbbing, pulsing head pain on one side of the head. The headache phase of a migraine usually lasts at least four hours, but it can also last for days. Considering the multitude of contributing factors to migraine, a multimodal treatment may be an effective therapeutic option. The purpose of this study was to evaluate the benefits of the multimodal approach, including cervical spine traction, myofascial release, trigger point release, relaxation exercise, stretching and strengthening exercises, in the treatment of patients with migraine. Sixteen 18-55 years old individuals both male and female diagnosed with migraine were randomly assigned into two groups; Group A (control group, n = 8) who received Active ROM of Cervical and active stretching exercises only the multimodal approach or group B (experimental group, n = 8) who received the multimodal approach. The trial evaluated the cutaneous allodynia, craniovertebral angle (CVA), disability, posture, cervical deep flexor strength and quality of life at baseline, end of 4th weeks and end of 8th weeks after intervention. Following the 8 weeks, multimodal exercise program significant improvements in cervical deep flexor strength, posture, disability and quality of life were observed in intervention group compared to the control group. Finding of the present study showed that a multimodal exercise program improving problems associated with migraine in patients.

* **Corresponding Author:** Saurabh Kumar ✉ saurabh04pt@gmail.com

Introduction

Migraine is a neurological disease considered as the second leading cause of disability, affecting over one billion people globally (de Almeida Tolentino *et al.*, 2021). It is characterized by severe, recurring headaches on one or both sides of the head. The headaches can last for hours to days and are often accompanied by nausea, vomiting, and sensitivity to light and sound (Yan *et al.*, 2012; Cutrer, 2010). Migraine, without aura is a type of headache that occurs in episodes and tends to recur. It has symptoms and features that make it different from types of headaches such as cluster headaches or tension type headaches. It's common for individuals to have a combination of migraines with and without aura (Sharpe *et al.*, 2019). The International Classification of Headache Disorders 3rd Edition provides criteria, for this condition (HIS 2018). It has an influence, on the disability of individuals under the age of 50 than any other condition and it is also acknowledged by the World Health Organization as a primary contributor, to disability (Carvalho *et al.*, 2020). Migraine attacks can be different from person to person in terms of how often they occur, how severe they are, and how long they last. Stress can make migraine attacks worse in all of these ways. Migraines often lead to disability, can result in missed work. These attacks are an occurrence, in the brain that can last for hours or even days happening repeatedly (Ruschel and De Jesus 2023; Lawler *et al.*, 2006) People with migraines often experience hypersensitivity to touch (allodynia) and increased pain sensitivity (sensitization), especially in the face, back of the head, and neck (Lawler *et al.,* 2006). Research shows that 80% of people with migraines also experience neck pain. This is more common than nausea, another common migraine symptom. Neck pain can worsen migraines and make medication less effective. It can also be triggered by tension in the neck muscles. Studies have shown that people with migraines have imbalances in their neck muscles, especially when they do activities that require force. Migraines affect about 10-12% of the population and can significantly impact their ability to work, live, and participate in social activities (Carvalho *et al.,* 2020; Luedtke *et al.,* 2020; Ferracini *et al.*, 2017).

Both pharmaceutical and non-pharmacological treatments are available to reduce headache episodes their frequency and intensity. Pharmacological therapy appears to be effective for prophylaxis and some acute cases. However, occasionally treatment is unsuccessful or has negative effects, and some patients end up with chronic illnesses. Chronic headaches increase the number of medical visits and can even result in drug overuse headache, which costs the healthcare system expense. Physiotherapy, which includes many modalities such aerobic exercise, manual therapy, electric stimulation, therapeutic pain neuroscience education, and relaxation therapy, is a non-pharmacological treatment for migraine (Lipton *et al.,* 2008). After reviewing the literature, more than 90% of patients reporting migraine have cervical musculoskeletal dysfunction (Carvalho *et al.*, 2020). Despite the prevalence, functional impairment, and economic consequences of migraine sufferers, there is a substantial gap in the literature exists, failing to provide sufficient and high-quality evidence to effectively guide the conservative management of migraine (Luedtke *et al.*, 2020). From a clinical perspective, considering the diversity of the contributing factors to migraine, a multimodal treatment might be considered as an effective therapeutic option. Nevertheless, there is a lack of randomized clinical trials evaluating the efficacy of this approach. Therefore, this research aimed to investigate the effects of a multimodal approach on various clinical outcomes in migraine.

Materials and methods

Participants

In this pilot study a convenience sample was recruited from the SGT Medical College Hospital &Research Institute, Gurugram Haryana. Sixteen individuals diagnosed with migraine referred to the physiotherapy department by physician/neurologist were sent information about the study prior to their first visit, inviting them to take part in the study. Individuals who opted to participate in the study were assessed, who then determined if they fit the inclusion criteria of the study. Individuals were included if they were between the ages of 18-55 years both male and female and reported Headache attacks

lasting 4-72 hours (when untreated or unsuccessfully treated). Subject fulfilling diagnostic criteria for migraine without aura, according to the international classification of Headache Disorder 3rd edition (ICHD III). Participants were required to confirmed diagnosis by neurologist. Concomitant primary or secondary headaches, a history of trauma to the face or neck, a history of cervical disc herniation or spondylolisthesis, any systemic degenerative disease (such as lupus erythematosus or rheumatoid arthritis), pregnancy, and/or beginning a new migraine medication three months prior to the trial's commencement, as well as congenital conditions like torticollis, muscular dystrophy, spina bifida, etc., were among the criteria for exclusion. The inclusion and exclusion criteria were based on previous studies investigating active management of patients with migraine (Gupta *et al.*, 2023; Rezaeian *et al.*, 2021; Rezaeian *et al.*, 2019; Espi-Lopez *et al.,* 2018; Dittrich *et al.,* 2008).

Procedure

Individuals with migraine selected for the study were diagnosed by a neurologist as per ICHD III guidelines. All individuals were randomly measured at baseline (pre- test) and following the intervention period (post- test). Following initial assessment, a structured exercise program was administrated to all individuals for 50 min per session, over a period of eight (8) weeks for a total of twenty-four (24) sessions. For experimental group, the 5 min of program included Relaxation Exercise. Manual Traction to the cervical spine Upper cervical Traction with diaphragmatic breathing was administered for five (5) minutes during each session. Myofascial Release (MFR) for Suboccipital muscles, Upper Trapezius, Sternocleidomastoid and Temporalis was administered for fifteen (15) minutes during each session. Myofascial Trigger point release for Suboccipital muscles, Upper Trapezius, Sternocleidomastoid for ten (10) minutes. Strengthening Exercise for Deep neck flexor of cervical spine, Scapular Stabilization exercise was administered for ten (10) minutes. And Stretching Exercise for Upper Trapezius and Sternocleidomastoid was administered for five (5) minutes during each session. While, subjects in control group were asked to continue their usual migraine care and self-management strategies. They also attended a single 50-minute appointment to learn about therapeutic pain neuroscience education and how to use a daily headache diary. In addition, to enhance health care attention and control the placebo effect they were asked to do active range-of-motion exercises for the neck for 5 minutes and active stretching exercises for 5 minutes, three days per week for 8 weeks.

Outcome measures

The following battery of reliable and valid tests were used to measure migraine related disability, posture, muscle strength and quality of life.

Cutaneous allodynia

Cutaneous Allodynia was measured by 12-item Allodynia Symptom Checklist (ASC-12). Twelve items about the frequency of different allodynia symptoms in relation to headache attacks were included in the ASC. Items were scored as 0 (i.e. never, rarely, or does not apply to me), 1 (less than half the time), and 2 (half the time or more), yielding scores that ranged from 0 to 24. The presence of cutaneous allodynia is indicated by a sum of points equal to or more than 3 (Lipton *et al.*, 2008).

Migraine-related disability

Severity of migraine-related disability was assessed by Migraine Disability Assessment questionnaire (MIDAS). The MIDAS questionnaire had a 4-point grading system: grade 1 (scores 0–5) represented little or no disability; grade 2 (scores 6–10) represented mild disability; grade 3 (scores 11–20) represented moderate disability; and grade 4 (>=21) represented severe disability (Ghorbani & Chitsaz 2011).

Cervical deep flexors strength

The muscular performance of the cervical deep flexors will be evaluated by using the CCFT, a neuromuscular low-load test used to evaluate the activation and endurance of the deep flexors (Benatto *et al.*, 2020).

Posture

Cervical spine Posture was assessed by Craniovertebral angle. Photogrammetry shall be used to measure the CVA on a sagittal plane (Sohn *et al.*, 2010).

Quality of life (QOL)

The migraine-specific quality of life questionnaire (MSQoL) was used to measure quality of life. The 14-item Migraine-Specific Quality of Life Questionnaire (MSQ) version 2.1 assesses the impact of migraine across three essential aspects of HRQL (role function-restrictive (RR), role function-preventive (RP), and emotional function (EF)) of a patient's has been affected by migraines during the previous four weeks (Rendas-Baum *et al.*, 2013).

Results

Outcome measures were analysed using a repeated measures ANOVA post hoc test for comparing mean within the group and independent t-test to compare the mean between the groups. All comparisons were evaluated at $p < 0.05$ level of significance.

Table 1. Effect of treatment on different variables within groups

Variable	Group	Mean (Standard Deviation)			F	*p*	Measurement time comparison mean difference (Bonferroni post hoc value); sig		
		T1	T2	T3			T1-T2	T1-T3	T2-T3
ASC	CG	6(0.93)	5.75 (0.71)	5.5 (1.07)	1.91	0.185	0.25 (1); 1	0.5 (1.53); 0.51	0.25 (1.53); 0.51
	EG	6.13 (0.84)	5.63 (0.74)	4.13 (0.84)	45.5***	< .001	0.5 (2.65); 0.09	2 (10.58) ***; <.001	1.5 (5.61); 0.002
MIDAS	CG	26.3 (11.09)	24.9 (10.01)	23 (9.67)	3.02	0.081	1.38 (2.31); 0.163	3.25 (1.98); 0.266	1.88 (1.26); 0.749
	EG	27.88 (3.94)	20.5 (7.21)	8.13 (2.59)	45.1***	< .001	7.38 (3.11)*; 0.052	19.75 (12.99)***; < .001	12.37 (5.38); 0.003
CFT	CG	4.5 (2.33)	5 (1.85)	5.5 (2.07)	2.33	0.133	-0.5 (-1.52); 0.511	-1 (-1.871); 0.311	-0.5(-1); 1
	EG	5.5(2.07)	8 (2.14)	15 (4.54)	49.7***	< .001	-2.5(-3.42)*; 0.034	-9.5 (-9.67)***; < .001	-7(-5.86); 0.002
CVA	CG	45.3(0.89)	45.5 (0.76)	45.6 (0.52)	2.88	0.089	-0.25(-1.53); 0.511	-0.375(-2.05); 0.239	-0.125(-1); 1
	EG	45.6 (0.52)	46.8 (1.04)	48.9 (0.84)	81.4***	< .001	-1.13(-3.81)*; 0.02	-3.25(-19.86)***; < .001	-2.13(-7.2)***; < .001
MSQoL	CG	50 (4.91)	50.5 (4.99)	51.4 (3.63)	2.67	0.104	-0.5(-1.65); 0.429	-1.375(-1.88); 0.307	-0.875(-1.29); 0.717
	EG	50 (2.96)	61.1 (8.74)	87.6 (2.71)	104***	< .001	-11.1(-3.44)*; 0.033	-37.5(-42.49)***; < .001	-26.4(-8.25)***; < .001

Table 2. Comparison of mean of effect of treatment on different variables between the groups

Variable		t-value	p-value	Mean difference	Effect size
ASC	T1	-0.28	0.781	-0.13	-0.14
	T2	0.34	0.736	0.13	0.17
	T3	2.87**	0.012	1.38	1.43
MIDAS	T1	-0.39	0.702	-1.63	-0.20
	T2	1.00	0.333	4.38	0.50
	T3	4.20***	< .001	14.88	2.10
CFT	T1	-0.91	0.38	-1.00	-0.45
	T2	-3.00**	0.01	-3.00	-1.50
	T3	-5.39***	< .001	-9.50	-2.69
CVA	T1	-1.03	0.319	-0.38	-0.52
	T2	-2.76	0.015	-1.25	-1.38
	T3	-9.36***	< .001	-3.25	-4.68
MSQoL	T1	-0.01	0.99	-0.03	-0.01
	T2	-2.99**	0.01	-10.65	-1.50
	T3	-22.59***	< .001	-36.19	-11.29

CG: Group A control Group; EG: Group B Experimental group. ASC: Cutaneous Allodynia; MIDAS: Migraine Disability Assessment Questionnaire; CFT: Cranio-cervical flexion test; CVA: Craniovertebral angle; MSQoL: migraine-specific quality of life questionnaire

Demographic

Subjects in Experimental group on average aged 25.5(±2.78), while subjects of control group had average age of 20.5(±1.51). There were 25% males and 75% females in control group while in experimental group 37.5% were males and 62.5% females.

Effect of treatment on cutaneous allodynia, posture, cervical deep flexor strength, migraine related disability and quality of life

There were significant intra group mean differences [95% confidence interval] in EG in Cutaneous Allodynia, Migraine Disability Assessment Questionnaire, Cranio-cervical flexion test, Craniovertebral angle and Migraine-specific quality of life questionnaire were 45.5, 45.1, 49.7, 81.4 and 104 respectively (Table 1). There were no significant intra-group differences in CG in any of the variables ($p \geq 0.05$). In addition, Post hoc Bonferroni test revealed significant mean difference at the end of 8th week in Experiment group. Table 2 shows the results of pairwise comparisons when the effect of the treatment was analysed in each group.

Regarding the differences between groups, there were significant inter-group mean differences [95% confidence interval] in EG in the scores (2.87, 4.20, -5.39, -9.36, -22.59) for different variables at the end of 8th week. Table 3 shows the result for comparison of mean of effect of treatment on the scores of different variables between the groups.

Discussion

Overall, the result of this study found strong evidence in support of benefits following eight weeks, structured multimodal exercise program in patients with migraine without aura. It is noteworthy that significant improvements were reported in the score of MIDAS, CFT, CVA and MSQol scale in migraine patients after treatment. Dittrich et al. reported that 6 weeks combined an aerobic exercise routine with relaxing techniques reduce the self-reported severity of migraine pain. Additionally, it can be posited that various nonpharmacological therapies for migraines, including exercise and relaxation, promote an active behavioural coping mechanism that facilitates beneficial cognitive processes such as fostering a sense of self-control and self-regulation (Dittrich *et al.*, 2008).

Multimodal physiotherapy program administered in this study were safe, feasible and an effective method of improving posture, quality of life in migraine patients. These findings are consistent with previous studies reporting that manual therapy, stretching, myofascial release, trigger point release, massage etc. significantly reduced headache frequency, intensity, pain and improves posture, migraine related disability and quality of life (Munoz-Gomez *et al.*, 2021; Rezaeian *et al.*, 2021; Rezaeian *et al.*, 2019; Espi-Lopez *et al.,* 2018; Bevilaqua-Grossi *et al.*, 2016).

Benefits of multimodal exercise programme successfully decreased self-reported pain frequency, intensity, duration, average pain intensity, most intense pain, mild pain intensity, pain-related disability, and depression and simultaneously enhancing perceptions of functional status, quality of life, and overall health status among migraine patients are well documented (Lemstra *et al.*, 2002), and similar results were found in our study. Active trigger points have been observed to be present in people with migraine (Fernandez-de-las-Penas *et al.,* 2006). The pathophysiology of trigger points has been sought to be explained by a number of theories. muscular fibre, local stiffness, and the blood-flow characteristics of the biochemical environment can all change as a result of muscular overload brought on by low levels of muscle contraction and repetitive, extended activity. In addition, trigger sites have been demonstrated to have more acidic biochemical conditions and high concentrations of inflammatory mediators, which are normally responsible for pain and tenderness (Tsai *et al.*, 2010). Simons states that passive stretching, as used in present study, with a progressive increase in range of motion appears to suppress the alpha motor neuron response and the inhibition of shortened muscle fibres under stretch. Sarcomeres thus revert to their typical length

(Simons, 2008). On the other hand, myofascial release and stretching methods have the ability to modify neck muscle tone via influencing the trigemino-reticular pathway; they may also modify the trigeminocervical nucleus's sensitivity (Piovesan *et al.,* 2007). The current study should be considered as preliminary as the sample size was small, convenient, limited parameter included, results must be interpreted with caution. Future studies should include a larger sample size, a sampling across age groups and other variables.

References

Benatto MT, Florencio LL, Bragatto MM, Dach F, Fernandez-de-las-Penas C, Bevilaqua-Grossi D. 2022. Neck-specific strengthening exercise compared with placebo sham ultrasound in patients with migraine: a randomized controlled trial. BMC Neurology **22(1)**.
https://doi.org/10.1186/s12883-022-02650-0

Bevilaqua-Grossi D, Goncalves MC, Carvalho GF, Florencio LL, Dach F, Speciali JG, Bigal ME, Chaves TC. 2016. Additional Effects of a Physical Therapy Protocol on Headache Frequency, Pressure Pain Threshold, and Improvement Perception in Patients with Migraine and Associated Neck Pain: A Randomized Controlled Trial. Archives of Physical Medicine and Rehabilitation **97(6),** 866–874.
https://doi.org/10.1016/j.apmr.2015.12.006

Carvalho GF, Schwarz A, Szikszay TM, Adamczyk WM, Bevilaqua-Grossi D, Luedtke K. 2020. Physical therapy and migraine: musculoskeletal and balance dysfunctions and their relevance for clinical practice. Brazilian Journal of Physical Therapy **24(4),** 306–317.
https://doi.org/10.1016/j.bjpt.2019.11.001

Cutrer F. 2010. Pathophysiology of Migraine. Seminars in Neurology **30(02),** 120–130.
https://doi.org/10.1055/s-0030-1249222

De Almeida Tolentino G, Lima Florencio L, Ferreira Pinheiro C, Dach F, Fernandez-de-las-Penas C, Bevilaqua-Grossi D. 2021. Effects of combining manual therapy, neck muscle exercises, and therapeutic pain neuroscience education in patients with migraine: a study protocol for a randomized clinical trial. BMC Neurology **21(1)**.
https://doi.org/10.1186/s12883-021-02290-w

Dittrich SM, Gunther V, Franz G, Burtscher M, Holzner B, Kopp M. 2008. Aerobic Exercise with Relaxation: Influence on Pain and Psychological Well-being in Female Migraine Patients. Clinical Journal of Sport Medicine **18(4),** 363–365.
https://doi.org/10.1097/jsm.0b013e31817efac9

Espi-Lopez GV, Ruescas-Nicolau MA, Nova-Redondo C, Benitez-Martinez JC, Dugailly PM, Falla D. 2018. Effect of Soft Tissue Techniques on Headache Impact, Disability, and Quality of Life in Migraine Sufferers: A Pilot Study. The Journal of Alternative and Complementary Medicine **24(11),** 1099–1107.
https://doi.org/10.1089/acm.2018.0048

Fernandez-de-las-Penas C, Cuadrado M, Pareja J. 2006. Myofascial Trigger Points, Neck Mobility and Forward Head Posture in Unilateral Migraine. Cephalalgia **26(9),** 1061–1070.
https://doi.org/10.1111/j.1468-2982.2006.01162.x

Ferracini GN, Chaves TC, Dach F, Bevilaqua-Grossi D, Fernández-de-Las-Penas C, Speciali JG. 2017. Analysis of the cranio-cervical curvatures in subjects with migraine with and without neck pain. Physiotherapy **103(4),** 392–399.
https://doi.org/10.1016/j.physio.2017.03.004

Ghorbani A, Chitsaz A. 2011. Comparison of validity and reliability of the Migraine disability assessment (MIDAS) versus headache impact test (HIT) in an Iranian population. Iranian Journal of Neurology **10(3-4),** 39–42.

Gupta A, Kumar S, Gupta A, Rishi P. 2022. Effect of aerobic exercises and therapeutic pain neuroscience education on disability, pain, head posture and QOL in migraine patients. Comparative Exercise Physiology **19(2),** 1–8. https://doi.org/10.3920/cep220029

International Headache Society. 2018. Headache Classification Committee of the International Headache Society (IHS) The International Classification of Headache Disorders, 3rd edition. Cephalalgia **38(1),** 1–211. https://doi.org/10.1177/0333102417738202

Lawler SP, Cameron LD. 2006. A randomized, controlled trial of massage therapy as a treatment for migraine. Annals of Behavioral Medicine **32(1),** 50–59. https://doi.org/10.1207/s15324796abm3201_6

Lemstra M, Stewart B, Olszynski WP. 2002. Effectiveness of Multidisciplinary Intervention in the Treatment of Migraine: A Randomized Clinical Trial. Headache: The Journal of Head and Face Pain **42(9),** 845–854. https://doi.org/10.1046/j.1526-4610.2002.02202.x

Lipton RB, Bigal ME, Ashina S, Burstein R, Silberstein S, Reed ML, Serrano D, Stewart WF. 2008. Cutaneous allodynia in the migraine population. Annals of Neurology **63(2),** 148–158. https://doi.org/10.1002/ana.21211

Luedtke K, Starke W, Korn K, Szikszay TM, Schwarz A, May A. 2020. Neck treatment compared to aerobic exercise in migraine: A preference-based clinical trial. Cephalalgia Reports **3,** 251581632093068. https://doi.org/10.1177/2515816320930681

Mosallanezhad Z, Rezaeian T, Ahmadi M, Nourbakhsh M. 2021. The impact of myofascial release and stretching techniques on the clinical outcomes of migraine headache: A randomized controlled trial. Journal of Research in Medical Sciences **26(1),** 45. https://doi.org/10.4103/jrms.jrms_745_18

Munoz-Gomez E, Ingles M, Serra-Ano P, Espi-Lopez GV. 2021. Effectiveness of a manual therapy protocol based on articulatory techniques in migraine patients. A randomized controlled trial. Musculoskelet Sci Pract **54,** 102386. https://doi.org/10.1016/j.msksp.2021.102386

Piovesan EJ, Di Stani F, Kowacs PA, Mulinari RA, Radunz VH, Utiumi M, Muranka EB, Giublin ML, Werneck LC. 2007. Massaging over the greater occipital nerve reduces the intensity of migraine attacks: evidence for inhibitory trigemino-cervical convergence mechanisms. Arq Neuropsiquiatr **65(3A),** 599–604. https://doi.org/10.1590/s0004-282x2007000400010

Rendas-Baum R, Bloudek LM, Maglinte GA, Varon SF. 2012. The psychometric properties of the Migraine-Specific Quality of Life Questionnaire version 2.1 (MSQ) in chronic migraine patients. Quality of Life Research **22(5),** 1123–1133. https://doi.org/10.1007/s11136-012-0230-7

Rezaeian T, Mosallanezhad Z, Nourbakhsh MR, Ahmadi M, Nourozi M. 2019. The Impact of Soft Tissue Techniques in the Management of Migraine Headache: A Randomized Controlled Trial. Journal of Chiropractic Medicine **18(4),** 243–252. https://doi.org/10.1016/j.jcm.2019.12.001

Ruschel MAP, Jesus OD. 2023. Migraine Headache (In StatPearls.). StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK560787/

Sharpe L, Dudeney J, Williams AC, Nicholas M, McPhee I, Baillie A, Welgampola M, McGuire B. 2019. Psychological therapies for the prevention of migraine in adults. Cochrane Database of Systematic Reviews. https://doi.org/10.1002/14651858.cd012295.pub2

Simons DG. 2008. New Views of Myofascial Trigger Points: Etiology and Diagnosis. Archives of Physical Medicine and Rehabilitation **89(1),** 157–159. https://doi.org/10.1016/j.apmr.2007.11.016

Sohn JH, Choi HC, Lee SM, Jun AY. 2010. Differences in cervical musculoskeletal impairment between episodic and chronic tension-type headache. Cephalalgia **30(12),** 1514–1523. https://doi.org/10.1177/0333102410372096

Tsai CT, Hsieh LF, Kuan TS, Kao MJ, Chou LW, Hong CZ. 2010. Remote Effects of Dry Needling on the Irritability of the Myofascial Trigger Point in the Upper Trapezius Muscle. American Journal of Physical Medicine & Rehabilitation **89(2),** 133–140. https://doi.org/10.1097/phm.0b013e3181a5b1bc

Yan J, Melemedjian OK, Price TJ, Dussor G. 2012. Sensitization of Dural Afferents Underlies Migraine-Related Behavior following Meningeal Application of Interleukin-6 (IL-6). Molecular Pain **8,** 1744–80698–6. https://doi.org/10.1186/1744-8069-8-6