

[RESEARCH REPORT]

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Is Mobilization of the Cervical Spine Effective in Decreasing Symptoms of Cervicogenic Headache?

Headaches are some of the most common health care complaints in adults and children. They result in multiple days of missed work, billions in healthcare dollars, and a reduction in quality of life. Successful management relies on correctly identifying there origin and contributing factors. Mobilization of the cervical spine has proven to be successful in managing cervicogenic headaches.^{7,8,13,26} This study examines the results of several treatment methods in relieving cervicogenic headaches. The participants in this study were randomly placed into 1 of 3 groups and the results of treatment or lack of, were documented throughout the treatment cycle lasting up to 8 weeks. These groups were a control group receiving no treatment; a non-joint mobilization therapy group whose treatment may have included therapeutic exercise, massage, ultrasound, electric stimulation with heat or cryotherapy; and the joint mobilization group. This group received therapist guided functional mobilization with movement techniques, along with therapist performed mobilization techniques.

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This study was designed to demonstrate the effectiveness of treating cervicogenic headaches with mobilization and self mobilization techniques. While there have been other studies demonstrating the effectiveness of joint mobilization in relieving cervicogenic headaches,^{7,13,31} none have addressed self mobilization by the patient in controlling intensity and duration of symptoms in relation to functional ability.

This study will attempt to answer the following two hypotheses: (1) Subjects who undergo physical therapy intervention for the treatment of cervicogenic headaches will have greater relief, or less frequency, duration, and intensity of headaches, with a lower score on the Northwick Park Pain Questionnaire (NWPPQ) than a non-treatment group. (2) Is there a propensity towards dominant sided cervicogenic headache and range of motion restrictions?

- **STUDY DESIGN:** Randomized, double blind placebo controlled trial.
- **OBJECTIVES:** To determine the effectiveness of mobilization of the cervical spine on reducing cervicogenic headache.
- **BACKGROUND:** Cervicogenic headaches are commonly occurring symptoms of neck pain. An effective form of treatment would be beneficial to the field of Physical Therapy in providing patients with lasting pain relief. The purpose of this study is to determine if the inclusion of mobilization of the cervical spine is more effective in decreasing cervicogenic headaches compared to treatment without mobilization and non-treatment. Determining a correlation between dominant sided cervicogenic headaches and range of motion restrictions could improve physical therapy assessment and treatment outcomes.
- **METHODS:** Through purposive sampling, 25 symptomatic subjects ages 24-65 with cervicogenic headaches were randomized into a mobilization, a traditional and a non-treatment group. Study inclusion was based upon subjects headache symptoms attributed to: tightness of the neck musculature, resistance to or limitation of neck movement, and headaches provoked by neck movement or positioning. Range of motion for lower or planar cervical rotation and upper cervical rotation using a flexion-rotation test (FRT) was goniometrically measured. The 'traditional treatment' group, was treated with modalities and therapeutic exercise based upon signs and symptoms.

The mobilization group included 'traditional treatment' with the addition of cervical spine mobilization. The control group received no physical therapy intervention. Pain levels were measured throughout the study's 8 week period using a visual analog scale (VAS).

A Northwick Park Pain Questionnaire (NWPPQ) was used to determine the client's perceived functional disability. Headache frequency was recorded daily using a headache log sheet. Upper cervical rotation range of motion was recorded using goniometric measurements by the same examiner. Data recorded throughout the study was compared between the three groups.

- **RESULTS:** Of the 25 subjects with cervicogenic headaches 15 complained of bilateral headaches, 3 with right sided headaches and 7 with left sided headaches. The C ½ region was deemed to be the main contributor of cervicogenic headaches in (72%) of the 25 individuals. The C 2/3 regions was found as the main contributor in (24%), and the C 0/1 region in (4%). The individuals in the mobilization group demonstrated less overall pain than the traditional and control groups ($P < .001$). The mobilization group also demonstrated lower scores (mean + or – SD, 6 + or – 6) on the (NWPPQ) than traditional (mean + or – SD, 11 + or – 6) and control group (mean + or – SD, 12 + or – 8). Although the mobilization group demonstrated a 50% decrease in perceived disability since initial visit, this was not found to be statistically significant ($P > .001$). A one way analysis of variance (ANOVA) for repeated measures of headache frequency was found to be less frequent and more statistically significant in the mobilization group ($P = .041$) compared to the traditional ($P = .076$) and control group ($P = .356$). The traditional and mobilization group demonstrated greater increases in planar cervical rotation than the control group. The mobilization group demonstrated the highest achievement of cervical rotation with a mean of ($85^\circ + \text{or } -5.2^\circ$). The flexion rotation test (FRT) range of motion demonstrated the most improvement in the traditional group with a mean improvement of 16° in left upper cervical mobility with a 12° increase in right upper cervical rotation. The mobilization group demonstrated a mean increase of 10° for left rotation and 14° for right rotation.
- **CONCLUSIONS:** The findings suggests the inclusion of cervical spine mobilization to traditional physical therapy treatment; specifically the C ½ segmental level; was more effective in reducing frequency and intensity of cervicogenic headaches, while increasing planar range of motion and overall function. It also demonstrated no association between specific dominant sided headaches and range of motion restrictions.
- **KEY WORDS:** atlantoaxial joint, flexion-rotation test, headaches, joint mobilization, Mulligan

cervicogenic headaches. The ages used for the study were restricted between ages 18 and 65 due to adult consent, and potential degenerative changes associated with advanced age. The inclusive criteria was based upon the International Headache Society's classification of cervicogenic headaches as being¹: 1) pain aggravated by a certain posture, or neck movement; 2) pain localized in the neck and occipital region which may refer pain to the temples, forehead, orbital region, vertex, and ears; 3) the presence of either limited cervical range of motion, palpatory changes in neck musculature, abnormal stretch/contraction reaction or abnormal cervical region tenderness to palpation. Individuals with headaches associated with head trauma, aura, infection, migraine headaches, cluster headaches, sinus headaches, toxic substances or their withdrawal, metabolic disorders, and headaches associated with temporomandibular disease, tumors, and glaucoma were excluded.¹ It has been found that migraine headaches with aura demonstrated no evidence of musculoskeletal dysfunction playing a role in its pathogenesis.¹² Subjects who were involved in litigation for a health problems were also excluded. Candidates could not participate in this study if they were currently receiving treatment for headaches from any other health care practitioner other than a Medical Doctor. On one occasion a participant was excluded from the study after she received chiropractic treatment while participating in the traditional therapy group. The subjects for the study were obtained through physician referral, advertisement, and marketing of the study through health magazine articles about cervicogenic headaches and promotion of the study. It has been found

that females are more prone to headaches with neck pain than their male counterparts.²⁷ It has also been found that certain occupations were more prone to shoulder/neck complaints than others.²⁷ These professions were: office workers/secretaries, house cleaning personnel, truck drivers, factory workers, telephone operators, and teachers.²⁷ Based upon previous studies there was a focus on recruiting female office workers, laborers, and teachers.

The total amount of potential candidates interested in the study amounted to 38 however 13 subjects were excluded. Subjects were first screened by phone by the primary investigator and excluded if they either did not meet the criteria for the study or had any contraindication for mobilization treatment: rheumatoid arthritis, ankylosing spondylitis, spondylolistheses, cervical fractures, osteoporosis, Paget's disease, osteomyelitis, malignancy, pregnancy, spinal cord syndrome or pain upon mobilization of the cervical spine.^{16, 21} If any individuals had any symptoms of neurovascular insufficiency they were excluded from the study and returned to their physician. Any subject of any group who has not reported relief by the end of the patient's eighth week of treatment was offered an alternative form of treatment to help relieve their symptoms. An important aspect of the study was; although the individual may have experienced some discomfort during the initial assessment process through the assessment of symptom provocation, the rule for treatment to proceed was only with absence of pain. If the patient did not experience any relief with any intervention or reported a worsening of symptoms their treatment was immediately terminated and they

were referred to either their physician of choice or a group of three physicians who were close to the subjects' local area.

Prior to physical assessment of the subject's complaints, these 25 individuals were separated into one of three treatment groups through random assignment. The subjects were examined for cervical ROM restrictions, inter-segmental joint restrictions, and an upper cervical spine flexion rotation test (FRT) was performed in a supine position. These measurements were recorded upon initial visit, and at the fourth, and eighth week of the study. The subjects were asked to rate the location, frequency, and duration of their headaches daily. Pain levels pre and post treatment were recorded on a visual analog scale. Frequency, duration and severity of headaches were recorded on a headache log sheet by the subjects. The subject were required to fill out a (NWPPQ) to determine perceived functional disability¹⁵ upon initial visit, fourth, and eighth week points during the study.

All subjects were permitted to take any present medication: over the counter or prescribed by their physician; during or prior to the study.

Materials and Measurements

Equipment required for the study consisted of copies of pictorial and written instruction explaining self mobilization with movement techniques and home exercises for the mobilization group. Copies of home exercise instruction were provided for the traditional and mobilization treatment group.

Although all groups were measured for cervical ROM in all motions and all planes, cervical rotation and upper cervical rotation were measured repeatedly

with a Chattanooga Corporation goniometer throughout the study in all 3 of the study groups. The client's mean active cervical rotation was measured and recorded with the client in a seated position using goniometric measurements of three trials in each direction. The end range of motion was determined by the client's limitation by reported pain or firm resistance of end range movement. The subjects upper cervical ROM was measured using the FRT on the individual in a supine position with the cervical spine fully flexed forward by the examiner and passively rotated to the right and left. The FRT was performed as described by Hall and Robinson,^{8,9,10} Fernandez-DeLas-Penas, and Cesar,⁶ and Mulligan.²¹ The mean range of motion of three repeated trials was recorded and determined to be the limitation reached through limitation of pain, or firm resistance of motion. To ensure intratester reliability the same examiner checked the person's range of motion pre-treatment for all cases, using the same goniometer, in the same location and same manner.

A headache log sheet issued to the study's participants resembling a calendar required recording of daily headache frequency, location, duration and severity. This was recorded over an eight week period. The client's pain levels were measured using a 10 cm visual analog scale (VAS) to determine pain level pre-treatment. This was performed pre-treatment to establish a better determination of the clients carry over from past treatment, or pre-intervention. These measurements were taken pre-treatment, at the initial, fourth, and eighth week point in the study of all subjects. A decline in pain levels and restoration of mobility were determining factors in the clients need to continue treatment or to

be discharged earlier from care. In addition to (VAS) pain measurements, a (NWPPQ) was used to determine the client's perceived disability throughout the study. The questionnaire consisted of 9 to 10 questions with each item scored 0–4 and the total score converted into a percentage (0–100%).¹⁵ In a comparison of cervicogenic to tension and migraine headaches it was found that cervicogenic headache sufferers had the lowest scores in perceived physical functioning.²⁸ It has been recommended by Niere and Robinson,²³ that the inclusion of both a pain index scale or estimation of treatment benefit is useful in determining if manual therapy treatment has positive effects in reducing cervicogenic headaches.

A small face towel was provided to subjects in the mobilization group based upon need, in order to complete self mobilization exercises at home. Data was collected and entered into a home computer system with antivirus and password protected security system to ensure anonymity.

Procedures

All procedures within this research study were undertaken by a licensed physical therapist with 12 years of experience using manual therapy for treatment of cervicogenic headaches. This therapist possesses a Manual Therapy certification as a Certified Manual Physical Therapist (CMPT) through the North American Institute of Manual Therapy (NAIOMT) and is a certified Mulligan Concept Practitioner (CMP).

All subjects were screened prior to inclusion in the study by the physical therapist conducting the research including and excluding participants based upon criteria for cervicogenic headache by the International Headache Society.¹

Prior to assessment of complaints subjects were randomly assigned their particular treatment group by selecting one of 30 tickets through a sealed container. All subjects were examined for planar and upper cervical ROM restrictions using the FRT. Manual passive inter-segmental joint mobility testing was performed on the upper and lower cervical spine. Subjects were asked to record the daily frequency, duration and severity of headaches over an 8 week period on their headache calendar. The subjects were required to fill out a (NWPPQ) upon initial visit, weeks four, and eight during the study. These forms were reviewed with the subjects at all periods and collected at the end of the study for data analysis.

Upon cessation of the study subjects with reports of continuation of cervicogenic headaches were given the opportunity to be randomly assigned to one of the other two groups and undergo another 8 week cycle.

This was an optional choice for the subjects included in the study with no guarantee of treatment group given to the client other than their exclusion from their past intervention group.

Upon examination, the subjects in the mobilization and non-mobilization group were evaluated and a treatment plan was formulated for the participants. Both groups were examined for range of motion testing as described by Maitland and with the NAIOMT system of evaluation.^{16, 17} Bilateral rotation and upper cervical

rotation was assessed with the FRT described by Hall and Mulligan,^{8, 9, 21} this was measured on 3 trials with the mean recorded. The FRT was included to analyze and determine if a correlation exists in subjects with complaints of cervicogenic headaches and limitations in upper cervical spine mobility as shown in research by Hall.^{9,10} Another assessment was made by determining any correlation between the side of cervical mobility restrictions to dominant sided cervicogenic headaches.

P/A pressures were performed to the subject's cervical spine assessing tenderness as described by Bogduk.^{3, 4}

The subject's strength was assessed for all cervical as well as upper extremity movements in all motions and all planes. Deficits in strength based the (0-5) scale as recommended by Maitland,¹⁶ were used to formulate a treatment plan based upon correcting deficits of strength, endurance or muscle coordination.

Passive joint motion testing was performed on all subjects through passive intervertebral motion testing as described in the NAIOMT system.¹⁷ Subjects were assessed in a supine position as well as a seated position. These results were compared to determine any contraindications to further treatment or assessment such as VA symptoms as described by Meadows.¹⁸ Throughout the study the clinical guidelines for assessing vertebrobasilar insufficiency in managing cervical spine disorders as established by the Australian Physiotherapy Association were followed.²⁵ There were no instances during the studies evaluation process where a subject had complaints of dizziness. If this did happen a cranial nerve exam would have been performed as per the Meadows protocol.¹⁸ If any subjects were

found to have positive cranial nerve signs, they may be suspected of having vertebral basilar artery symptoms¹⁸ and would have been excluded from the study. If a subjects symptoms were vague, they were screened for VBI with a DeKlynes test: performed with the patient in a supine position and tested with neutral rotation, flexion and rotation, and then extension and rotation with the addition of traction to combined motions for each side.¹⁸ If any suspicion of a VBI injury was suspected based upon the patients history, end range provocation testing; treatment or further evaluation would have been avoided, and the individual would have been referred out to the appropriate medical practitioner.¹¹

Craniovertebral stress tests were also performed on the cervical spine to rule out cervical hypermobility and/or instability. These were performed with anterior/posterior glides, posterior/anterior glides, C/V Traction, lateral glides, rotation testing, and a sharps purser test as demonstrated by Pettmen.⁹

The non mobilization and mobilization group were instructed on cervical and upper extremity strengthening, stretching, and/or stabilization exercises. These exercises were individualized and selected based upon the subject's objective findings determined from the evaluation.

The mobilization group completed their selected exercises in addition to the proper self mobilization techniques chosen for them based upon manual examination during the evaluation process by the sole investigator.

Once the mobilization group was assessed, the joints found to be restricted were mobilized by the investigator in the restricted plane. After assessing the subject's reaction to mobilization and re-assessing the range of motion, the client was

instructed on self mobilization techniques using a towel. This technique is described for various areas of the cervical spine by Mulligan.²¹ One type of mobilization is the C 2/3 SNAG. This technique is performed by positioning the center of a towel under the C 2 spinous process and drawing the vertebrae forward and slightly superior by both of the subject's hands; this is then held for 3-10 seconds. A C ½ rotation self mobilization or SNAG is performed to the C ½ region. The subject's towel is placed just below the posterior arch of C 1 and the pulled horizontally across the subjects face with the contralateral hand, while the ipsilateral hand draws the other side of the towel in an inferior direction. The client was asked to complete a rotation towards the restricted side of limitation. So, for a right rotation limitation the towel would be positioned on the subjects L posterior arch of the Atlas. While this position is sustained the client turns their head into right rotation for 3 to 10 reps with a sustained 3 second hold on the first day and then up to 3 sets of 10 on follow up treatment days. All subjects were given written verbal and practical instruction on this technique. Performance was reviewed until the subject was deemed competent with the procedure. All self mobilization techniques were performed in a pain free range of motion and no symptoms other than stretching or localized pressure was encouraged. A total of 4 subjects were found to have lower segmental cervical hypermobility and were unable to perform a pain free traditional cervical rotation SNAG. For these individuals a modification of the SNAG was demonstrated and performed. This included a modified mobilization SNAG without cervical movement, but with a type of isometric hold for up to 10 seconds. The hold was similar to that which

is attempted to be regained with PT assisted cervical rotation. This technique proved useful when a C 0/1 restriction was found. If a R extension limitation of the C 0/1 region was found, an isometric pull on the R C 1 posterior arch would be performed with a towel assisted R cervical rotation. For the C ½ region right rotational restriction, a L sided pull was performed on the L side of the C 1 posterior arch with a 3 to 10 second hold for 1 to 3 sets. This was effective in eliminating lower cervical movement while still enabling some subjects to perform self upper cervical mobilization to enhance treatment effects.

Approval for this study was granted post data collection by the Andrews University Institutional Review Board. It had been explained to all subjects that they were required to give written informed consent prior to participation in the study and were under no obligation to continue the study and given the option to withdraw at any time.

Data Analysis

Statistical analysis was carried out with SPSS V11.5 (SPSS Inc. Chicago, IL).

A general linear model with repeated measures factor of time (admit headache frequency, end treatment frequency, and DC headache frequency) and a between subjects factor group (mobilization group, non-mobilization group, and control group) was used to determine the difference in frequency of headaches between the 3 treatment groups. This difference was determined based upon data from the initial visit, to a fourth and eighth week follow up visit.

A general linear model was also used with repeated measures to determine pain levels (admit pain, end PT pain, and DC pain) among treatments groups (mobilization group, non-mobilization group, and control group) over time.

A general linear model with repeated factor of range of motion over time (admit ROM, end treatment ROM, and DC ROM) and a between subjects factor group (Mobilization group, non-mobilization group, and control group) was used to determine the differences in range of motion among the 3 treatment groups over time.

To determine any changes in between the three group's (mobilization group, non-mobilization group, and control group) perceived functional capabilities over time. A general linear model for repeated measuring of the (NWPPQ) (admit nwq, end treatment nwq, and DC nwq) results was used to determine any difference in functional improvement among the 3 treatment groups over time.

Of interest was whether or not the specific intervertebral segmental level of restriction diagnosed was related to a specific location of cervicogenic headaches. A crosstabs calculation of the independent variable of headache location (L sided, R sided or Bilateral) was compared to the dependent variable of segmental level (C 0/1, C 1/2, and C 2/3) using a chi squared test.

RESULTS

The mean (+/- SD) for the average age of participants used in the study was 42.5 +/- 12.1 years old. Of the 25 subjects with a mean age on 42.5, the gender distribution was almost entirely female; with 23 female and only 2 male. Because of this small diversity among the gender of the subjects participating in the study the only significance was that most of the individuals who volunteered were female.

Upon comparison of pain levels prior to intervention, through discharge, the mobilization group demonstrated the most significant change in pain level improvement. The mobilization group demonstrated an average pain score of 5/10 which decreased to 1/10 by discharge ($t= 4.262$, $df= 11$, $P=.001$). The traditional group also demonstrated an average 5/10 pain level upon initial visit which decreased to an average 3/10 upon discharge ($t= 1.7$, $df= 5$, $P=.150$). The control group averaged an initial pain level of 4/10 remaining at 4/10 upon discharge ($t=0.603$, $df= 6$, $P=.569$) (**FIGURE 1**).

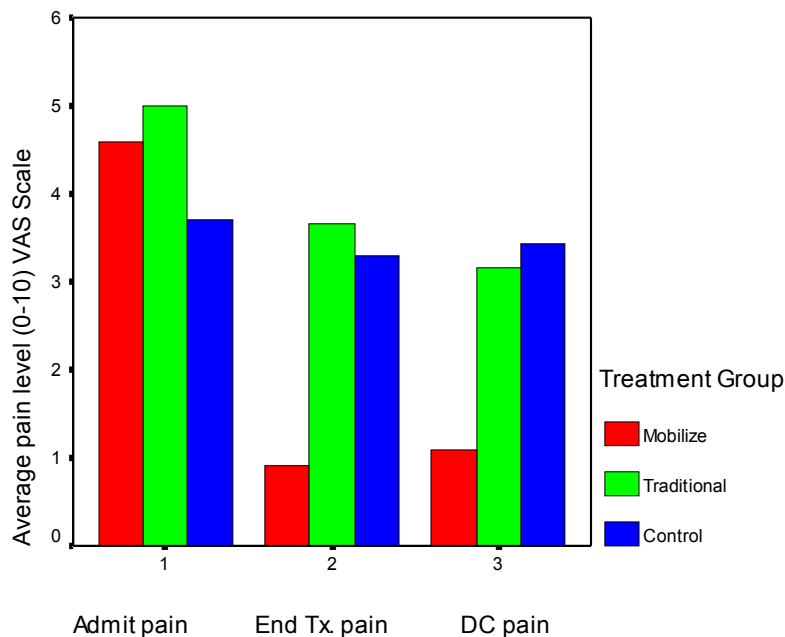


FIGURE 1. Subject pain levels from admit through end treatment, to discharge.

Headache frequency also demonstrated a significant reduction of occurrence with the mobilization group once again showing the most significant drop in headaches from an average of 1.8 to 0.6 headaches a day. ($t=2.31$, $df= 11$, $P=.041$). The traditional group demonstrated a less prominent decrease from 1.5

to 1 headache a day ($t=2.24$, $df=5$, $P=0.76$), while the control group demonstrated almost no change from 1.1 headaches a day to 1 headache a day ($t= 1$, $df= 6$, $P=.356$) upon discharge (**FIGURE 2**).

Range of motion was tested for upper and lower cervical rotation. When the results of lower cervical rotation was compared between groups; the mobilization group demonstrated an average increase of 21° from 64° (SD, 10°) to 85° (SD, 5°) for left lower cervical rotation, (**FIGURE 3**) and an increase of 19° from 64° (SD, 7°) to 83° (SD, 5°) for right lower cervical rotation.

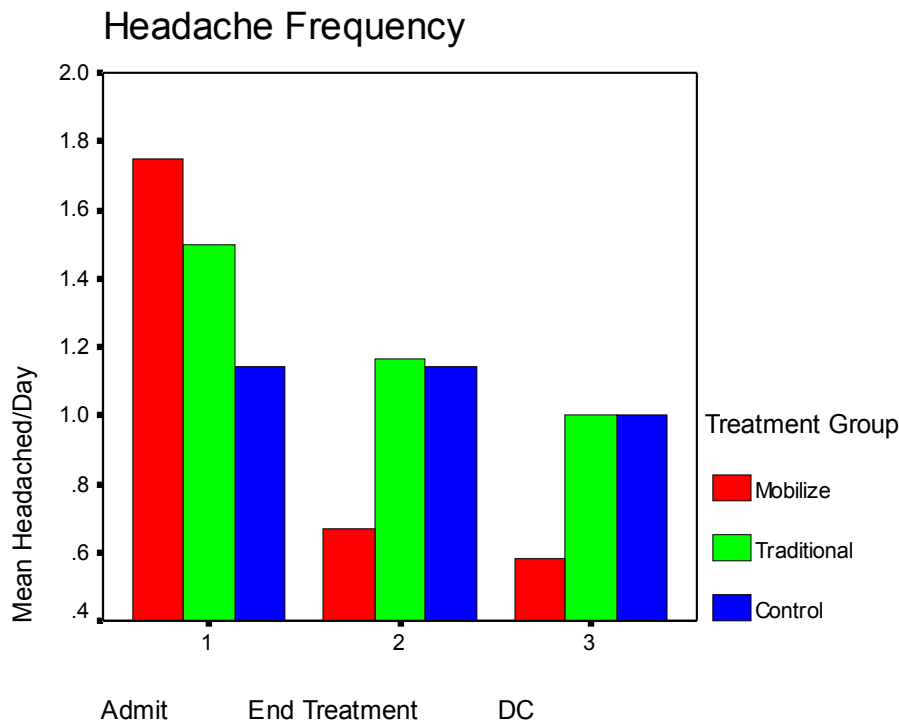


FIGURE 2. Estimated marginal means of headache frequency per day

The traditional group also demonstrated a moderate change of $+13^{\circ}$ from 63° (SD, 20°) to 76° (SD, 14°) for left cervical rotation, and increase in right lower cervical rotation of $+13^{\circ}$ from 56° (SD, 19°) to 69° (SD, 13°). The control group

demonstrated a loss of lower cervical mobility from an initial average left rotation of 64° (SD, 11°) declining to 62° (SD, 5°), or -2° , while right rotation changed little from 62° (SD, 12°) to 61° (SD 9°), or -1° . These changes appeared most profound in the mobilization and traditional groups between the initial visit and end of PT treatment. There appeared to be either a mild to minimal range of motion changes during the 4 week period between the end of PT treatment and 8th week, or DC from PT. The mobilization group demonstrated an end PT measure of 83° (SD, 7°) to 85° (SD 5°), for left rotation, and 83° (SD, 5°) remaining at 83° (SD 5°) for right cervical rotation. The traditional group demonstrated an end PT measure of 75° (SD, 11°) to 76° (SD 14°), for left rotation, and 71° (SD, 11°) decreasing to 69° (SD 13°) for right cervical rotation (**FIGURE 4**). One may postulate that maximum improvement in lower cervical range of motion may be achieved after 4 weeks of physical therapy treatment with or without mobilization of the cervical spine.

Upper cervical rotation range of motion using the FRT, had changes upon testing in the mobilization and traditional treatment groups however the traditional treatment group demonstrated the most significant changes. The traditional groups unexpected, but more significant improvement in mobility from an initial left upper cervical rotation of 44° (SD 15) to 60° (SD 14°), or a 15° increase. Right upper cervical rotation also demonstrated an improvement of 12° , from an initial 43° (SD 13°), to 55° (SD 17°).

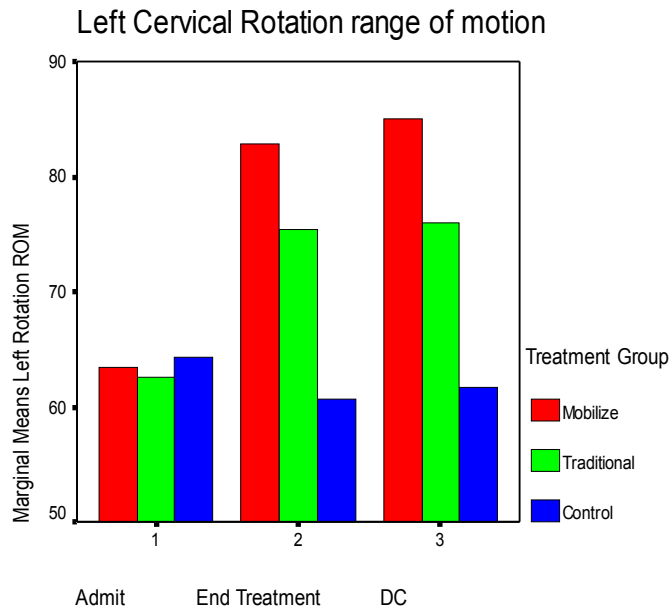


FIGURE 3. Marginal means for left cervical range of motion from admit through discharge.

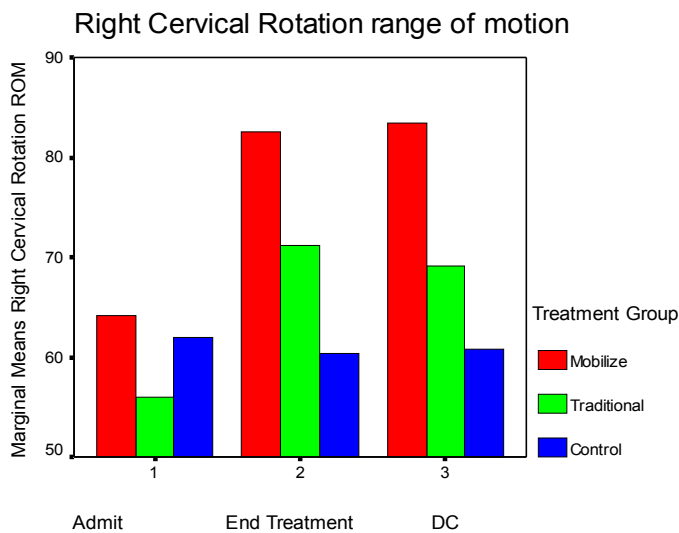


FIGURE 4. Marginal means for right cervical range of motion from admit through discharge.

Upper cervical rotation demonstrated a less than expected increase of 10° from an initial left rotation measurement of 50° (SD 8°), to 60° (SD 7°) in the

mobilization group. Right rotation demonstrated an increase of 14°, or from 47° (SD 10°), to 61° (SD 7°) (**FIGURE 5**).

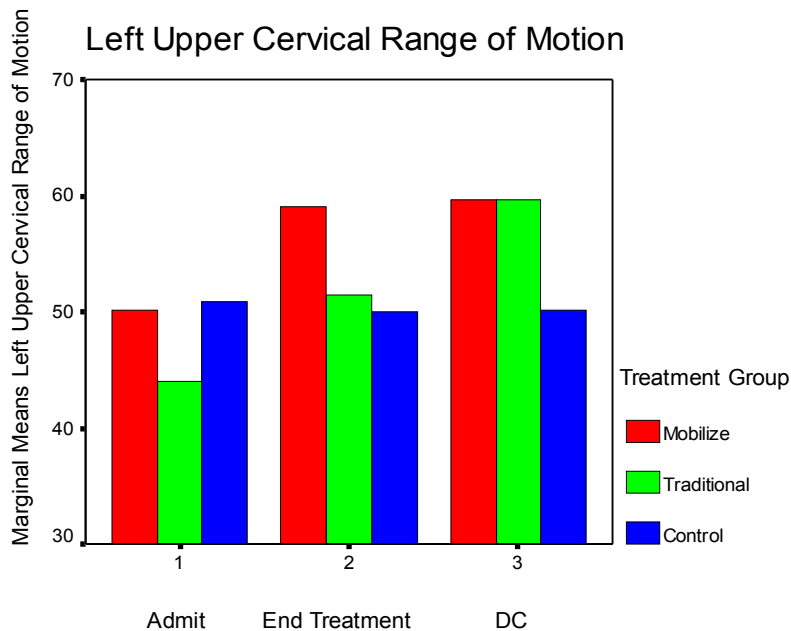


FIGURE 5. Marginal means for upper left cervical range of motion

The control group demonstrated no improvement in upper cervical rotation with a -1° decrease in left upper cervical rotation from an initial 51° (SD 7°), to 50° (SD 6°). The control groups upper cervical right rotation demonstrated a slight improvement in mobility of 4° from 47° (SD 8°), to 51° (SD 9°). (**FIGURE 6**).

Although joint mobilization was performed on the upper cervical spine, this did not result in a significant improvement of upper cervical spine mobility when compared to the non-mobilization or traditional treatment group. A difference in

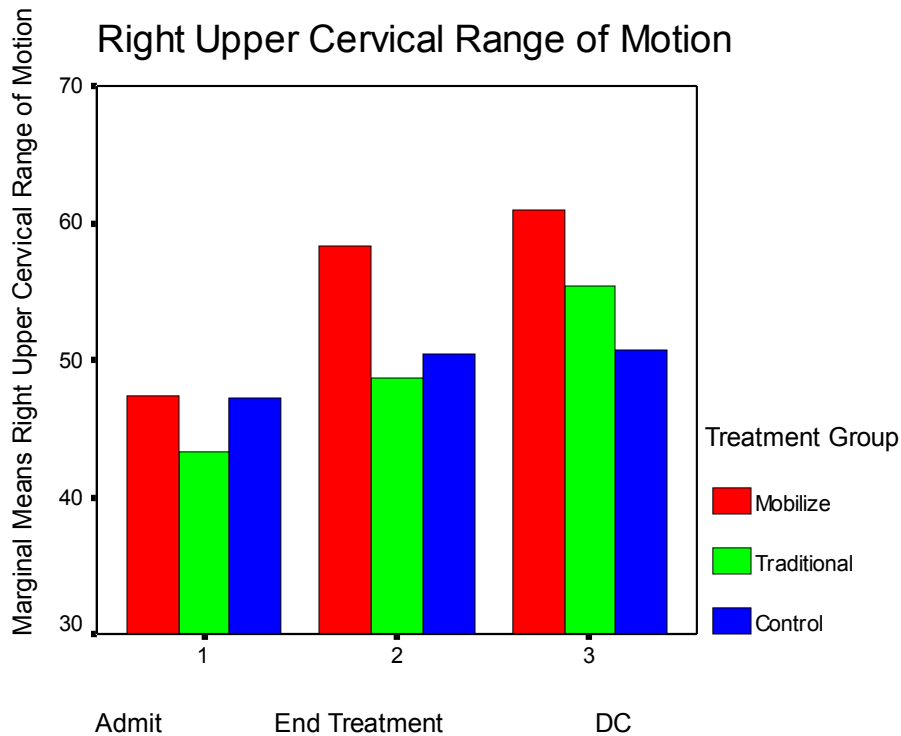


FIGURE 6. Marginal means for right upper cervical range of motion

this study compared to research performed by Hall ^{8,9,10} is that the upper cervical spine range of motion measured with the flexion rotation test was performed with a CROM. Symptomatic subject range of motion results in that study were found to average between 28° and 37°, compared to between 46° and 49° in this study with no distinction between side dominant headaches and range of motion restrictions. **(TABLE 1).**

HA Location		Admit UC ROM L	Admit UC ROM R
Left sided HA	Mean	44.8571	46.7143
	N	7	7
	Std. Deviation	5.89996	8.71233
Right sided HA	Mean	45.6667	47.3333
	N	3	3
	Std. Deviation	4.50925	7.23418
Bil. Headache	Mean	51.3333	46.0000
	N	15	15
	Std. Deviation	11.51810	11.48291
Total	Mean	48.8400	46.3600
	N	25	25
	Std. Deviation	9.87708	10.02447

TABLE 1. ADMISSION HEADACHE LOCATION AND UPPER CERVICAL RANGE OF MOTION RESTRICTIONS

Upon examination of the results of the (NWPPQ); the mobilization group demonstrated the most significant decline in perceived disability scores. Upon initial examination the mobilization group demonstrated a 6 point decrease with a mean score of 12 (SD 6°), and an end score of 6 (SD 7°). The traditional treatment group initially displayed a mean score of 15 (SD 3°), and ended the study with a score of 11 (SD 6°) or a 4 point decrease.

The control group demonstrated an increase in their perceived disability of 3 points in their final score increasing from 9 (SD 6°), to 12 (SD 8°) (**FIGURE 7**).

In assessing headache location per segmental level revealed 60% or 15 of the 25 total subjects in the study had bilateral headaches compared to left or right alone.

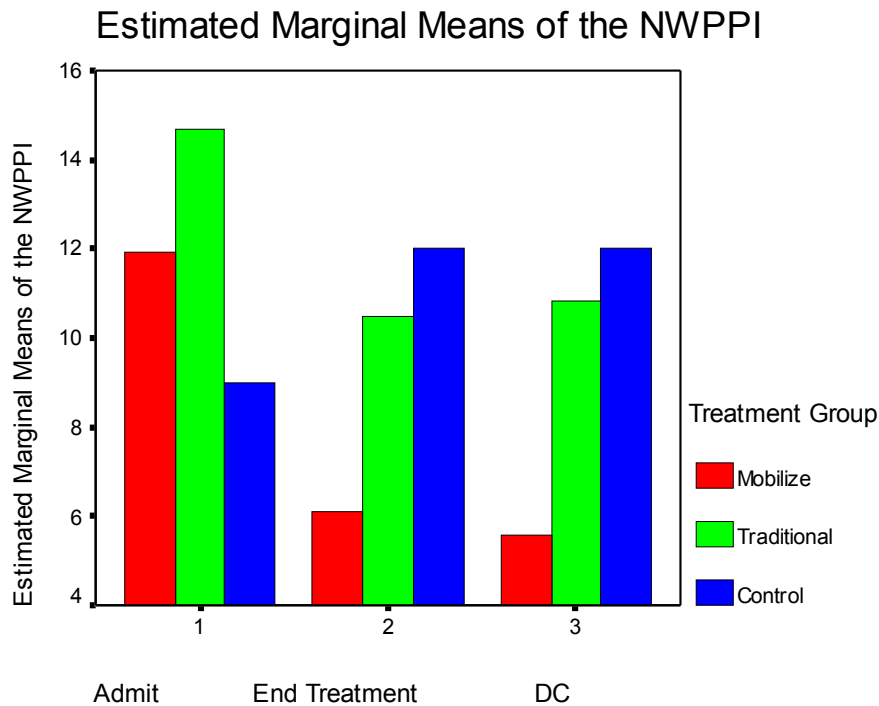


FIGURE 7. Marginal means for the Northwick Park Pain Questionnaire

Of the remaining 10 subjects; 7 were found to have left, and 3 right sided headaches (**TABLE 2**).

HA Location * Segmental Level Crosstabulation

			Segmental Level			Total
			C 0/1	C 1/2	C 2/3	
HA Location	Left sided HA	Count	0	6	1	7
		% within Segmental Level	.0%	33.3%	16.7%	28.0%
	Right sided HA	Count	0	2	1	3
		% within Segmental Level	.0%	11.1%	16.7%	12.0%
	Bil. Headache	Count	1	10	4	15
		% within Segmental Level	100.0%	55.6%	66.7%	60.0%
Total	Count		1	18	6	25
	% within Segmental Level		100.0%	100.0%	100.0%	100.0%

TABLE 2. HEADACHE LOCATION AND SEGMENTAL LEVEL OF

RESTRICTION

The three intervertebral areas most often found to be the area of provocation or dysfunction were the C 0/1, C 1/2, and C 2/3 regions. The segmental level most often treated or suspected to be the cause of the individual's headaches was overwhelmingly the C 1/2 region. This area was found to be the area of dysfunction in 72% of all treatment groups, or 18 of the 25 subjects examined. The remaining areas of dysfunction were the C 0/1 region with one subject or 4%, and the C 2/3 region with 6 individuals or 24% (**FIGURE 8**).

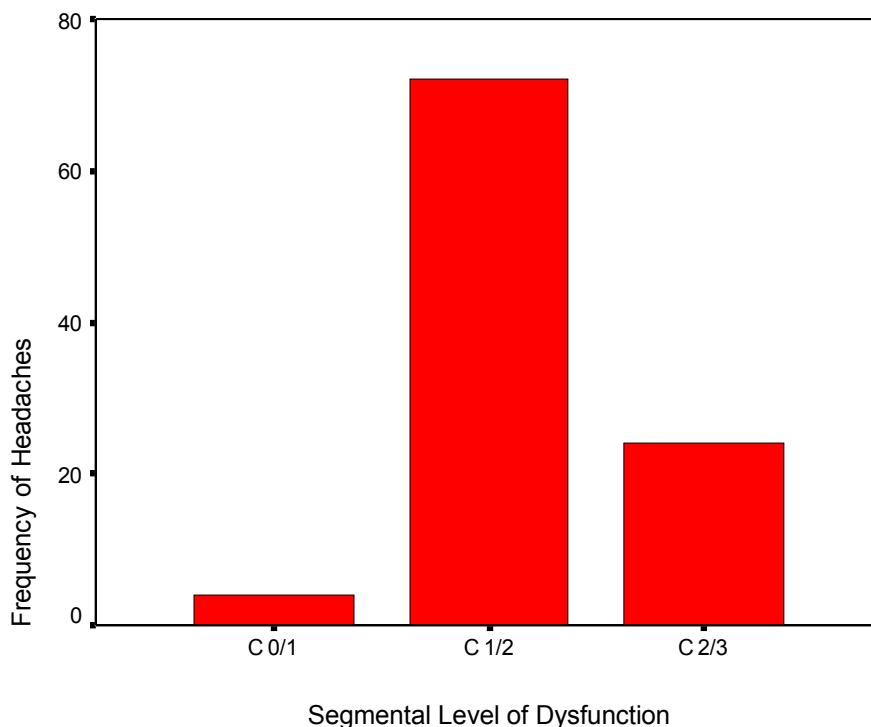


FIGURE 8. Graph of frequency of headaches per segmental level

No areas of mid to lower cervical spine were found to be related to, or required treatment in this study for cervicogenic headaches.

Upper cervical range of motion restrictions has been a predictor of headaches in a number of studies.^{2, 6, 8, 9, 10} In this study; upper cervical restrictions of range of

motion was not used as a criteria for inclusion into the study. Upon analyzing the data it was found that the mobilization and traditional treatment groups showed a similar improvement in upper cervical ROM increases: (9°-14°) in the mobilization group; and (12°- 15°) in the traditional group. This is compared to no signs of improvement in the control group (0°-3°) (**FIGURE 9**).

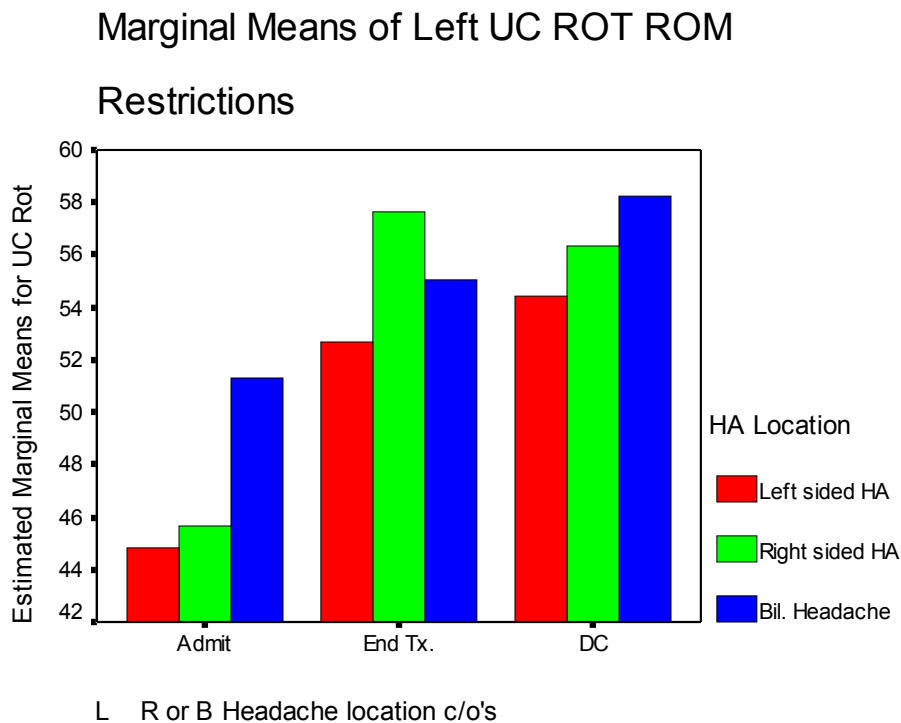


FIGURE 9. Left upper cervical range of motion restrictions compared to dominant sided headaches

Most subjects were found to have complaints of bilateral headaches: 15 of 25 subjects. There were 7 subjects with left sided headaches, and only 3 with right sided headaches. Of these 3 subjects with right sided dominant headaches only one was found to have R > L sided upper cervical range of motion restrictions, and 0 of 3 were found to have right sided dominant headaches (**FIGURE 10**).

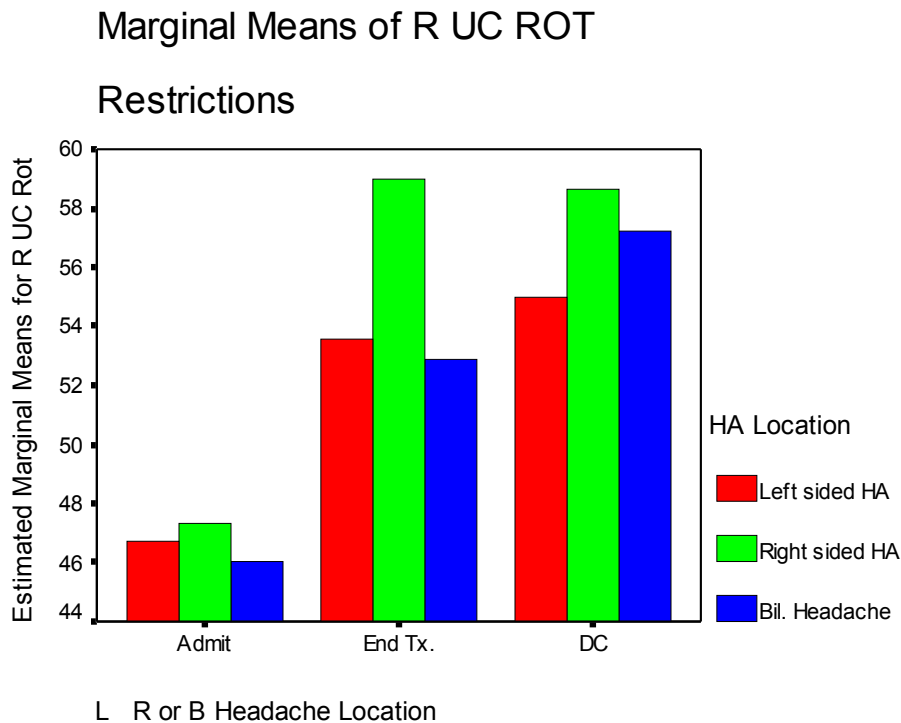


FIGURE 10. Right upper cervical range of motion restrictions compared to dominant sided headaches

DISCUSSION

Upon final analysis of study participants; those individuals who underwent physical therapy treatment demonstrated greater relief of symptoms including decreased pain, frequency, and duration than those subjects without treatment. A reduction in headache pain levels were found to be reduced significantly more in the mobilization than the traditional treatment group, and the control group. In the mobilization group, the greatest difference was noted at the 4th week period after initiation of treatment. This was an 80% reduction with the least change noted at the 8 week period. The traditional treatment group demonstrated a mild reduction in pain compared to the control group with an average 32% reduction

by the 8th week, however not significant. The control group demonstrated almost no reduction in pain levels with only an 8% reduction in headache.

This study demonstrated the how mobilization of the cervical spine resulted in the greatest decrease, or a 67% reduction in headache frequency compared to the traditional group, of 33% and only a 12% in the control group.

Headache frequency demonstrated the most significant changes by the 4th week of treatment in the mobilization group, and appeared to maintain results over the next 4 weeks of treatment or until re-examined and discharged from the study.

The limitation of measuring frequency of headaches was that some individuals may have been experiencing a constant unrelenting long duration headache of a particular severity resulted in an arbitrary rating of 1 on the frequency scale.

Another individual may have a comparative rating from a single short duration headache, at significantly lower pain level. A total resolution of headaches occurred in 7 of the 12 individuals in the mobilization group, 1 of 6 in the traditional group, and 0 of 7 in the control group.

Perceived functional disability, as measured with a (NWPPQ) showed greater improvements in the PT intervention groups than the control group. As demonstrated before, the group receiving mobilization in addition to regular PT treatment displayed the most significant decrease in reported disability. This translated into a 50% decrease in functional disability as a result of treatment intervention. The traditional treatment group displayed less significant decrease in functional disability or only a 33% decrease. There was found to be an increase in perceived disability with time in the non treatment or control group

during the study. The individuals not receiving treatment demonstrated a 33% increase in disability.

In an age of insurance companies such as Medicare looking more and more at functional outcome measurements, this data can be an integral component used to determine the effectiveness of treatment.²⁸ The documentation of functional improvement can be an objective and effective way of demonstrating increased physical and social functioning, and improved overall quality of life.

As predicted, range of motion was improved significantly in the mobilization group for both cervical range of motion and upper cervical range of motion. The mobilization group demonstrated by far the most significant increase in planar range of motion upon discharge. The traditional treatment group demonstrated a less significant increase in left and right cervical rotation, while the non-treatment or control group demonstrated a loss in left cervical rotation and right cervical rotation.

Upper cervical range of motion range of motion was found to have increased in a similar manner to the C ½ SNAG group which was tested in Hall's study, which demonstrated an average increase of up to 15° (SD, 9)⁸

Because of specific mobilization of the upper cervical spine, it was originally predicted that the mobilization group would have shown the greatest increases in upper cervical range of motion. It was not anticipated that the traditional treatment group would have improved as much as the mobilization group without the inclusion of upper cervical spine mobilization. This may be due to the smaller sample size than that which was used in Hall's study.⁸

Planar or long axis range of motion was found to show the highest degree of improvement in the mobilization group. With the exception of upper cervical range of motion demonstrating minimal improvement, all other areas of the study strongly pointed towards the mobilization group as the group receiving the most effective treatment. This was displayed through the mobilization group demonstrating the lowest pain levels, the lowest frequency of headaches, the highest return of function, and the highest overall restoration of range of motion. The most significant values making a contribution to predicting the dependent variable of cervicogenic headaches is the restriction in upper cervical ROM for both left and right sides. While this correlates with Hall's study depicting upper range of motion restrictions in headache sufferers.⁸ It does not support the relationship between upper cervical restrictions and the dominant side of headaches. Is it possible that due to a smaller sample size, no significant range of motion restrictions were found related to a certain headache location?

Of those individuals with left sided dominant headaches 4 of 7 or 57% were found to have left upper cervical range of motion restrictions. This was not found to be as significant as in previous studies where interrater reliability using the flexion rotation test was found to be up to 92% accurate in predicting range of motion restrictions among symptomatic subjects with dominant sided headaches.¹⁰ A CROM was also used in the previous study to measure upper cervical range of motion compared to a goniometer in this study. Due to the awkward nature of measuring upper cervical range of motion with a goniometer, could the CROM be a more accurate way of measuring upper cervical

range of motion by freeing up the examiners hands allowing for a more accurate measurement?

There was a correlation with other studies which found the C ½ region to be the most dominant area of dysfunction in sufferers of cervicogenic headaches.^{2,8,22,26} This was determined through evaluation with biomechanical testing, palpation to areas of pain; and if in the mobilization treatment group: the identified area of dysfunction found to be most effective in reducing symptoms of headaches. There was no difference in those subjects experiencing right versus left sided headaches, or bilateral headaches in assessing the area of segmental dysfunction.

Of interest, was whether or not those subjects in the mobilization treatment group with either right, left or bilateral headaches would show a relationship towards treatment on the corresponding side of headaches? There was no relationship in individuals experiencing left sided headaches requiring left sided dominant treatment. Those with bilateral headaches or headaches which may change from left to right may have required treatment on the right and left, or at times just one side of a specific segmental level. These results may prove of interest to a follow up study.

This may be due to what is often seen clinically where an individual may be complaining of a specific dominant sided pain with post examination findings of a hypermobile or unstable segment as the pain contributor. This may require superior, inferior, or a times contralateral mobilization of a segmental level.^{7,}

^{16,17,18} The positional fault hypothesis was examined in with both calibrated measurements¹⁴ and through MRI.³⁰ Both studies demonstrated a positional fault,

or altered joint position prior to treatment, a correction after the treatment, but a return to the original initial joint positioning after the cessation of the treatment.^{14,}

³⁰ Although joint positioning appeared to return to pre treatment levels, pain was reduced, range of motion increased, and function restored.^{13, 31} An MRI study attempting to diagnose patients with cervicogenic headaches was found to be a poor diagnostic indicator.⁵ This may be due to most findings of cervicogenic headaches as demonstrated in this study as well as other studies to originate from the atlanto/axial intervertebral joint region.^{2, 4, 8, 9, 10, 12, 22, 26} It is known that there is no intervertebral disc present at the atlanto-axial and the occipital-atlas region. Research has shown MRI's being more useful at diagnosing degenerative changes and discogenic pain, and less reliable at diagnosing pain originating from nerve roots, intervertebral joints and periosteum.⁵

It is not yet clear by what mechanism this relief of pain occurs. It is postulated that this may be due to a sympathoexcitatory effects as demonstrated in previous studies.^{20,24} Physiological processes demonstrating these effects may be an elevation of skin temperature and conduction, an elevation of increased tissue blood flow, elevated blood pressure and heart rate.²⁹ These effects have been documented after both spinal and peripheral joint mobilization techniques.^{20,24} In a study on peripheral joint mobilization of the elbow; pain free grip strength was also improved after mobilization techniques.^{19,24,29} The specificity in one study was of interest in how; pain free grip strength was improved only in the affected arm being treated.²⁹ The effects of improved pain free grip strength and decreased

pain were documented during, after and post therapeutic peripheral mobilization.

29

Other studies have shown relief of cervicogenic headaches from cervical spine mobilization without the addition of therapeutic exercise,^{8,26} and with the combined use of therapist mobilization and therapeutic exercise,¹³ but none with the combined use of patient assisted self mobilization and exercise to the researchers knowledge. From the data analysis of this study, it appears that the addition of mobilization to the traditional treatment group is more effective in relieving cervicogenic headaches than traditional physical therapy treatment alone. A future study may include a fourth or mobilization group only, compared to a mobilization with traditional therapy, a traditional treatment group and a control group in determining relief of cervicogenic headaches and improved function. A limitation of the study was the time factor. It would be of interest how these subjects maintained their results after a significant time period of 2-12 months.

CONCLUSION

The combination of traditional physical therapy treatment with therapist and patient assisted cervical spine mobilization techniques provided an effective form of treatment in decreasing cervicogenic headache frequency, duration, and intensity. This form of treatment also demonstrated improved range of motion, and functional outcomes in patients suffering from cervicogenic headaches. While the study demonstrated the high probability of the C ½ region as the dominant segmental level of dysfunction in cervicogenic headache sufferers. It

demonstrated a lack of correlation between side specific loss of range of motion, and dominant sided headaches.

Because of the ability of the patient to perform the self mobilization as a component of a cervicogenic headache management program there may be potential benefits in reducing medication and overall healthcare costs. Further long term research in this area may have exciting implications for physical therapy evidence based practice.

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