MCU Research References

"Investigating the effectiveness of adding microcurrent therapy to a traditional treatment program in myofascial pain syndrome in terms of neck pain and function."

Battecha KH, Kamel DM, et al. Investigating the effectiveness of adding microcurrent therapy to a traditional treatment program in myofascial pain syndrome in terms of neck pain and function. *Physiotherapy Quarterly.* 2021;29:17-23

ABSTRACT

Introduction. To investigate the effect of microcurrent on pain, pain threshold, range of motion, neck muscle strength, and neck function.

Methods. It is a pilot study involving 28 female subjects (aged 18–24 years) complaining of neck pain due to active unilateral trigger points in upper trapezius muscle. The subjects were randomly assigned to 2 groups: group I (n = 15) received microcurrent (frequency: 20 Hz, intensity: 25–30 μA) and traditional treatment in the form of stretching exercise for upper fibre of trapezius, isometric strengthening exercise, ischaemic compression technique; group II (n = 13) received only traditional treatment. All subjects received 2 sessions per week for 3 weeks.

Results. There was a significant improvement ($p < 0.05$) in cervical range of motion, pain level, neck disability index, and pain threshold in both treatment groups. Isometric muscle strength was significantly increased ($p < 0.05$) in group I, with no significant ($p > 0.05$) difference in group II. Group I showed a more significant effect in all measured variables than group II. Neck disability index and muscle strength presented a significant change ($p < 0.05$) with respect to group and time interaction.

Conclusions. Microcurrent therapy added to traditional treatment increased the effectiveness of myofascial pain syndrome treatment as compared with traditional treatment alone.

Use of MCU: measure isometric strength of cervical muscles

"Effects of combining manual therapy, neck muscle exercises. And therapeutic pain neuroscience education in patients with migraine: a study protocol for a randomized trial."

de Almeida Tolentino G, Florencio LL, et al. Effects of combining manual therapy, neck muscle exercises. And therapeutic pain neuroscience education in patients with migraine: a study protocol for a randomized trial. *BMC Neurology*. 2021;21:249

ABSTRACT

Background: Non-pharmacological approaches for the management of migraine exhibit low to moderate effectiveness due to a lack of high-quality randomized clinical trials. In fact, previous studies applied isolated techniques, which were not representative of common clinical practice. A multimodal approach for migraine may benefit these patients more than isolated approaches. This randomized clinical trial aims to determine the effectiveness of a multimodal protocol combining manual therapy, exercise, and therapeutic pain neuroscience education versus the application of manual therapy or pain neuroscience education alone in patients with migraine.

Methods: This clinical trial will include 75 individuals of both sexes, aged between 18 and 55 years, with migraine. Participants will be randomized into three groups: the therapeutic pain neuroscience education (TPNE; n = 25) group, the manual therapy (MT; n = 25) group, and the multimodal (MM; n = 25) group. The TPNE group will receive one orientation session on migraine and pain self-management, and recommendations for daily active stretching and walking, with subsequent therapist monitoring. The MT group will receive manual therapies targeting musculoskeletal disorders of the cervical spine. The MM group will receive manual therapies targeting musculoskeletal disorders of the cervical spine, active neck

exercises, and therapeutic pain neuroscience education. The treatment period will last 12 weeks. The primary outcome will be the headache impact, measured using the Headache Impact Test (HIT-6). Secondary outcomes will include migraine frequency and intensity, cervical mobility and strength parameters, neck pain-related disability, kinesiophobia, cutaneous allodynia, pain-related catastrophizing, quality of life, and self-perception of change. All outcomes will be evaluated at the fourth, eighth, and twelfth weeks of the treatment period. Primary and secondary clinical outcomes, such as headache impact, frequency, and intensity, will also be evaluated at the 1-, 2-, and 4-month follow-ups.

Use of MCU: measure cervical range of motion and isometric strength of cervical muscles

"Is there a correlation of cervical mobility with clinical variables and psychosocial factors in women with migraine?"

Folkins CF, Marcal JCS, Oliveira AS, et al. Is there a correlation of cervical mobility with clinical variables and psychosocial factors in women with migraine? *Appl Sci.* 2021;11,6077. https://doi.org/10.3390/app11136077

ABSTRACT

We aimed to determine the association of cervical range of motion (ROM) with the clinical features of headache and neck pain and psychosocial factors in patients with migraine. Seventy women diagnosed with migraine were questioned regarding migraine onset and frequency, and the presence, frequency, and intensity of self-reported neck pain. These individuals also completed the following questionnaires: Neck Disability Index, Migraine Disability Assessment, Patient Health Questionnaire (PHQ-9), and Tampa Scale for Kinesiophobia. Active cervical ROM was assessed in the sagittal, frontal, and transverse planes using the Multi-Cervical Unit Rehabilitation® equipment. Potential associations were calculated using Pearson's correlation test or Spearman's correlation ($p < 0.05$). A weak negative correlation was observed between the PHQ-9 scores and sagittal ($p = -0.30$, $p = 0.010$), frontal ($p = -0.34$, $p = 0.004$), and transverse ($p = -0.31$, $p = 0.009$) cervical ROM. No correlation was found between cervical ROM and kinesiophobia, migraine-related disability, neck pain disability, or clinical features of neck pain and migraine ($p > 0.05$). Our findings indicated that cervical mobility was associated with the severity of depressive symptoms, but not with the clinical variables of migraine and neck pain, kinesiophobia levels, neck pain disability, and migraine-related disability in women with migraine.

Use of MCU: measure cervical range of motion

"Neck active movements assessment in women with episodic and chronic migraine."

Pinheiro CE, Oliveira AS, et al. Neck active movements assessment in women with episodic and chronic migraine. *J Clin Med.* 2021;10,3805 https://doi.org/10.3390/jcm10173805

ABSTRACT

We aimed to compare movement parameters and muscle activity during active cervical spine movements between women with episodic or chronic migraine and asymptomatic control. We also assessed the correlations between cervical movement measures with neck-related disability and kinesiophobia. Women with episodic (n = 27; EM) or chronic (n = 27; CM) migraine and headache-free controls (n = 27; CG) performed active cervical movements. Cervical range of motion, angular velocity, and percentage of muscular activation were calculated in a blinded fashion. Compared to CG, the EM and CM groups presented a reduced total range of motion ($p < 0.05$). Reduced mean angular velocity of cervical

movement was also observed in both EM and CM compared to CG ($p < 0.05$). Total cervical range of motion and mean angular velocity showed weak correlations with disability ($r = -0.25$ and -0.30, respectively; $p < 0.05$) and weak-to-moderate correlations with kinesiophobia ($r = -0.30$ and -0.40,

respectively; $p < 0.05$). No significant correlation was observed between headache features and total cervical range of motion or mean angular velocity ($p > 0.05$). No differences in the percentage of activation of both flexors and extensors cervical muscles during active neck movements were seen ($p > 0.05$). In conclusion, episodic and chronic migraines were associated with less mobility and less velocity of neck movements, without differences within muscle activity. Neck disability and kinesiophobia are negative and weakly associated with cervical movement.

Use of MCU: to measure active range of motion of the neck

"Progressive resistance exercise for improving pain and disability in chronic neck pain: a case series."

Cox LG, Savur KT, De Nardis RJ, et al. Progressive resistance exercise for improving pain and disability in chronic neck pain: a case series. *Physiother Res Int*. 2020. https://doi.org/10.1002/pri.1863

ABSTRACT
Objectives: Chronic neck pain is known to be associated with neck muscle weakness. However, many strengthening programs do not target multi-directional weakness in a functional position. Specialized assessment and treatment technology that is able to strengthen the neck muscles in an upright position may be used to achieve this. There is little research available on the efficacy of neck-specific progressive resistance exercise interventions in patients with chronic neck pain; therefore, this study aimed to determine whether this style of program led to a change in pain and disability, and to investigate the relationship between neck strength, pain and disability.
Methods: Secondary analysis of participants with chronic neck pain who completed a minimum of nine sessions of a neck-specific progressive resistance program at a physiotherapy clinic between the years of 2002 and 2018. Outcomes were the Neck Disability Index (NDI), Numerical Rating Scale of Pain (NRS) and multi-directional neck strength (flexion, extension and lateral flexion – pounds). Data were analyzed through paired samples t-tests and backwards stepwise multiple linear regression models.
Results: A total of 127 participants were eligible for inclusion. All neck strength measures, NDI scores and NRS scores showed significant improvements after the nine sessions (all $p < .0001$). Significant predictors of NDI were symptom duration ($\beta = -0.023$, $p = .009$) and NRS score ($\beta = 4.879$, $p < .000$). Significant predictors of NRS were symptom duration ($\beta = 0.004$, $p = .005$), NDI score ($\beta = 0.105$, $p < .000$), extension strength ($\beta = -0.950$, $p = .012$) and gender ($\beta = 0.777$ [male =1, female = 0], $p = .029$).
Conclusion: This study showed that a neck-specific progressive resistance exercise intervention led to significant improvement in neck strength, pain and disability in a clinical population. However, caution should be taken when interpreting results due to a lack of comparison group and the variation in treatment given and, therefore, further higher-quality research should be undertaken to confirm these findings.

Use of MCU: measure isometric strength of cervical muscles

"Neck muscle stiffness measured with shear wave elastography in women with chronic nonspecific neck pain."

Dieterich AV, Yavuz U, Petzke F, et al. Neck muscle stiffness measured with shear wave elastography in women with chronic nonspecific neck pain. *J Ortho Sports Phys Ther*. 2020;50:179-188.

ABSTRACT:
Objective: Utilizing shear wave elastography, we compared the stiffness of the neck extensor muscles and the stiffness in muscle-specific regions between women with chronic nonspecific neck pain and asymptomatic controls.
Design: Cross-sectional observational study.

Methods: We measured the average muscle stiffness over multiple neck extensor muscles and in regions corresponding approximately to the trapezius, splenius capitis, semispinalis capitis, semispinalis cervicis, and multifidus muscles using ultrasound shear wave elastography in 20 women with chronic nonspecific neck pain and 18 asymptomatic women during multiple tasks. The measurements were automatically quality controlled and computer processed over the complete visible neck region or a large muscle-specific region.
Results: Pooled over all tasks, neck muscle stiffness was not significantly different between those with neck pain and asymptomatic controls (neck pain median, 11.6 kPa; interquartile range, 8.9 kPa and control median, 13.3 kPa; interquartile range, 8.6 kPa; *P* = .175). The measure of neck muscle stiffness was not correlated with the intensity of neck pain or perceived disability.
Conclusion: Shear wave elastography revealed similar muscle stiffness in people with and without chronic neck pain, despite the sensation of increased neck stiffness in those with chronic neck pain. Therapeutic interventions aiming to reduce neck muscle tone are often based on the assumption that perceived neck stiffness corresponds to objective muscle stiffness. The current results question this assumption

Use of MCU: musculoskeletal evaluation of cervical muscle stiffness in asymptomatic and chronic nonspecific neck pain female populations. Utilizing isometric mode, participants exerted defined force levels using visual feedback

"Range of motion in the cervical spine after odontoid fracture treated with anterior screw fixation."

Wolan-Nieroda A, Maciejczak A, Guzik A, Et al. Range of motion in the cervical spine after odontoid fracture treated with anterior screw fixation. *J Ortho Surg Res.* 2019;14:104, https://doi.org/10.1186/s13018-019-1135-8

ABSTRACT:
Background: It is believed that direct odontoid screw fixation preserves the physiological cervical range of motion following surgery. However, there are no clinical studies confirming the motion sparing value of this technique. This study aims to (1) to assess active cervical range of motion following types II and III odontoid fracture, successfully treated with anterior odontoid screw fixation, and (2) to examine the relationship between the range of motion of the head and duration of collar usage, neck pain, quality of life, and patients' age.
Methods: The study involved 41 patients subjected to a procedure of direct osteosynthesis of the dens with lag screw. Following the operation all the patients had to wear a cervical collar to protect the osteosynthesis. The control group consisted of 41 individuals with no clinical diagnosis of any cervical spine disorders. The spinal motion was assessed using multi-cervical unit, taking into account bending/extension, left and right lateral flexion, and left and right axial rotation.
Results: In the study group, spine mobility correlated with the duration of hard collar usage following the operation, with a longer duration corresponding to poorer spine mobility at the end of the treatment. Statistically significant correlation was observed in the case of extension ($p < 0.021$) and axial rotation ($p < 0.007$). In the study group, there was a negative correlation between the range of motion and the patients' age, i.e., the older the patient the poorer his/her spinal mobility ($p < 0.001$).
Conclusions: Active cervical range of motion in patients following direct osteosynthesis of the dens, augmented with a hard collar, was significantly lower than in the control population, and it correlated negatively with the duration of collar usage, the patients' age, and intensity of spinal pain.

Use of MCU: musculoskeletal evaluation of cervical range of motion of individuals post-odontoid fracture with anterior screw fixation

“Shi’s Daoyin therapy for neck pain: a randomized controlled trial.”

Wang H, Jiang E, Wang K, et al. Shi’s Daoyin therapy for neck pain: a randomized controlled trial. *Evidence-Based Complementary and Alternative Medicine.* 2018, https://doi.org/10.1155/2018/4983891

ABSTRACT:
Objective: To compare the immediate and short term effectiveness of Shi’s Daoyin therapy (DT) rather than the Melbourne Protocol (MP) in terms of pain, mobility, and isometric strength of cervical muscles in nonacute nonspecific neck pain patients.
Material and Methods: A total of 114 nonacute nonspecific neck pain patients aged 20~50 years were recruited and randomly assigned to be treated by either Shi’s DT or the MP. 56 cases and 54 cases received treatment for 3 weeks and were evaluated before and after intervention and at 3-week follow-up in Shi’s DT group and MP group, respectively. The outcome measures were Chinese version of the Neck Disability Index (NDI), cervical range of motion (ROM), maximal voluntary isometric force (MVIF), and pain intensity (Numeric Pain Rating Scale, NPRS).
Results: All outcomes of both groups showed statistically significant improvements after the intervention and at 3-week follow-up ($P < 0.05$), while no statistically significant difference was found in NDI between groups. When followed up after 3 weeks, the ROM in axial rotation was significantly greater in the Shi’s DT group ($P < 0.05$), and the NPRS in the Shi’s DT group was significantly lower than the MP group ($P < 0.05$). At the end of the treatment period, the MVIF in lateral bending in the Shi’s DT group had a lower value ($P = 0.044$) than in the MP group, but there was no significant difference in flexion and extension between the two groups.
Conclusions: Both Shi’s DT and MP groups demonstrated an obvious reduction in pain intensity and improvements in neck mobility after a short term follow-up period. The improvement of Shi’s DT in disability and pain during functional activities is generally similar to that of the MP for the treatment of nonacute nonspecific neck pain.

Use of MCU: musculoskeletal evaluation and treatment utilizing the Melbourne Protocol of patients with nonacute nonspecific neck pain to qualify the immediate and short-term effectiveness in terms of pain, mobility, and isometric strength of cervical muscles

“Activation of the semispinalis cervices and splenius capitis with cervical pulley exercises.”

Rivard J, Unsleber C, Schomacher J, et al. Activation of the semispinalis cervices and splenius capitis with cervical pulley exercises. *Musculoskel Sci Pract*. 2017, doi:10.1016/j.msksp.2017.05.007.

ABSTRACT:
Study Design: Quasi-Experimental
Objective: To assess the activation of semispinalis cervicis (d-SSC) and splenius capitis (s-SC) muscles, and the activation between the two during neck pulley and free weight exercises.
Background: Altered activation of cervical extensors may occur with neck pain, suggesting exercises should be designed to target these muscles.
Methods: d-SSC and s-SC activity was recorded unilaterally with intramuscular electromyography from healthy volunteers during cervical isometric exercises: 1) extension with a pulley rope angled from incline to vertical, 2) extension with right, left and central forehead hanging weight, and 3) rotation with pulley rope angled from incline to decline.
Results: Extension against a vertical force led to greater activation of d-SSC ($P<0.001$) and s-SC ($P<0.001$) compared to the inclined, declined and horizontal pulley. With each of these conditions, amplitude of muscle activity was higher for the d-SSC compared to the s-SC muscle ($P<0.0001$). Extension with free weight hanging on right, left or central forehead, showed no differences across conditions, although in each condition, the d-SSC amplitude was higher than the s-SC. For cervical rotation, the declined pulley led to the greatest activation of both muscles ($P<0.05$). Higher levels of activity were observed for the s-SC compared to the d-SSC ($P<0.01$) for all rotation conditions.

Conclusion: A vertical resistance during an extension exercise, or a declined resistance during cervical rotation, increased neck extensor activation. The results from this preliminary study provide guidance for future work on the exploration and development of low-load exercise design for patients with neck pain disorders.

Use of MCU: musculoskeletal evaluation of cervical muscle strength (isometric) in a healthy population

"Exercises for mechanical neck disorders: A Cochrane review update."

Gross AR, Paquin JP, Dupont G, et al. Exercises for mechanical neck disorders: A Cochrane review update. *Manual Therapy*. 2016, http://dx.doi.org/10.1016/j.math.2016.04.005.

ABSTRACT:
Background: Neck pain (NP) is disabling and costly.
Objectives: To assess the effectiveness of exercise on pain, disability, function, patient satisfaction, quality of life (QoL) and global perceived effect (GPE) in adults with NP.
Methods: We searched computerized databases up to May 2014 for randomized controlled trials (RCTs) comparing exercise to a control in adults with NP with/without cervicogenic headache (CGH) or radiculopathy. Two reviewers independently conducted selection, data abstraction and assessed risk of bias. Meta-analyses were performed to establish pooled standardized mean differences (SMDp). The Grade of Recommendation, Assessment, Development and Evaluation (GRADE) was used to summarize the body of evidence.
Main Results: The following exercises (27 trials) were supported by 'Moderate GRADE' evidence: For chronic NP, 1) cervico-scapulothoracic and upper extremity (UE) strengthening for moderate to large pain reduction immediately post treatment (IP) and at short-term (ST) follow-up; 2) scapulothoracic and UE endurance training for a small pain reduction (IP/ST); 3) cervical, shoulder and scapulothoracic strengthening and stretching exercise for a small to large pain reduction in the long-term (LT) (SMDp -0.45 [95%CI: -0.72 to -0.18]) and function improvement; 4) cervico-scapulothoracic strengthening/ stabilisation exercises for pain and function at intermediate-term(IT) (SMDp -14.90 [95%CI: -22.40 to -7.39]). 5) mindfulness exercises (Qigong) for minor improved function but not GPE (ST). For chronic CGH, cervico-scapulothoracic strengthening and endurance exercises including pressure biofeedback for small/moderate improvement of pain, function and GPE (IP/LT).
Conclusions: Specific strengthening exercises of the neck, scapulothoracic and shoulder for chronic NP and chronic CGH are beneficial. Future research should explore optimal dosage.

Use of MCU: musculoskeletal evaluation and treatment of cervical range of motion and muscle strengthening by various researchers

"Neck muscular strength, training, performance and sport injury risk: a review."

Hrysomallis C: Neck muscular strength, training, performance and sport injury risk: A review. *Sports Med.* 2016, doi:10.1007/s40279-016-0490-4.

ABSTRACT:
The neck musculature has an essential role in positioning and stabilising the head and may influence sport performance and injury risk. The objectives of this review are to (1) compare the neck strength of different athletes; (2) report on the outcomes of training programmes; (3) explore the association between neck strength and head stabilisation; (4) examine the relationship between neck strength and sport injury risk; and (5) identify areas for future research. There was a difference in strength between different player positions in football
codes, gender and age. Detected differences were partly attributed to variation in neck muscle mass. Neck strength training programmes were generally shown to be effective for untrained and trained participants using dynamic or isometric actions and various types of resistance devices. There was a wide

range of reported increases in neck strength; the smallest gains were usually for programmes that utilised lower intensity or frequency. There was limited
evidence that greater isometric strength or dynamic training was associated with better head stabilisation during low-level force application, while there is direct evidence of an association between neck isometric training or strength and injury risk. A retrospective analysis of professional rugby union players revealed that isometric training reduced match-related cervical spine injuries and a prospective study found that greater overall isometric neck strength reduced concussion risk in high school athletes.
Recommendations for future research include substantiating the link between neck strength and sport injury risk and assessing the effectiveness of neck plyometric and perturbation training on stabilisation and injury risk.

Use of MCU: musculoskeletal evaluation and treatment of cervical muscle strength by various researchers

"Neck muscle strength training in the risk management of concussion in contact sports: critical appraisal of application to practice."

Gilchrist I, Storr M, Chapman E, Pelland L: Neck muscle strength training in the risk management of concussion in contact sports: critical appraisal of application to practice. *J Athl Enhancement*. 2015;4:2. http://dx.doi.org/10.4172/2324-9080.1000195.

ABSTRACT:
Background: Neck strength training has been advocated as a player-specific modifiable factor in the risk management for concussion in contact sports. A scoping review of the literature was undertaken to address two specific aims. The first was to identify and critically appraise the level and quality of evidence relating neck strength and resistance training to concussion incidence and risk in contact sports. The second was to compare and contrast the effectiveness of resistance neck strengthening programs and to evaluate effects of increased strength in attenuating the post-impact kinematics of the head, a proxy measure of concussion risk.
Methods: Structured search of five electronic databases (Ovid MEDLINE, CINAHL, PubMED, EMBASE, and AMED), combining MeSH and generic search terms relating neck strength to concussion biomechanics, risk and incidence. Level of research evidence (Oxford Centre of Evidence-based Medicine) and methodological quality were determined (PEDro and Newcastle-Ottawa Scales).
Results: Total isometric neck strength predicted concussion incidence in one prospective study (level 1b). The effect size of strength on concussion incidence was small (Cohen's d, 0.29). Peak isometric strength did not predict the odds of sustaining a moderate or severe head impact in contact sports (level 1b, 2b, and 4). Short-latency anticipatory strength exerts an attenuating effect on post-impact kinematics of the head (level 1b, 2b) and can be facilitated by selective parameters of isotonic strength training. Methodological quality of the research evidence ranged from 6/10 to 8/10 for controlled trials and 6/9 to 9/9 for case-series and cohort studies.
Conclusion: Short-latency strength, developed prior to impact, is a key modifying variable of the post-impact kinematics of the head. By facilitating short-latency neck strength, muscle strength training is a potential target to favorably influence concussion risk, but further study is required to determine the translation of neck/head kinematics to concussion risk. Standardized methods for assessment of multi-directional short-latency, and peak neck, strength need to be adopted and combined with prospective studies.

Use of MCU: musculoskeletal evaluation and treatment of cervical muscle strengthening by various researchers

“Can neck exercises enhance the activation of the semispinalis cervicis relative to the splenius capitis at specific spinal levels.”

Schomacher J, Erlenwein J, Dieterich A, et al. Can neck exercises enhance the activation of the semispinalis cervicis relative to the splenius capitis at specific spinal levels. *Manual Ther*. 2015;20:694-702.

ABSTRACT:
The deep cervical extensor, semispinalis cervicis, displays changes in behavior and structure in people with chronic neck pain yet there is limited knowledge on how activation of this muscle can be emphasized during training. Using intramuscular electromyography (EMG), this study investigated the activity of the deep semispinalis cervicis and the superficial splenius capitis muscle at two spinal levels (C2 and C5) in ten healthy volunteers during a series of neck exercises: 1. Traction and compression, 2. Resistance applied in either flexion or extension at the occiput, at the level of the vertebral arch of C1 and of C4, and 3. Maintaining the neck in neutral while inclined on the elbows, with and without resistance at C4. The ratio between semispinalis cervicis and the splenius capitis EMG amplitude was quantified as an indication of whether the exercise could emphasize the activation of the semispinalis cervicis muscle relative to the splenius capitis. Manual resistance applied in extension over the vertebral arch emphasized the activation of the semispinalis cervicis relative to the splenius capitis at the spinal level directly caudal to the site of resistance (ratio: 2.0 ± 1.1 measured at C5 with resistance at C4 and 2.1 ± 1.2 measured at C2 with resistance at C1). This study confirmed the possibility of emphasizing the activation of the semispinalis cervicis relative to the splenius capitis which may be relevant for targeted exercise interventions for this deep extensor muscle. Further studies are required to investigate the clinical efficacy of these exercises for people with neck pain.

Use of MCU: musculoskeletal evaluation of cervical spine in healthy volunteers. Isometric mode was utilized to measure maximum voluntary contractions of neck extension

“Immediate effects of active cranio-cervical flexion exercise versus passive mobilisation of the upper cervical spine on pain and performance on the cranio-cervical flexion test.”

Lluch E, Schomacher J, Gizzi L, et al. Immediate effects of active cranio-cervical flexion exercise versus passive mobilisation of the upper cervical spine on pain and performance on the cranio-cervical flexion test. *Manual Therapy*. 2014; 19:25-31.

ABSTRACT:
This study compared the immediate effects of an assisted plus active cranio-cervical flexion exercise (exercise group) versus a passive mobilisation plus assisted cranio-cervical flexion (mobilisation group) on performance of the cranio-cervical flexion test (CCFT), cervical range of motion (ROM) and pain in patients with chronic neck pain. Eighteen volunteers with chronic idiopathic neck pain participated in the study and were randomised to one of the two intervention groups. Current level of pain, cervical ROM and pain perceived during movement, pressure pain threshold (PPT) and surface electromyography (EMG) during performance of the CCFT were measured before and immediately after the intervention. A significant reduction in resting pain and PPT measured over cervical sites was observed immediately following both interventions, although a greater change was observed for the exercise group. No change in cervical ROM was observed after either intervention. Reduced sternocleidomastoid and anterior scalene EMG amplitude were observed during stages of the CCFT but only for the participants in the active exercise group. Although both active and passive interventions offered pain relief, only the exercise group improved on a task of motor function highlighting the importance of specific active treatment for improved motor control of the cervical spine.

Use of MCU: musculoskeletal evaluation of cervical range of motion of volunteers with chronic idiopathic neck pain

"The clinical utility of cervical range of motion in diagnosis, prognosis, and evaluating the effects of manipulation: a systematic review."
Snodgrass SJ, Cleland JA, Haskins R, et al. The clinical utility of cervical range of motion in diagnosis, prognosis, and evaluating the effects of manipulation: a systematic review. *Physiother.* 2014;100:290-304.

ABSTRACT:
Background: Clinicians commonly assess cervical range of motion (ROM), but it has rarely been critically evaluated for its ability to contribute to patient diagnosis or prognosis, or whether it is affected by mobilization/manipulation.
Objectives: This review summarizes the methods used to measure cervical ROM in research involving patients with cervical spine disorders, reviews the evidence for using cervical ROM in patient diagnosis, prognosis, and evaluation of the effects of mobilization/manipulation on cervical ROM.
Data sources and study selection: A systematic search of MEDLINE, EMBASE, CINAHL, AMED and ICL databases was conducted, addressing one off our constructs related to cervical ROM: measurement, diagnosis, prognosis, and the effects of mobilization/manipulation on cervical ROM.
Study appraisal and synthesis: Two independent raters appraised methodological quality using the QUADAS-2 tool for diagnostic studies, the QUIPS tool for prognostic studies and the PEDro scale for interventional studies. Heterogeneity of studies prevented meta-analysis.
Results: Thirty-six studies met the criteria and findings showed there is limited evidence for the diagnostic value of cervical ROM in cervicogenic headache, cervical radiculopathy and cervical spine injury. There is conflicting evidence for the prognostic value of cervical ROM, though restricted ROM appears associated with negative outcomes while greater ROM is associated with positive outcomes. There is conflicting evidence as to whether cervical ROM increases or decreases following mobilization/ manipulation.
Conclusion and implications of key findings: Cervical ROM has value as one component of assessment, but clinicians should be cautious about making clinical judgments primarily on the basis of cervical ROM.

Review cites 2 MCU studies investigating the utility of use measurement of ROM in diagnosis, prognosis, and/or evaluation of the effects of manipulation/mobilization

Off-Label Use Evidence:

"Effects of head flexion posture on the multidirectional static force capacity of the neck."
Gilchrist I, Moglo K, Storr M, et el. Effects of head flexion posture on the multidirectional static force capacity of the neck. *Clin Biomech*. 2016;37:44-52

ABSTRACT:
Background: Neck muscle force protects vertebral alignment and resists potentially injurious loading of osteoligamentous structures during head impacts. As the majority of neck muscles generate moments about all three planes of motion, it is not clear how the force capacity of the neck might be modulated by direction of force application and head posture. The aim of our study was to measure the multidirectional moment generating capacity of the neck and to evaluate effects of 20° of head flexion, a common head position in contact sports, on the measured capacity.
Methods: We conducted a cross-sectional study, with 25 males, 20–30 years old, performing maximum voluntary contractions, with ballistic intent, along eight directions, set at 45° intervals in the horizontal plane of the head. Three-dimensional moments at C3 and T1 were calculated using equations of static

equilibrium. The variable of interest was the impulse of force generated from 0–50 ms. Effects of direction of force application and head posture, neutral and 20° flexion, were evaluated by two-way analysis of variance and linear regression.
Findings: Impulse of force was lower along diagonal planes, at 45° from the mid-sagittal plane, compared to orthogonal planes (P b 0.001). Compared to neutral posture, head flexion produced a 55.2% decrease in impulse capacity at C3 and 45.9% at T1.
Interpretation: The risk of injury with head impact would intrinsically be higher along diagonal planes and with a 20° head down position due to a lower moment generating capacity of the neck in the first 50 ms of force application.

Use of MCU: musculoskeletal evaluation of cervical muscle strength in young adult males

NOTE THAT MCU WAS RETROFITTED WITH A CUSTOM HEAD FRAME DEVELOPED BY PELLAND AND GILCHRIST.