Evidence-based Practice Initiative – MCU

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

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.”

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 computerised 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 standardised mean differences (SMDp). The Grade of Recommendation, Assessment, Development and Evaluation (GRADE) was used to summarise 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.”

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.”

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 multidirectional 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.

“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.”

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.

“The effect of two different training methods on isometric strength of the head and neck extensor muscles.”

ABSTRACT:
Background and purpose: Strengthening the cervical extensor muscles is recommended as a way of prevention and treatment of neck pain. The purpose of this study was to investigate the effect of two different exercise protocols on isometric strength of the head and neck extensor muscles in healthy subjects.
Material and Methods: In this study, a total of twenty-eight healthy females, 20-25 years of age, were randomly allocated into a head and neck-extension strengthening exercise group (n=14) and a shoulder-abduction strengthening exercise group (n=14). Each two study groups performed exercises 3 days/week for 10 weeks. In groups, head and neck muscle isometric strength was measured by an isometric muscle strength measurement device both before and after the intervention.
Results: Two study groups showed a significant increase in isometric strength of the head and neck extensor muscles (p<0.001). Although head and neck-extension strengthening exercise group showed more increase in the muscle strength, but the results indicate no significant difference between the two training groups in this regard.
Conclusion: The results of this study showed that shoulder-abduction strengthening exercises as well as head-extension strengthening exercises are effective in increasing isometric strength of the extensor muscles. Therefore, when patients are not able to properly perform neck and head exercises due to pain or other limitations, this training program can be used as a suggestion method to strengthen the head and neck extensor muscles.

(Full article in Persian)

Use of MCU: musculoskeletal evaluation of cervical strength (isometric).

“Collegiate and high school athlete neck strength in neutral and rotated postures.”

ABSTRACT: A knowledge of neck strength is important for developing conditioning protocols and for evaluating the relationship between neck strength and head and neck injury, but very few studies have examined neck strength in relationship to athletic participation. The purpose of this study was to quantify
isometric neck strength in collegiate and high school athletes. We hypothesized that (a) male athletes would have significantly greater neck strength than females; (b) collegiate athletes would be significantly stronger than high school athletes; and (c) neck strength would vary significantly with head posture. A total of 149 subjects participated (77 men and 72 women; 90 college and 59 high school level). Flexion, extension, and lateral flexion neck strength were measured in neutral and rotated head and neck postures. Neck strength varied significantly according to participants' sex, age, and posture ($p < 0.05$). Male college students were stronger than those in all other groups (female college students, male high school students, and female high school students). The average female neck strength was 61, 54, and 56% of the average male neck strength for extension, flexion, and lateral flexion, respectively. High school athletes' neck strength was 75, 68, and 65% of collegiate athletes' neck strength for extension, flexion, and lateral flexion, respectively. On average, neck strength was the greatest for extension compared with other force directions. The subjects showed large variation in neck strength with posture, but in general, there were no consistent trends among the subjects. This finding suggests that those whose neck strength was considerably lower in non-neutral postures may consider training to increase strength in rotated postures. These data provide important baseline information for future studies evaluating injury risk or training protocols.

Use of MCU: musculoskeletal evaluation of cervical strength (isometric).

“A study on the effectiveness of shoulder strengthening exercises on thickness of the neck extensor muscles.”


ABSTRACT:

Background and Aim: Neck extensor muscles play an important role in stabilizing the cervical spine. Upper limbs muscle activities may increase cervical extensor muscles function. The purpose of this study was to assess changes in neck extensor muscles thickness after a shoulder-abduction strengthening exercise program.

Methods & Materials: In this study participants were 28 healthy women (age 20-25 years of old) who were randomly assigned to a shoulder-abduction strengthening exercise group (n=14) and control group (n=14). Intervention period in both groups was 10 weeks. The thickness of five cervical muscles including upper trapezius, semispinalis cervicis, semispinalis capitis, splenius capitis and multifidus muscles was measured by ultrasonography.

Results: Shoulder-abduction strengthening exercise program lead to significant increase in thickness of the neck extensor muscles ($p<0.001$). Semispinalis capitis muscle showed the greatest increase in muscle thickness among the extensor muscles.

Conclusion: Upper limbs muscle training as was used in this study plays an important role in increasing neck posterior muscles thickness. It is recommended to use this kind of training to improve the function of neck extensor muscles.

(Full article in Persian)

Use of MCU: musculoskeletal evaluation of cervical strength (isometric).
“Chiropractic Treatment of NTOS.”

ABSTRACT:
Chiropractic as defined by the World Federation of Chiropractic is “a health profession concerned with the diagnosis, treatment and prevention of mechanical disorders of the musculoskeletal system, and the effects of these disorders on the functions of the nervous system and general health. There is an emphasis on manual treatments including spinal adjustment and other joint and soft-tissue manipulation.” In patients with Neurogenic Thoracic Outlet Syndrome [NTOS] there may be mechanical compression of neural structures within the brachial plexus at one of several anatomical sites, several of which may be targeted by the techniques used in Chiropractic.

Use of MCU: musculoskeletal evaluation of cervical strength (isometric) and treatment to increase muscle strength.

“A critical review on physical factors and functional characteristics that may explain a sex/gender difference in work-related neck/shoulder disorders.”

ABSTRACT:
The objective of this paper is to critically review recent literature on physical and functional sex/gender (s/g) differences, with focus on physical determinants associated with neck/shoulder musculoskeletal injuries. It is well known that there are s/g differences in anthropometrical and functional body characteristics (e.g. size and strength). However, s/g differences may be wrongly attributed if data analysis does not include appropriate corrections (e.g. by strength for endurance). Recent literature on motor control shows that there may indeed be s/g differences in muscle coordination and movement strategies during upper limb tasks that are not currently explained by methodological inadequacies. Moreover, recent studies have shown differences between men and women in sensory hypersensitivity characteristics associated with neck/shoulder injuries. Taken together, the literature points to the importance of accounting for possible s/g differences at all levels of the biopsychosocial system in order to better understand sex- and gender-specific issues relevant to workplace health.

Practitioner Summary: This article critically reviews recent literature and a conceptual model highlighting s/g differences in physical and functional characteristics related to neck/shoulder musculoskeletal disorders (NSMSD). Findings have implications on understanding how personal factors may affect NSMSD risk. With better understanding, practitioners can make more appropriate decisions to prevent work-related NSMSD.

Use of MCU: musculoskeletal evaluation of cervical strength (isometric) by various researchers.

“Exercises for mechanical neck disorders (Review).”

ABSTRACT:
**Background:** Neck disorders are common, disabling and costly. The effectiveness of exercise as a physiotherapy intervention remains unclear.

**Objectives:** To improve pain, disability, function, patient satisfaction, quality of life and global perceived effect in adults with neck pain.

**Search methods:** Computerized searches were conducted up to February 2012.

**Selection criteria:** We included single therapeutic exercise randomized controlled trials for adults with neck pain with or without cervicogenic headache or radiculopathy.

**Data collection and analysis:** Two review authors independently conducted selection, data extraction, 'Risk of bias assessment, and clinical relevance. The quality of the body of evidence was assessed using GRADE. Relative risk and standardized mean differences (SMD) were calculated. After judging clinical and statistical heterogeneity, we performed meta-analyses.

**Main results:** Six of the 21 selected trials had low risk of bias. Moderate quality evidence shows that combined cervical, scapulothoracic stretching and strengthening are beneficial for pain relief post treatment (pooled SMD -0.35, 95% confidence interval (CI): -0.60, -0.10) and at intermediate follow-up (pooled SMD -0.31, 95% CI: -0.57, -0.06), and improved function short term and intermediate term (pooled SMD -0.45, 95% CI: -0.72, -0.18) for chronic neck pain. Moderate quality evidence demonstrates patients are very satisfied with their care when treated with therapeutic exercise. Low quality evidence shows exercise is of benefit for pain in the short term and for function up to long-term follow-up for chronic neck pain. Low to moderate quality evidence supports self-mobilization, craniocervical endurance and low load cervical-scapular endurance exercises in reducing pain, improving function and global perceived effect in the long term for subacute/ chronic cervicogenic headache. Low quality evidence supports neck strengthening exercise in acute cervical radiculopathy for pain relief in the short term.

**Conclusions:** Low to moderate quality evidence supports the use of specific cervical and scapular stretching and strengthening exercise for chronic neck pain immediately post treatment and intermediate term, and cervicogenic headaches in the long term. Low to moderate evidence suggests no benefit for some upper extremity stretching and strengthening exercises or a general exercise program. Future trials should consider using an exercise classification system to establish similarity between protocols and adequate sample sizes. Factorial trials would help determine the active treatment agent within a treatment regimen where a standardized representation of dosage is essential. Standardized reporting of adverse events is needed for balancing the likelihood of treatment benefits over potential harms.

*Use of MCU: musculoskeletal evaluation of cervical strength (isometric) and treatment to increase strength by various researchers.*

“A randomized controlled trial on the efficacy of intermittent cervical traction for patients with chronic neck pain.”


**ABSTRACT:**

**Objective:** To investigate the efficacy of intermittent cervical traction in the treatment of chronic neck pain over a 12-week follow-up.

**Design:** A randomized controlled trial.

**Setting:** Hospital-based outpatient practice.

**Subjects:** Seventy-nine patients with chronic neck pain.

**Interventions:** Subjects were randomly assigned to either experimental group (n=39, mean age=50.5±9.8) or control group (n=40, mean age=48.8±9.1). Experimental group received intermittent
cervical traction and control group received infrared irradiation alone; twice a week over a period of six weeks.

**Outcome measurements:** The values of Chinese version of the Northwick Park Neck Pain Questionnaire (NPQ), verbal numerical pain scale (VNPS), and cervical active range of motion (AROM) were measured at baseline, six-week and 12-week follow-up.

**Results:** No significant differences were found between the two groups in the NPQ \( (P>0.05) \), VNPS \( (P>0.05) \) and AROM \( (P>0.05) \).

*Use of MCU: musculoskeletal evaluation of isometric strength of the cervical extensors.*


**ABSTRACT:**
The aim of our study was to assess the effectiveness of thoracic manipulation (TM) on patients with chronic neck pain. 120 patients aged between 18 and 55 were randomly allocated into two groups: an experimental group which received TM and a control group without the manipulative procedure. Both groups received infrared radiation therapy (IRR) and a standard set of educational material. TM and IRR were given twice weekly for 8 sessions. Outcome measures included craniovertebral angle (CV angle), neck pain (Numeric Pain Rating Scale; NPRS), neck disability (Northwick Park Neck Disability Questionnaire; NPQ), health-related quality of life status (SF36 Questionnaire) and neck mobility. These outcome measures were assessed immediately after 8 sessions of treatment, 3-months and at a 6-month follow-up. Patients that received TM showed significantly greater improvement in pain intensity \( (p = 0.043) \), CV angle \( (p = 0.049) \), NPQ \( (p = 0.018) \), neck flexion \( (p = 0.005) \), and the Physical Component Score (PCS) of the SF36 Questionnaire \( (p = 0.002) \) than the control group immediately post-intervention. All these improvements were maintained at the 6-month follow-ups. This study shows that TM was effective in reducing neck pain, improving dysfunction and neck posture and neck range of motion (ROM) for patients with chronic mechanical neck pain up to a half-year post-treatment.

*Use of MCU: musculoskeletal evaluation of cervical range of motion.*

“Neck pain in military helicopter aircrew and the role of exercise therapy.”

**ABSTRACT:**
Neck pain is a growing aeromedical concern for military forces on an international scale. Neck pain prevalence in the global military helicopter community has been reported in the range of 56.6 – 84.5%. Despite this high prevalence, historically, research examining helicopter aircrews has focused predominantly on low back pain. A number of recent studies have emerged examining flight-related factors that are hypothesized to contribute to the development of flight-related neck pain. Loading factors such as the posture adopted during flight, use of night vision googles, and vibration have all been found to contribute to neck pain and muscular fatigue. Prolonged or repeated exposure to these loading factors has been hypothesized to perpetuate or contribute to the development of neck pain. Despite the high number of helicopter aircrew personnel that suffer from neck pain, very few individuals seek treatment for
the disorder. The focus of medical personnel should, therefore, be directed toward a solution that addresses not only the issue of muscular fatigue, but the hesitancy to seek treatment. Previous re-search in military and civilian populations have used exercise therapy as a treatment modality for neck pain and have found improved endurance capacity in the neck musculature and reduced self-reported neck pain.

*Use of MCU: musculoskeletal evaluation of isometric strength and treatment using resistance training to increase cervical muscle strength.*

“A systematic review of reliability and validity studies of methods for measuring active and passive cervical range of motion.”

**ABSTRACT:**
**Objective:** The purpose of this study was to systematically review the literature evaluating the reliability and validity of all available methods for measuring active and passive cervical range of motion (CROM).
**Methods:** Electronic databases (PubMed, MEDLINE, CINAHL, EMBASE, and AMED) were searched through OVID from their inception to January 2008. Articles were selected according to a priori defined criteria. Data were extracted regarding publication details, type of study, movements and device evaluated, subject and observer characteristics, and measurement protocol including blinding and statistical analysis methods. Quality assessment was undertaken using developed criteria to assess internal validity, external validity, and statistical methods. An estimate of the level of reliability and validity was calculated and used to categorize studies as good, moderate, or poor.
**Results:** A total of 56 articles fulfilled the selection criteria and were included in the review. Forty-six of these articles described 66 reliability studies and 21 described 21 concurrent criterion validity studies. Twelve different methods were evaluated. Although it was the intention of this review to conduct meta-analysis, this was deemed inappropriate due to studies being too heterogeneous. Most of the reliability and validity studies involved asymptomatic subjects measured by allied health professionals investigating active ROM. Devices that were deemed to have “good” reliability and validity were the CROM device, the Spin-T goniometer, and the single inclinometer.
**Conclusions:** A considerable number of reliability and concurrent validity studies have been published for CROM. The CROM device has undergone most evaluation and has been shown to be clinimetrically sound. Further research with significantly improved methodology and reporting is warranted for all devices.

*Use of MCU: musculoskeletal evaluation of cervical range of motion. References to reliability and validity data of MCU are cited.*

“Effects of fear-avoidance beliefs on Chinese patients with neck pain.”

**ABSTRACT:**
**Aims and objectives:** To translate and adapt the Fear-Avoidance Beliefs Questionnaire (FABQ) into Chinese (Cantonese) and assess its content validity, test-retest reliability, construct validity, factor structure, and responsiveness. To assess the correction between fear-avoidance beliefs and future disability and work capacity I patients with neck pain.
Study design: In phase I, the English version of the FABQ3 was adapted and translated into Chinese (Cantonese) and then validated by different panels involving physiotherapists, psychiatrists, neck pain patients, and secondary school students. The validated Chinese version of FABQ was then tested for reliability and construct validity in four physiotherapy out-patient departments in different regions of Hong Kong. In phase II, the role of fear-avoidance beliefs in predicting future disability and work capacity of patients with neck pain who had 6 weeks of physiotherapy was prospectively studied. Subjects and sample size: Patients were recruited from physiotherapy out-patient departments of three public hospitals and one private clinic in Hong Kong. They were diagnosed with neck pain, with or without radiation symptoms, and were able to read and write Chinese. Patients who had other musculoskeletal problems, an infectious condition, previous brain surgery, congenital abnormality, or a history of malignancy or mental illness were excluded. A total of 476 patients were recruited for validation and 120 patients for 6 weeks of physiotherapy.

Outcome measures: In the validation study, patients completed the FABQ, the Northwick Park Neck Pain Questionnaire (NPQ), the medical outcomes 36-item Short-Form Health Survey (SF-36), and the 11-point Numerical Rating Scale (NRS) when they attended for physiotherapy at weeks 1, 3, 6, and upon discharge.

Results: The responsiveness of the FABQ assessed by standardised response mean and effect size is low (0.38 and 0.32 respectively) compared to that of the NPQ (0.73 and 0.62 respectively) and pain measured by the NRS (0.83 and 1.0 respectively). The low responsiveness of the FABQ may be because the follow-up period was not long enough to allow adequate detectable change in the effects of fear-avoidance beliefs in patients with neck pain.

Use of MCU: musculoskeletal evaluation of cervical range of motion and isometric strength.

“A pilot study to determine the effects of a supine sacroiliac orthopedic blocking procedure on cervical spine extensor isometric strength.”

ABSTRACT:
Objective: The purpose of this study was to determine if an orthopedic pelvic blocking procedure affects cervical spine extensor isometric strength.
Methods: Twenty-two participants were sequentially assigned into treatment and control groups. Treatment consisted of a 2-minute procedure using orthopedic blocks (padded wedges with a 45° incline) that were placed bilaterally under the ilia as determined by leg length assessment. Isometric strength measurements took place in 2 sessions with a day of rest between. The treatment group received therapy at the second session immediate to post- isometric measures.
Results: Outcome measures were the pre- and posttreatment measurements of cervical isometric extension strength in pounds. The t tests showed no statistically significant difference between groups in isometric extension strength before treatment. One-way analysis of variance demonstrated a significant difference between groups after treatment (F1,21 = 7.174, P = .014). The treatment group demonstrated an average increase of 6.35 (8.18) lb in extensor strength.
Conclusions: The current study showed a statistically significant change in cervical isometric extensor strength after sacroiliac joint blocking.

Use of MCU: musculoskeletal evaluation of cervical range of motion and isometric strength.
“Maximal voluntary isometric neck strength deficits in adults with whiplash-associated disorders and association with pain and fear of movement.”

ABSTRACT:
Study Design: Controlled laboratory study using a cross-sectional, repeated-measures design.
Objectives: To quantify maximal voluntary isometric neck forces in healthy subjects and individuals with whiplash-associated disorder (WAD), using an objective measurement system to evaluate the test-retest properties of these strength measurements and to assess the links between neck strength, pain, kinesiophobia, and catastrophizing in patients with WAD.
Background: The prognosis of WAD is difficult to predict due to a lack of objective measurement methods and to our limited understanding of Neck Disability Index (NDI), the Tampa Scale for Kinesiophobia (TSK), and the Pain Catastrophizing Scale (PCS).
Methods and Measures: Fourteen subjects with chronic WAD grade I or II and an age-matched, healthy group (n = 28) participated in this study. Cervical strength was measured with the Multi-Cervical Unit (MCU) in 6 directions, and pain was measured with a visual analog scale. Individuals in the WAD group completed the Neck Disability Index (NDI), the Tampa Scale for Kinesiophobia (TSK), and the Pain Catastrophizing Scale (PCS).
Results: Significant deficits in strength were observed for the individuals in the WAD group compared to the healthy group, particularly in extension, retraction, and left lateral flexion (P < .05). The MCU demonstrated good intra-tester reliability for the healthy group (ICC = 0.80-0.92) and the WAD group (ICC = 0.85-0.98), and small standard errors of measurement for both groups. No significant association was found between neck strength and NDI, TSK, and PCS.
Conclusion: The MCU demonstrated good test-retest properties for healthy subjects and individuals with WAD. Cervical strength was lower in individuals with WAD; however, the strength deficits were not clearly linked with psychological factors.

Use of MCU: musculoskeletal evaluation of cervical strength (isometric).

“Correction of a muscular-tonic syndrome at a cervical osteochondrosis by device Multi-Cervical Unit (Hanoun Medical).”
Soroka AV, Nadezhdina MV, Stolayrov IA, Khizhenok VA, Afina ET: Correction of a muscular-tonic syndrome at a cervical osteochondrosis by device Multi-Cervical Unit (Hanoun Medical). Бюллетень сибирской медицины. 2008; 5:137- 143. (Abstract only in English)

ABSTRACT: Neurologic, radiological inspection of 30 men (middle age is 36.5 ± 7.5) with a muscular-tonic syndrome at a cervical osteochondrosis. According to an index of a muscular syndrome on 3 degrees of weight 3 groups of patients are allocated. Diagnostics by device MCU allows to reveal authentically and precisely dysfunction in the certain group of muscles of a neck and to spend their adequate training, promoting duly correction. The medical technique of device MCU leads to full recourse muscular-tonic and liquidations of a painful syndrome at muscular-tonic syndrome I and to II degree, significant recourse of expressiveness of syndromes at sick of a cervical osteochondrosis with muscular-tonic a syndrome of III degree. Formation of a correct muscular stereotype provides achievement of proof medical effect, preventive maintenance of a reflex painful syndrome in a cervical department of a backbone and prevention of chronic disease.

(Full article in Russian)
Use of MCU: musculoskeletal evaluation of cervical range of motion and isometric strength and treatment to increase strength.

“Interexaminer reliability of measures of cervical active range of motion and isometric strength in healthy young adults.”

ABSTRACT:
Objective: The primary objective of the current study was to investigate the interexaminer reliability of cervical range of motion (AROM) and cervical isometric muscle strength (CIMS) in a sample of healthy young adults using computerized equipment designed for this purpose, the Multi-Cervical Unit (MCU). Secondary objectives were to compare cervical AROM and CIMS values between men and women participants and to begin developing a pool of reference data for the MCU.
Methods: Thirty consenting, healthy young adult participants received AROM and CIMS measurements in two sessions 2 days apart performed by trained student examiners. In each session, AROM was taken for flexion, extension, rotation, and lateral flexion and CIMS was taken for flexion, extension, and lateral flexion. All measurements were automatically recorded by the MCU computer system. Interclass correlation coefficients (ICCs) and independent t tests were calculated in SPSS 15.
Results: There were one good ICC (0.851) and five high ICCs (0.917 – 0.962) for AROM and four high ICCs (0.979 – 0.987) for CIMS. Comparisons between male and female participants showed no difference between the cervical AROM measures and significant differences between CIMS measures (p values ranging from .0006 to .0075).
Conclusion: The primary results of this study demonstrate good to high interexaminer reliability for cervical active range of motion and high interexaminer reliability cervical isometric muscle strength using the Multi-Cervical Unit. Cervical active range of motion measures were not different between male and female participants. Cervical isometric muscle strength measures were significantly greater for male participants than for female participants.

Use of MCU: musculoskeletal evaluation of cervical range of motion and isometric strength. Reliability measures are cited.

“Cervical resistance training: effects on isometric and dynamic strength.”

ABSTRACT:
Introduction: Neck injuries signify a physical fitness and human system problem with high operational significance. The prevalence of injuries in tactical aviators has been reported to be as high as 84%, although few report engaging in neck-specific strengthening exercises. It is generally believed that neck strengthening may result in fewer neck injuries. This study was designed to investigate the effects of 12-wk of cervical strength training (3 d per wk) on isometric strength, dynamic strength, and hypertrophy in a sample of military men.
Methods: Participants were tested for each of the above-mentioned variables before and after the training program as well as at 4-wk intervals, and results were compared with a control group that performed no cervical resistance training.
Results: Results indicated significant improvements in isometric strength and dynamic strength, typically occurring as early as 4-wk and improving throughout the 12-wk period. Modest increases in neck circumference were also noted.

Discussion: These findings have implications for military personnel at risk of neck injury in their occupational activities.

Use of MCU: musculoskeletal evaluation of cervical strength (isometric and dynamic) treatment to increase strength.

“A comparison of training methods to increase neck muscle strength.”

ABSTRACT:
Objective: To compare two neck strength training modalities.
Background: Neck injury in pilots flying high performance aircraft is a concern in aviation medicine. Strength training may be an effective means to strengthen the neck and decrease injury risk.
Methods: The cohort consisted of 32 age-height-weight matched participants, divided into two experimental groups; the Multi-Cervical Unit (MCU) and Thera-Band tubing groups (THER), and a control (CTRL) group. Ten weeks of training were undertaken and pre-and post-isometric strength testing for all groups was performed on the MCU. Comparisons between the three groups were made using a Kruskal-Wallis test and effect sizes between the MCU and the THER groups and the THER and CTRL groups were also calculated.
Results: The MCU group displayed the greatest increase in isometric strength (flexion 64.4%, extension 62.9%, left lateral flexion 53.3%, right lateral flexion 49.1%) and differences were only statistically significant ($p < 0.05$) when compared to the CTRL group. Increases in neck strength for the THER group were lower than that shown in the MCU group (flexion 42.0%, extension 29.9%, left lateral flexion 26.7%, right lateral flexion 24.1%). Moderate to large effect sizes were found between the MCU and THER as well as the THER and CTRL groups.
Conclusions: This study demonstrated that the MCU was the most effective training modality to increase isometric cervical muscle strength. Thera-Band tubing did however produce moderate gains in isometric neck strength.

Use of MCU: musculoskeletal evaluation of cervical strength (isometric) and treatment to increase strength.

“A randomized clinical trial of TENS and exercise for patients with chronic neck pain.”

ABSTRACT:
Objective: To investigate the effect of transcutaneous electrical nerve stimulation (TENS) on acupuncture points and neck exercise in chronic neck pain patients.
Design: A randomized clinical trial.
Setting: Hospital-based practice.
Subjects: Two hundred and eighteen patients with chronic neck pain.
**Interventions:** Subjects were randomized into three groups, receiving either (1) TENS over the acupuncture points plus infrared irradiation (TENS group); (2) exercise training plus infrared irradiation (exercise group); or (3) infrared irradiation alone (control); twice a week for six weeks.

**Outcome measures:** The values of verbal numeric pain scale, Northwick Park Neck Pain Questionnaire, and isometric neck muscle strength were assessed before, at the end of the six-week treatment, and at the six-month follow-up.

**Results:** Results demonstrated that after the six-week treatment, significant improvement in the verbal numerical pain scale was found only in the TENS group (0.60 ± 2.54, p=0.027) and the exercise group (1.57 ± 2.67, p<0.001). Though significant reduction in Northwick Park Neck Pain Questionnaire score was found in all three groups, post-hoc tests showed that both the TENS and the exercise group produced better improvement (0.38 ±0.60% and 0.39 ±0.62% respectively) than the control group (0.23 ±0.63%). Significant improvement (p= <0.001 to 0.03) in neck muscle strength was observed in all three groups, however, the improvement in the control group was not clinically significant and it could not be maintained at the six-month follow-up.

**Conclusions:** After the six-week treatment, patients in the TENS and exercise group had a better and clinically relevant improvement in disability, isometric neck muscle strength, and pain. All the improvements in the intervention groups were maintained at the six-month follow-up.

*Use of MCU: musculoskeletal evaluation of cervical strength (isometric) and treatment to increase strength.*

“A randomized controlled trial on the efficacy of exercise for patients with chronic neck pain.”


**ABSTRACT:**

**Study Design:** A randomized controlled trial with single-blind outcome assessments.

**Objective:** To evaluate the efficacy of a neck exercise program in patients with chronic neck pain.

**Summary of Background Data:** The effect of exercise for patients with chronic neck pain has been investigated in a number of studies. The efficacy is, however, questionable.

**Methods:** A total of 145 patients were randomly allocated into an exercise (n = 67) and a non-exercise (control) group (n = 78). Patients in the control group were given infrared irradiation and neck care advice. In addition to infrared irradiation and advice, patients in the exercise group had undergone an exercise program with activation of the deep neck muscles and dynamic strengthening of the neck muscles for 6 weeks. Subjective pain and disability and isometric neck muscle strength were measured at baseline, 6 weeks, and 6 months. Analysis was by intention-to-treat.

**Results:** At week 6, the exercise group had a significantly better improvement in disability score (P = 0.03), subjective report of pain (P = 0.01), and in isometric neck muscle strength (P = 0.57–0.00) in most of the directions than the control group. However, significant differences between the two groups were found only in the subjective report of pain and patient satisfaction at the 6-month follow-up.

**Conclusions:** At week 6, patients with chronic neck pain can benefit from the neck exercise program with significant improvement in disability, pain, and isometric neck muscle strength in different directions. However, the effect of exercise was less favorable at 6 months.

*Use of MCU: musculoskeletal evaluation of cervical strength (isometric) and treatment to increase strength.*
“Predicting short-term response and non-response to neck strengthening exercise for chronic neck pain.”

ABSTRACT:
Summary of Background Data: People with chronic neck pain respond variably to exercise therapy. The likely success of exercise for chronic neck pain cannot be predicted.
Study Design: This prospective study tested the relationship between patient characteristics assessed prior to intervention and response to an exercise program for chronic neck pain.
Objectives: To investigate whether responders differed from non-responders with respect to presenting characteristics.
Method: Data were collected on 336 consecutive patients receiving physiotherapy for chronic neck pain. Subject age, sex, duration of symptoms, compensation status, Neck Disability Index (NDI) item and total scores, cervical spine range of movement, and isometric strength were assessed prior to treatment. Response to therapy was defined as a change of 14/100 or more NDI points. Subjects received a progressive, concentric/ eccentric, strengthening program using computerized equipment designed for cervical spine assessment and rehabilitation. Logistic regression formulae for predicting outcome at the completion of the program were developed on one sample (n = 122) data and tested on another (n = 214).

Results: In the first sample, NDI scores and item responses predicted response or non-response with approximately 70% accuracy. When tested on the second sample, a prediction model using NDI item scores predicted responders (positive predictive value 56%) and non-responders (negative predictive value 74%) with considerable loss of responder prediction accuracy. Participants with low initial NDI scores (higher functional ability) appeared to benefit less from the exercise program.

Conclusions: Functionally able patients may benefit less from exercise for chronic neck pain than those with greater functional limitations.

Use of MCU: musculoskeletal evaluation of cervical range of motion and isometric strength and treatment to increase strength.

“Flight-training effect on the cervical muscle isometric strength of trainee pilots.”

ABSTRACT: External stimulus/loading initiates adaptations within skeletal muscle. It has been previously found that the cervical area has the highest loading while performing flying maneuvers under +Gz. The first purpose of this study was to examine the neck muscle response to the physical environment associated with flight training, incorporating limited exposure to +Gz force, in a Pilatus PC-9 aircraft. The second purpose was to examine the short-term range of movement (ROM) response to flight training. Isometric cervical muscle strength and ROM was monitored in 9 RAAF pilots completing an 8-mo flight-training course at Pearce Airbase in Western Australia, and in 10 controls matched for gender, age, height, and weight. Isometric cervical muscle strength and ROM were measured at baseline and at 8 mo using the multi-cervical rehabilitation unit (Hanoun Medical, Downsview, Ontario, Canada). Results indicated that an increase in pilot neck strength was limited to flexion while in a neutral position. No strength changes were recorded in any other site in the pilots or for the controls. These findings suggest that short-term exposure to the physical environment associated with flight training had a limited significant effect on increasing isometric cervical muscle strength. No significant changes were observed in pilot ROM, indicating that short-term exposure to flight does not affect ROM.
Use of MCU: musculoskeletal evaluation of cervical strength and range of motion.

“Evaluation of cervical range of motion and isometric neck strength: reliability and validity.”

ABSTRACT:
Objective: To examine the test–retest reliability and construct validity of cervical active range of motion and isometric neck muscle strength as measured by the Multi Cervical Rehabilitation Unit (Hanoun Medical Inc., Ontario).
Design: A cross-sectional study.
Setting: Institutional practice.
Subjects: Twenty-one patients with neck pain and 25 healthy volunteers.
Methods: After a trial-run session, active range of motion (AROM) was measured in the subsequent two sessions, with 2–3 days in between. During each session, three measurements were taken for each direction (flexion, extension, lateral flexions and rotations). The measurement of isometric strength was after a 15-minute break following completion of the measurement of AROM. Three measurements were made for each of the six directions (flexion, extension, lateral flexions, protraction and retraction). The software of the Multi Cervical Rehabilitation Unit automatically recorded and calculated the maximum AROM and isometric strength.
Results: There was a good to high level of reliability in the measurement of AROM for both groups of subjects, with intraclass correlation coefficients (ICCs) ranging from 0.81 to 0.96. Results also demonstrated very good to excellent reliability in isometric strength measurement (ICCs ranged from 0.92 to 0.99). Moreover, there was a significant difference in isometric neck muscle strength \(p = 0.001\) and in AROM \(p = 0.034\) between the two groups.
Conclusions: The Multi Cervical Rehabilitation Unit was found to be reliable and valid for testing the cervical active range of motion and isometric neck muscle strength for both normal and patient subjects.

Use of MCU: musculoskeletal evaluation of cervical range of motion and isometric strength.

“Maximal isometric muscle strength of the cervical spine in healthy volunteers.”

ABSTRACT:
Objective: To describe the maximal isometric neck muscle strength in healthy Chinese volunteers, in six different directions, as measured by a Multi Cervical Rehabilitation Unit.
Design: A standardized cross-sectional observational study.
Setting: A university rehabilitation unit.
Subjects: Ninety-one healthy volunteers aged 20–84.
Methods: During the measurement the subject was instructed to do three consecutive steady contractions as hard as possible, with a 10-second rest in between each contraction and a 2-minute rest between different directions. The peak isometric strength for each of the six directions (flexion, extension, lateral flexions, protraction and retraction) was calculated.
Results: No significant difference was found in muscle strength between different age groups. Isometric muscle strength in the direction of right lateral flexion was significantly greater than that to the left in men \(p = 0.030\), but no difference was found in women \(p = 0.297\).
Isometric strength in all directions in men was 1.2–1.7 times that than in women (all \( p < 0.028 \)). Correlations between physical measurements (height and weight) and strength values were all insignificant in both genders.

**Conclusion:** Men have approximately 20–70% greater isometric neck muscle strength than women. Both men and women can maintain high levels of cervical muscle strength in six different directions up to their seventh decade. There is no significant correlation between physical measurements and isometric neck muscle strength.

*Use of MCU: musculoskeletal evaluation of cervical strength (isometric).*

**Off-Label Use Evidence:**

“Effects of head posture on the multidirectional static force capacity of the neck.”

**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 moment 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 20º 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 8 directions, set at 45º 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 20º flexion, were evaluated by 2-way analysis of variance and linear regression.

**Findings:** Impulse of force was lower along diagonal planes, at 45º from the mid-sagittal plane, compared to orthogonal planes (\( P < 0.001 \)). 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 20º 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 strength (isometric).*

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

**Supporting Evidence:**

“A twelve-item symptom intensity rating scale for cervical spine dysfunction.”

**ABSTRACT:**
Study Design: Retrospective cohort study.

Objective: To evaluate the internal consistency, construct validity, and test-retest reliability of the Symptom Intensity Rating Scale (SIRS) in a clinical sample of people with cervical spine dysfunction.

Summary of Background Data: The SIRS was developed by experienced clinicians at the Melbourne Whiplash Centre as an assessment tool and outcome measure for people with cervical spine dysfunction. The 12-item scale rates the severity of neck, shoulder, shoulder blade and arm pain, neck and arm weakness, headaches dizziness nausea neck stiffness, pins and needles, and numbness.

Methods: Internal consistency was explored by item-item and corrected item-total correlations, Cronbach alpha, and Principle Components analysis. Construct validity was examined by correlation of SIRS scores with Neck Disability Index (NDI) scores, and with cervical range of motion (ROM). Test-retest reliability was determined by examining a subset of patients with NDI scores that changed by less than 10% points.

Results: A dataset of 397 cases was analyzed. Missing data for the SIRS was very low. Item intercorrelations ranged from weak (<0.3) to moderate (>0.6). Corrected item-total correlations ranged from 0.35 to 0.63. Cronbach alpha was 0.85. Principle Components Analysis identified 2 correlated subscales. SIRS total scores were correlated with NDI scores at initial (r = 0.574) and final (r = 0.757) assessment. Correlations between initial SIRS scores and ROM were absent or weak, and correlations between final SIRS and ROM were stronger. Test-retest reliability Intraclass Correlation Coefficient (2,1) of the SIRS for a subset of 65 cases with unchanged NDI scores was 0.858 (95% CI, 0.766–0.913). The standard error of measurement was 8 points and the Minimum Detectable Change (90% confidence) 18.7 points.

Conclusion: The SIRS is a sufficiently reliable, internally consistent scale that can be used to make valid inferences about symptom severity in ambulatory patients with cervical spine dysfunction.