

Research Paper Review

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1. Cervical range of motion and strength in 4,293 young male adults with chronic neck pain. *Eur Spine J 2012; 21:1522-1527*

Kauther MD, Piotrowski M, Hussmann B, et al.

2. Neck Muscle Strength and Mobility of the Cervical Spine as Predictors of Neck Pain: A Prospective 6-Year Study. Eur Spine J 2012; 21:1522-1527

Salo P, Ylinen J, Kautiainen H et al.

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ABSTRACT 1

Purpose: The correlation of cervical biomechanics and neck pain in young patients has, to date, only been described in terms of small cohorts. This study focuses on the correlation of chronic neck pain and cervical biomechanics.

Methods: Neck pain, cervical range of motion (CROM) and maximal cervical torque were recorded in 746 patients with conservatively treated chronic neck pain and 3,547 participants of physiotherapy training without chronic neck pain aged 16–32 years.

Results: The "neck pain" group had a highly significant (s < 0.001) higher neck disability index (44.7 vs. 10.4 %), longer history of neck pain (3.47 vs. 0.59 years), higher pain intensity (VAS 5.93 vs. 0.93), higher pain frequency (VAS 6.98 vs. 1.09). No differences of CROM and maximal torque in the sagittal, frontal and transverse plane were found.

Conclusion: This study describes the largest cohort of biomechanical data of the cervical spine in young adult recorded to date. The findings demonstrate that no correlation was found between neck pain, CROM and maximal torque in the study cohort. On this basis, we conclude that the CROM and maximal cervical torque

should not be used as indicators to measure the progress of chronic neck pain in physiotherapy training and sports medicine for the young adult.

Keywords: CROM, Neck pain, Biomechanics, Adaptation, Cervical Torque

ABSTRACT 2

Study Design: Follow-up study.

Objective: To study whether neck muscle strength or cervical spine mobility values could serve as predictors for future neck pain among originally pain-free working-age subjects during a long period.

Summary Of Background Data:Neck pain has been associated with weaker neck muscle strength and lower cervical spine mobility in several studies. However, causality between physical capacity and neck pain has not been shown.

Methods: Isometric neck muscle strength and passive range of motion of the cervical spine of 220 healthy female volunteers, aged 20 to 59 years, were measured. A postal survey was conducted 6 years later to determine whether any volunteers had experienced neck pain. The receiver operator characteristics curve was used to study how well the neck strength and mobility values in different movement planes at baseline served as predictors of future neck pain.

Results: Of the 192 (87%) responders, 37 (19%) reported neck pain for 7 days during the past year. In predicting neck pain, areas under the receiver operator characteristics curves (95% confidence intervals) in different movement planes were 0.52 to 0.56 (0.41-0.66) for isometric neck strength and 0.54 to 0.56 (0.44-0.76) for passive mobility of the cervical spine.

Conclusion: The results suggest that neither isometric neck muscle strength nor passive mobility of cervical spine has predictive value for later occurrences of neck pain in pain-free working-age women. Thus, screening healthy subjects for weaker neck muscle strength or decreased mobility of the cervical spine may not be recommended for preventive purposes.

ANALYSIS

Background Information

What biomechanical factors are predictive of healthy people developing neck pain? What biomechanical factors are correlated to neck pain in our patient population? Strength and range of motion (ROM) are two obvious answers that most clinicians, including myself, would have offered. Not so fast...

You may be asking: Wouldn't it make sense that decreased neck muscle strength would contribute to neck pain? We know rehabilitation programs including intensive strengthening of the cervical musculature (or even simple rehab exercises) can significantly reduce pain and disability – this is well established in the literature. However, similar to the age old chicken or egg question, *we do not know whether weak neck muscles promote neck pain or whether neck pain results in a weaker musculature*. Relationships cannot imply causation...

Similarly, it would seem logical that individuals with neck pain would have reduced cervical spine

mobility compared with healthy subjects. Truthfully, the relationship between spinal mobility and neck pain is not as clear as one might think.

Most research in this area, which is sparse to begin with, has only been described in terms of small cohorts, including heterogeneous patient populations. A relationship between the biomechanical or physical features of the cervical spine and neck pain, whether we are speaking of predictive factors or associated factors, has not been definitively identified.

This review will discuss two interesting studies that aimed to answer these simple, but not so obvious questions.

- Kauther's study focused on determining the correlation of chronic neck pain and cervical biomechanics by examining cervical ROM and maximal cervical torque in a large group of patients with and without chronic neck pain.
- Salo's study intended to determine whether neck muscle strength or passive mobility of the cervical spine among initially pain-free working-age women could be used to predict future neck pain.

PERTINENT RESULTS

Study #1: Cervical range of motion and strength in 4,293 young male adults with chronic neck pain (Kauther et al.)

In this study, average participant age was 27. On average, the neck pain group (n = 746) had a pain intensity (0-10) of 5.93, pain frequency (0-10) of 6.98, pain duration (in years) of 3.47 and a neck disability index of 44.67 (out of 50), which were all significantly different (p < 0.001) from the control group (n = 3547). The results from this study found no differences in cervical spine ROM between males and females, as well as no difference in ALL cervical spine ranges of motion between the neck pain and control group. In their analysis of maximal isometric cervical torque (strength), men were 30% stronger in flexion and 33% stronger in extension compared to women (p < 0.001). However, again there were NO significant differences between the neck pain and control group.

Study #2: Neck Muscle Strength and Mobility of the Cervical Spine as Predictors of Neck Pain: A Prospective 6-Year Study (Salo et al.)

Salo's study had an average participant age of 40 years. Information was recorded for 192 participants: At the 6-year follow-up, 155 (81%) reported having neck pain for 7 or fewer days or not at all in the past year (NOP group), whereas 37 (19%) reported having had pain for more than 7 days during the past year (NP group). Sensitivity, specificity, positive predictive value, likelihood ratio (with their 95% confidence interval values) and the areas under the receiver operator characteristics curves (AUC) with their 95% confidence were calculated.

The key results from this study illustrated using AUC (area under the curve, 95% CI) data. AUC is a graphical representation of data created by plotting the fraction of true positives out of the positives vs. the fraction of false positives out of the negatives. Basically, accuracy is measured by the area under the receiver operator characteristics (ROC) curve. It boils down to this: an area of 1 represents a perfect test; an area of .5 represents a worthless test. Back to the study we're discussing – the value for predicting neck pain via isometric neck strength was found to be 0.56 (95% CI = 0.46–0.66) for extension, 0.54 (0.43–0.65) for flexion, and 0.52 (0.41–0.62) for rotation. Predicting neck pain for the passive mobility

of the cervical spine was found to be 0.54 (0.44-0.65) in the sagittal plane, 0.55 (0.46-0.65) in the horizontal plane, and 0.56 (0.45-0.76) in the frontal plane. These results suggest that neither isometric neck muscle strength, nor passive mobility of cervical spine has predictive value for later occurrences of neck pain in the pain-free working-age women.

CLINICAL APPLICATION & CONCLUSIONS

Strength tests and ROM measurements are the most commonly used physical capacity measures in cases of neck pain. They are used (sometimes exclusively) as outcomes in medicolegal cases, work place injury and motor vehicle collision cases. In these environments, such measures can dictate financial outcomes for the patient, or guide decisions on approval of treatment plans etc.

However, in general, physical capacity measures seem to be unable to predict back or neck pain. Recent research in the low back field has shown strong evidence that there is no relationship between trunk muscle endurance and the risk of lower back pain (1). Now these studies complement the growing evidence illuminating the relationship between physical capacity measures and future neck pain. Future neck pain is not predicted by isometric neck muscle strength or passive cervical spine range of motion measurements in healthy subjects.

This information should be of interest to the healthcare professional that examines and treats healthy patients. We all know that prevention and maintenance are important aspects with respect to musculoskeletal care. It makes perfect sense that it's easier to intervene before the problem starts, or at the very least early on before the neck or back pain progresses. However, incorporating this new evidence into our practices will help us focus on factors that are important; those that will make a difference in our patient's health, while saving us time spent on factors that may not matter as much as we once thought.

With regards to treatment of neck pain, many studies have demonstrated a positive influence of cervical strengthening on pain levels. However, cervical ROM and maximal isometric torque can neither be easily used as diagnostic criteria to differentiate healthy individuals from those with neck pain, nor to determine the extent of pain itself. We should avoid maximal isometric strengthening exercises and maximal cervical spine ROM exercises as these will not necessarily give us additionally meaningful clinical results in our rehabilitation efforts. Low intensity strengthening and stretching of the cervical muscles will most likely suffice, without aggravating our patients' symptoms. Further, when monitoring progress in our chronic neck pain patients, outcome measures such as orthopaedic testing, pain scales or functional activities of daily living may be more relevant than maximal ROM or maximal isometric strength.

STUDY METHODS

Study #1: Cervical range of motion and strength in 4,293 young male adults with chronic neck pain (Kauther et al.)

This study recruited subjects between the ages of 16–32 - 746 subjects formed the "neck pain" group while 3,547 participants who started their supervised physiotherapy/fitness program for reasons other than neck pain formed the control group (although 12.1% of them reported at least some history of, but not current, neck pain – see Study Limitations below). Anthropometry and pain history in the study population was ascertained, including a neck disability index (NDI) score, pain history, pain

intensity (VAS), pain regularity (VAS), pain duration (VAS), pain radiation, subjective well-being, subjective fitness, treatment and physician consultations. Cervical mobility was measured in the sagittal, frontal and transverse planes with a head goniometer. The maximal torque of the cervical spine was measured by having the participant perform a maximum isometric exertion (forward, backward, lateral bending and rotation) against an immovable resistance in a neutral standardized position of trunk, head and cervical spine.

Study #2: Neck Muscle Strength and Mobility of the Cervical Spine as Predictors of Neck Pain: A Prospective 6-Year Study (Salo et al.)

220 participants, healthy women aged 20-59 years, were recruited for this study. Baseline characteristics were ascertained including anthropomorphic measurements, grip strength and physical workload. Neck muscle strength was measured by flexion, extension, and rotation to the right and left with an isometric neck strength measurement system. A cervical measurement system was used to measure the passive range of motion (PROM) of the cervical spine. The measurements were performed in 3 planes of movement: lateral flexion and rotation to both the right and left sides, and flexion-extension.

As a follow-up, a questionnaire package was sent to the subjects 6 years after the baseline measurements were taken. The subjects were asked whether they had experienced neck pain during the past year, and also during the past 6 years since the baseline measurements. The amount and length of neck pain experienced were defined, as well as whether medication was used for neck pain. Accidents, illnesses and treatments were also included in the questionnaire.

STUDY LIMITATIONS

A limitation in Kauther's study was that most of the participants started a supervised physiotherapy/exercise program because of another medical reason, the most common of which was low back pain. Out all the 'healthy participants' (the control group), 12.1% periodically complained about cervical neck pain. This is consistent with comparable recent investigations. The investigators felt that since there were significant differences between the pain and control groups, this amount of variation in the control group would be considered acceptable. However, a control group where 12.1% experienced neck pain is a finding that needs to be considered within the results and interpretation.

Salo's study also had several limitations that were worth noting. The sample from this study consisted of volunteers, which may have biased the outcomes. Furthermore, the results of this study could have been stronger if the sample had been screened consistently for neck pain throughout the 6-year follow-up period. The subjects in this study had to recall their neck pain during the previous year. A 6-year period would be considered too long a recall period and would have been deemed unreliable. Results collected throughout the six year period would have provided much stronger and more robust clinical information.

Additional References

1. Hamberg-van Reenen HH, Ariens GA, Blatter BM et al. A systematic review of the relation between physical capacity and future low back and neck/shoulder pain. Pain 2007; 130: 93–107 .

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