Exercise for Neck Pain

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The enormous burden of neck pain

Neck pain is one of the most common musculoskeletal disorders with an annual prevalence up to 50% and a lifetime prevalence up to 70%

In the main it is not a catastrophic condition, but it can have a significant impact on a person’s work, recreation and quality of life

Neck pain spares no age group, gender or culture

The enormous burden of neck pain

Following a first episode of neck pain, there is a high chance of repeated episodes, which may extend over a lifetime.

Up to 85% of people can expect some degree of ongoing pain for many years after their first episode.

30% of patients develop chronic pain.

Haldeman et al. J Occup Environ Med 2010
Systematic reviews and meta-analyses confirm the effectiveness of exercise for relieving neck pain and also for the prevention of pain.

- Bertozzi et al. Phys Ther. 2013
- Fredin et al. Musculoskelet Sci Pract. 2017
- de Campos et al. J Physiother. 2018

Effective and early management of pain via exercise is promoted as a critical element of management for neck pain, recommended by clinical practice guidelines internationally.
When considering the analgesic effect of exercise, multiple forms of exercise have been proposed to relieve neck pain. Currently there is little evidence of superiority of one exercise approach over another. Geneen et al. Cochrane Database Syst Rev. 2017
Cranio-cervical Flexion Training
Motor Control

General Neck Flexion Training
Strength

Chronic idiopathic neck pain
Mild to moderate disability
6 week intervention
Practising daily

Falla et al. Phys Ther. 2007
Falla et al. Man Ther. 2008
Jull, Falla et al. Man Ther. 2009
Comparable reduction of pain and disability between groups


Falla et al. Phys Ther. 2007
Comparable reduction of pain and disability between groups

Baseline 10 wk  26 wk
CCF Training
Endurance

Baseline 10 wk  26 wk
CCF Training
Motor Control

Baseline 10 wk  26 wk
Range of Motion Training
Flexibility

Mechanical neck pain
Mild to moderate disability

Comparable reduction of pain and disability between groups

Neck Pain Disability (NDI)

Baseline 10 wk  26 wk
CCF Training
Endurance

Baseline 10 wk  26 wk
CCF Training
Motor Control

Baseline 10 wk  26 wk
Range of Motion Training
Flexibility

Comparable reduction of pain and disability between groups

**Progressive Resistance Exercise**
Elastic bands

**Physical Activity**
General activity and Resistance

Chronic non-specific neck pain
Mild to moderate disability

Iversen et al. J Rehab Med. 2018
Systematic reviews indicate little evidence of superiority of one exercise approach over another.

Decision on the type of exercise to use should be dictated by clinician preference.
Exercise for Neck Pain

The same exercise does not achieve the same effect in different neck pain disorders.

Perceived pain and disability is not the only relevant outcome measure.

Specificity of exercise is critical to modify neuromuscular function.
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Effect of cranio-cervical flexion exercise in cervicogenic headache

Cervicogenic headache
Average 6 years duration
6 week intervention
12 month follow up

>50% reduction in Headache Frequency
6 weeks 76%
12 months

100% reduction in Headache Frequency
31%
~40%

Jull et al. Spine. 2002
Symptomatic relief following a neck-specific exercise in various neck pain disorders


MILD IDIOPATHIC

% Reduction in Neck Pain

47%
Predicting response to neck-specific exercise interventions in chronic whiplash

Chronic Whiplash (n=205)

Predictors
- Average pain intensity
- Catastrophizing
- Post-traumatic stress
- Quality of life
- Pain extent

Pain extent significantly associated with changes in the NDI at one year and two year follow-up

Alalawi et al. 2018
Superiority of long term efficacy of neck-specific exercise over general physical activity for Chronic Whiplash Associated Disorders

- Participation in a neck-specific exercise intervention, in contrast to general physical activity, was the only factor that consistently indicated higher odds of treatment success.

- At 12 months patients in the neck-specific exercise intervention had up to 5.3 times higher odds of disability reduction, and 3.9 times higher odds of pain reduction compared to those in the physical activity group.

Landén Ludvigsson et al., Eur J Pain, 2015
Exercise for Neck Pain

The same exercise does not achieve the same effect in different neck pain disorders.

Perceived pain and disability is not the only relevant outcome measure.

Specificity of exercise is critical to modify neuromuscular function.
Reductions in pain and disability are often the main outcome measure in randomised controlled trials for various types of exercise programmes in patients with neck pain.

As pain is multifactorial, a single subjective method of measuring pain as the sole outcome to evaluate the superiority of a particular exercise protocol for chronic neck pain is insufficient.
Cranio-cervical Flexion Training
Motor Control

General Neck Flexion Training
Strength
Comparable reduction of pain and disability between groups

- Falla et al. Phys Ther. 2007

Bars represent Neck Pain Disability Reduction.
Cranio-cervical flexion exercise induces a superior immediate hypoalgesic effect

Qualitative research: Patients articulated that the immediate demonstration that exercise could help their pain gave them hope and motivated them to continue

Rebbeck et al. 2015, Sterling et al. 2011

PPT (kP) of the most symptomatic cervical motion segment

Pre-Intervention

Post-Intervention

Cranio-cervical Flexion

Cervical Flexion

Neck-specific exercise with or without a behavioural approach achieves the same reduction in perceived pain and disability in Chronic Whiplash Associated Disorders.

Motor control exercises progressed to resistance training - 12 weeks
NSEB: Patients were encouraged not to focus on temporary increases in neck pain.
Monitoring changes in the size of the painful area over time

Baseline | Post Treatment | 6 months
---|---|---
Dorsal | 22% | 8.5% | 3.2%
Frontal | 16% | 3.9% | 3.4%

Falla et al. 2018
Neck-specific exercise with or without a behavioural approach achieves a different effect on the size of the painful area.

Significant changes in:
- Kinesiophobia
- Anxiety
- Self-efficacy


Falla et al. 2018
Exercise for Neck Pain

The same exercise does not achieve the same effect in different neck pain disorders.

Perceived pain and disability is not the only relevant outcome measure.

Specificity of exercise is critical to modify neuromuscular function.
PAIN is an important consideration and patients usually seek pain relief as a primary goal of treatment.

The challenge is not only to resolve an episode of pain, but to prevent or limit its recurrence for future quality of life.

EXERCISE should also be prescribed with the aim of restoring NEUROMUSCULAR FUNCTION.
Exercise to restore neuromuscular function is a logical component of the management programme.
15 N contraction, 0-360°
EMG Tuning Curves

Left Sternocleidomastoid

Right Sternocleidomastoid

Left Splenius Capitis

Right Splenius Capitis

mean resultant vector
(preferred direction)

Falla et al. Clin Neurophysiol. 2010
15 N contraction, 0-360°
EMG Tuning Curves

Left Sternocleidomastoid

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Left Splenius Capitis

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mean resultant vector (preferred direction)

Falla et al. Clin Neurophysiol. 2010
Directional specificity of muscle activity is reduced in persons with neck pain

Falla et al. Clin Neurophysiol. 2010
Effectiveness of an 8-week exercise programme on specificity of neck muscle activity

- Patients with chronic idiopathic neck pain – NDI: 18.2(7.4)/50
- Randomised into 1 of 2 groups
  - program of neck-specific exercise Jull et al 2008; Jull et al 2018
  - control: treatment as usual including general exercise
- 8 week exercise intervention
- Measures baseline and week 9
- Outcome: Directional specificity of neck muscle activity

**Treatment as usual**

15 N contraction, 0-360°
Relative muscle specificity to direction, RSD (%)

**Neck-Specific Exercise**

15 N contraction, 0-360°
Relative muscle specificity to direction, RSD (%)

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Falla et al. Phys Ther. 2007
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Jull, Falla et al. Man Ther. 2009
Altered co-ordination between the deep and superficial neck flexor muscles in patients with neck pain

Falla et al. Spine; 2004
Increased activation of the deep neck flexors following training

Jull, Falla et al. Man Ther. 2006
Decreased activation of the superficial neck flexors following training

**CCF training**

**Strength training**

Jull, Falla et al. Man Ther. 2006
Cervical angle
People with neck pain drift into a forward head posture during prolonged sitting.

Falla et al; Phys Ther 2007
Improved postural endurance following training

Falla et al; Phys Ther 2007

Change in Cervical Angle (°)

CCF training

Strength training

T0-T2 T0-T4 T0-T6 T0-T8 T0-T10

Pre Post

T0-T2 T0-T4 T0-T6 T0-T8 T0-T10

Falla et al; Phys Ther 2007
Increased neck flexor strength following training

Maximal Neck Flexion Force (N)

Strength training  CCF training

Pre  Post

Falla et al, Clin Neurophysiol 2006
RCTs – Neuromuscular adaptations are specific to the type of exercise

- Falla et al. 2007
  - Increased neck muscle strength
  - Increased neck muscle endurance
- Falla et al. 2006
  - Reduced neck muscle fatigability
- Falla et al. 2006
  - Increased postural endurance
- Jull et al. 2007
  - Improved neck proprioception
- Jull et al. 2009
  - Increased activation of the deep neck flexors
  - Reduced activation of the superficial neck flexors
  - Faster onset of deep neck flexor activity
- O’Leary et al. 2009
  - Reduced fatty tissue content
- Falla et al. 2013
  - Enhanced specificity of neck muscle activity
  - Decreased muscle co-contraction
- Brage et al. 2015
  - Reduced activation of the superficial neck flexors

Exercises should be selected to target deficits in neuromuscular function.
The *baseline neuromuscular features* determine the extent of neuromuscular adaptations to exercise.


Chronic neck pain
6 weeks of CCF exercise
The baseline neuromuscular features are an important **determinant for symptomatic relief with exercise**

Highlighting the need for **assessment driven targeted exercise interventions**

Participant inclusion criteria in clinical trials usually do not include measures of muscle function that link to the intervention

Is exercise A better than exercise B at reducing pain?

What are the causal mechanisms of recovery for an individual patient?

Has the mechanism(s) changed to warrant a change in outcome?

Which exercise is better at altering the mechanism(s)?
Neck-specific exercise is superior to physical activity in Chronic Whiplash Associated Disorders

NSE: Motor control exercises progressed to resistance training - 12 weeks
PA: Increase overall physical activity, either with home exercise or activities in gym

Landén Ludvigsson et al., Clin J Pain, 2015
Evaluating the mechanisms underlying the effectiveness of neck specific exercises

Dynamic Bayesian Networks – a probabilistic graphical modelling approach, to understand the causal mechanisms underpinning treatment

NSE > PA

Δ Neck Endurance
Δ WAI
Δ Pain
Δ HAD
Δ PCS
Δ SES
Δ ND

Δ Pain
Δ HAD
Δ PCS
Δ SES
Δ ND

2 pathways by which exercise reduces pain

Liew et al, 2018
Rather than the type of exercise being dictated by clinician preference

Decision must be based on knowledge/skills and informed by a comprehensive assessment and clinical reasoning

What mechanism(s) should I intervene, rather than what approach should I choose?
What are the key drivers?

**Pathology driven**
- Red flags
  - Pathoanatomical disorders
    - Spinal stenosis with radicular pain
    - Neurological deficits
    - Inflammatory pain

**Psycho-socially driven**
- Anxiety, fear, anger
- Depression
- Negative beliefs
- Poor coping strategies
- Negative social and interpersonal circumstances

**Movement driven**
- Painful aberrant movement patterns
- Altered muscle activation
- Suboptimal muscle use

**Biologically driven**
- Central hypersensitivity
- Inflammatory system response

Adapted from Glasgow. PhysioFirst. 2017
Persistent or recurrent neck pain

Multisystem assessment

Physical factors that load tissues suboptimally leading to on-going nociceptive input that continues to drive and maintain their chronic pain disorder

Biological factors (e.g. central sensitization, inflammatory system response) that contribute to maintenance of pain

Psychological features (e.g. pain catastrophizing, fear avoidance, anxiety, depression or stress) which contribute to pain experience and interact with biological processes

Social factors such as poor support or high job demands with low reward that amplify the patient’s perceived pain

Selection of exercise components

Modified motor control (muscle activation, posture/alignment, and movement) to optimise tissue loading to reduce nociceptive input

Improve strength and endurance to enhance function

Exercise to enhance physical fitness

Exercise for analgesic effects

Graded activity using cognitive behavioural principles to enhance function and overcome disability

Exposure to movement to reduce threat

Change exercise beliefs and attitudes

Individualised exercise interventions

Development of individualised package of exercise interventions targeted to the patient’s unique mix of presenting features for more effective management of neck pain

Falla & Hodges. Exerc Sport Sci Rev. 2017
Patient-specific, tailored interventions

- Reduced pain
- Improved function
- Less recurrence
- Improved quality of life
To conclude.....

Perceived pain and disability are relevant but pain is multifactorial and other features should also be considered.

Whilst pain is important there should be an equal focus on exercise prescription for "rehabilitation".

Neuromuscular adaptations are specific to the mode of training.

Targeting mechanisms and functional impairments.

SPECIFICITY OF EXERCISE IS RELEVANT