Exercise for Chronic Axial Neck Pain:
Efficacy, Physiology and the NEBH Experience

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Neck Pain

Lifetime Incidence 75%
12 mo Prevalence 30-50%
Persistence 16–22%

Not life threatening
Work/life restriction
Most do not seek care
Still among most common complaints
Millions MD visits/alt care
$$$$$$ health care cost
Chronic Neck Pain

Reduced isometric neck strength
Reduced ROM
Increased disability
Fear avoidance
Central sensitization
Greater pain = less strength
Greater neck muscle “fatigue”

• References 1-9 and 28-41
Association of NP with Reduced Strength/ROM

Chicken or egg
Test results may not = true strength
Pain may prevent full effort
Fear and motivation play a role
Exercise makes sense
Systematic Reviews: CNP

**Insufficient Evidence**
- Mobilization/Manipulation
- Manual therapy
- Traction
- Modalities

**Limited Evidence**
- Injections
- Surgery

**Moderate/Strong Evidence**
- Exercise
Randomized Controlled Studies

Chronic axial neck pain
Exercise interventions
High quality studies
Specific neck vs UB vs general
CBT

N=191 (Minnesota, USA)
3 groups, 20 sessions, 11 weeks

• Resisted neck strength with pulley Upper back and shoulder dumbbells AND massage, manip vs.
• MedX, UB strength and stretch vs.
• Massage, manip, sham microcurrent

At one and two year followup
Both exercise groups: Significant

• reduction in pain (5.8-3.0)
• improvement in Strength/ROM
• No change in passive group
Viljanen, Malmivaara et al., BMJ, 2003 (Finland)

N=393 chronic nonspecific neck pain
3 groups, 12 weeks train, 30 min, 3x week, reinforce at 6 mo
• Dynamic UB mm training dumbbells
  large mm groups of shoulder/back
• vs mm and general relaxation
• vs ordinary activity
No direct neck exercises
Same evidence
Viljanen, Malmivaara et al., BMJ, 2003

Pain, disability, ROM, strength reduced all 3 groups 3, 6 and 12 mo
No difference *between* groups
Pain 4.5-2.7
Upper body training not superior to relaxation train or ordinary act advice
Ylinen et al., JAMA, 2003 and J. Strength Cond Res 2006 (Finland)

180 women with CNP (2000-2)
2 treatment groups:
12 45min session, 3x week, maint
• Strength: 80% max band (15 F/E/obl)
• Endurance: head lifts (3x20)
Both
  UB, legs
  Stretch, aerobic and CBT
• Control: Stretch and aerobic
Ylinen et al., JAMA, 2003 and J. Strength Cond Res 2006 (Finland)

Both strength and endurance groups significant improvements in

- Pain (5.7-2.2 and 5.8-1.8)
- Disability (22-14 and 21-12)
- Strength
- Range of motion

Compared to control at 1 year
Ylinen et al., Journal of Rehab Medicine, 2010 (Finland)

Significant reduction in Headache, Arm Pain. Improved HR, QOL. Strength and Endurance groups only at 1 year.
Ylinen et al., Eur J Pain, 2005

12 month followup 180 women
Pressure pain threshold measures at 6 cervical sites and the sternum
Significant increase in pain pressure in both training groups ct baseline
No change in controls
6/6 sites in strength group
4/6 sites in endurance group
At one year
59 women in “stretch and aerobic”
Underwent high intensity training with band at 80%
Significant decrease pain and disability at 2 year followup
Chiu et al, Clin Rehab, 2005 and Spine, 2004 (Hong Kong)

N=145 (>3m, 67% >12m)
2x/wk x 6 wks
• Dynamic flexion and extension vs.
• Control infrared irradiation
At 6 weeks and 6 months exercise significant improved pain, disability and strength, satisfaction
  Pain (39-34%) Disability (29-27%)

N=549 3 groups, 7 diff workplaces
20min, 3x week, 1 year
• Specific resistance to neck and upper body, row/kayak
• All around exercise, equip in work, encourage walk to work, take stairs
• General health group
Neck/Shoulder Pain

At end of one year intervention
Significant reduction in pain in active groups only (5.0-3.4)
Supports neck specific and general exercise
Zebis, et al., BMC Musculoskeletal Disorders, 2011

Denmark, 537 high risk workers
2 groups
20 weeks, 3xweek
• 5 dumbbell exercises vs
• Advice to remain active
Specific exercise group significant reduction in neck and shoulder pain (4.7-1.8)
Evans, Bronfort et al., Spine, 2012, Minnesota

279 subjects with CNP
3 groups
• High Dose Supervised Exercise (ET)
• ET plus spinal manipulation
• Home Exercise Advice

20 one hour sessions over 12 weeks
Vs 2 one hour sessions
Similar Significant Reduction in Pain in Both Exercise Groups

Compared to home exercise group
At 12 and 52 weeks followup
No advantage in manipulation group
Pain 5.6-3.1
Significant improvement in strength, endurance, ROM, satisfaction, disability in both exercise groups
Summary of Active Neck Exercise versus “Other” Studies

5 specific superior to modal, control, radiation, home ex program
No advantage to manipulation
1 study specific AND non specific superior to health advice
1 nonspecific not superior to relax v ord act (all improve)
Cognitive Behavioral Therapy
(ref 24 and 25)

PT with CB orientation superior

- Delivers a message; give permission; educate; try new response; challenge passivity; confront thinking patterns; explore barriers to exercise, success and function; problem solve; set goals; relax; take ownership; challenge effort to achieve desire; delegate specific tasks (laundry, garbage, recreation); undo proscriptions; positive reinforcement “well” behaviors; support, coach; believe; unified team

- Mundane/banal/low tech/ unglamorous/ enthusiasm/ passion/belief/ hope
Cognitive Behavioral Therapy for Neck Pain, Jensen I, Bergstrom et al., Pain, 2005

4 groups N=214, sick list 1-6 mo (blue)
4 w, 4-8 per group
• PT (20 h/w, str, cardio, relax, ind goal, physical and functional, open to PT)
• CBT (13 h/w, goal, plan and set, problem solve, relax, activity pacing, role of vicious circle, sig other, cog cope-imagery, external focus, coping statements
• PT plus CBT versus CG (rx as usual)
Jensen I, Bergstrom et al., Pain, 2005

PT plus CBT superior to other 3
Sick leave, retirement, health-related QOL
201 less sick leave days than CG, 3 year followup
10 year followup 42 fewer sick days per year
Cost effectiveness of two rehabilitation programs

Jensen, Busch, Bodin et al., Pain, 2009, Sweden

Neck and back pain N=255 (27% neck)

7 year followup

• Ortho manual therapy with low intensity exercise versus
• Full time multidisc program (MDP)
• 8h/d, 5d/w, 4w cbt, efficacy, function
Cost effectiveness of two rehabilitation programs

Significantly reduced sickness absence and disability pension
Multidisciplinary program only
Cost reduction 94,500 EUR per pt
Conclusion: CNP

Is safe!!!

Associated with:

• Deconditioning
• Disability
• Fear avoidance/central sensitization

Effective rehabilitation

• Simple progressive exercise
• Cognitive behavioral approach
How Might Exercise Work for Chronic Neck Pain?
Exercise helps

- Reduce pain
- Improve strength and ROM
- Improve function
- Reduce fear-avoidance

HOW?
Individuals with CNP

Atrophic muscle fibers
Mitochondrial damage


Lower trapezius blood flow

- Larsson et al., Pain, 1999
Histology in Neck Pain

Decreased tissue metabolism

- Decrease Na+ and K= pumps and ATP
- Associated with muscle fatigue and pain

- Clausen, Ann NY Acad Sci, mediating activity
Mechanisms potentially reducing pain as a result of muscle training

**Endurance and strength training**

- Increase Na+ and K+ pump concentration in neck mm
- Improve capillarization

- Leivseth et al., Muscle and Nerve, 1992
Cycling with Relaxed Shoulders for 20 Minutes

Reduced neck pain
Increased trapezius mm oxygenation

• Near infra-red spectroscopy

Linear fashion both nl and CNP
Normals greater 2 minute post ex O2

• Andersen LL et al., Eur J Appl Physiol, 2010
Strength Training

Elicits hypertrophy of neck mm fibers
• Kadi et al., Acta Neuropath, 2000

Transforms catabolic metabolism to anabolic

Increase GH, testosterone
• Hakkinen et al., J Geront A Biol Sci Med, 2000
• Kraemer et al., Eur J Appl Physiol Occ Physiol, 1995

Increases insulin-like growth factor
• Marx et al., Med Sci Sports Ex, 2001
Strength AND Endurance Training

Reduce cytochrome c protein (apoptosis)

Increase capillarization to fibers

- Kadi et al., Acta Neuropath
Strength and Endurance Training

Pain may be relieved by modification of the environment and peripheral nociceptors

- Increased circulation and metabolism
- Clear inflammation and irritants
- Muscle tissue healing
- Strengthen other tissue
Neural Adaptation Due to Training

- **Increased motor unit firing rates**
- **Recruitment high threshold motor units**
- **Improved control over motor units**
Increased Motor Control

Increased activity efferent motor pathways
Increased strength and control
improve stability
Reduce strain on ligaments, joint capsule
Reduce hyperesthesia, stimulate endorphins

• Kettler et al., J Biomech, 2002
Excitation of muscle spindles, Golgi tendon organs and mechanoreceptors around joints from training

Increase activity of efferent nerves

Inhibit small-diameter afferent fibers mediating pain in dorsal horn
Training

Activate descending pain pathways
Supraspinal-thalamus, basal ganglia, periaqueductal grey, pre-frontal, post-parietal cortex
Affect pain perception
Inhibit “central sensitization” associated with CNP (desensitization)
May be affected by belief, behavior, fear, training

• Bonica, Management of Pain, 1990
Emotions and Fear

May exacerbate pain

• Keefe et al., J Pain, 2004

Fear diminished by conscious exercise of areas associated with pain

• Klaber et al., Spine, 2004
Positive Effects of Exercise for Neck Pain

Histologic
Physiologic
Neurologic
Psychologic
Intensive Rehabilitation for Chronic Neck Pain at NEBH

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NEBH Quality Assessment Database 2009-2010

August 24, 2010
SPSS Paired student t-test
144 CNP patients (23mo)
62% female, mean age 51
Average 9 visits (5-6 weeks)
Pain 5.1-2.9
ODS 26-16
Cervical lift 11-21 lbs
ROM 10°, 14°, 10°, 11°
Goals

Normal
Less illness behavior
Reduce dependence
Resume function
Experience success
Reduce pain
Conclusion: Chronic Benign Axial Neck Pain

Passive treatments unproven

Exercise improves symptoms, function, changes micromilieu

Works at NEBH
References

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THANK YOU!

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We can argue about:

The “pain generator”
Best “integrative” approach/passive treatment
Which injection from the menu to choose
Best surgical approach
How to hyperanalyze the anatomy
OR
We can focus on function and choice and challenge