Q: Does exercise therapy reduce pain and increase function in persons with chronic neck pain?

To answer this question, we performed a comprehensive search of the PubMed database (November 2008) for randomized, controlled trials and systematic reviews that addressed this specific research question. 1

Five studies met the criteria for inclusion in this review, comparing neck muscle exercise to general exercise or control (1,3), neck exercise to neck support during sleep (2), strength vs endurance training for neck muscles (4), and neck exercise to spinal manipulation (5).

The outcomes evaluated for this review included patient rated measures of pain and/or disability. Pain was assessed in all of the studies and was significantly reduced with exercise in three of the studies (1,3,4). The length of these interventions ranged from 6 wks to 12 mos. When exercise was used in combination with neck support during sleep, there was a significant reduction in pain (2). The effect of neck exercises on pain reduction after 11 wks of treatment was similar to that of spinal manipulation (5). However, neck exercises were found to be more effective at long term pain reduction (12 mos) compared to spinal manipulation (5). Disability was assessed in three of the studies (3,4,5), and was significantly reduced with exercise compared to controls in two (3,4).

Follow-up assessments were included in all of the studies, including two long-term follow-ups of 2-3 yrs (4a,5a). Among the three studies finding a significant reduction in pain with exercise (1,3,4), differences from the control group were maintained post intervention at 10 wks (1) and 6 mos (3). Similarly, reduction in pain was maintained with exercise up to 3 yrs post treatment, although significance from controls was not determined (4a). Among the two studies finding a significant reduction in disability (3,4), one found that the differences from controls were no longer significant after 6 mos, while the other found that reductions in disability had been maintained up to three years post-intervention (4).

Based on this review, it can be concluded that inclusion of neck exercise improves outcomes for patients with chronic neck pain. Sample exercises from VHI PC-Kits have been provided based on examples from these studies.

Exercise for Rehabilitation and Treatment:

Summary 8: Chronic neck pain

April 2009
Table 1: Overview of Research Studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Overview</th>
<th>Description of Intervention</th>
<th>Results &amp; Conclusions</th>
</tr>
</thead>
</table>
| 1)    | **Hypothesis/Aim:** To determine the effect of specific strength training vs general fitness training on work-related neck muscle pain. | All groups required 1 hr/wk for participation, with the SST and GFT groups completing high intensity training 3x/wk for 20 mins each. | **Outcome Measure:**

  **Pain:** Intensity of pain in the trapezius muscle was measured on a 100 mm visual analog scale (VAS), with 0 indicating “no pain at all” and 100 indicating “worst possible pain”. Clinically significant change was set at 10 mm.

  a. **Prolonged effect of training:** General and worst pain were assessed 3x/wk using separate VAS scales.

  b. **Acute effect of training:** Pain before, during and after training sessions (SST and GST groups only) were completed 3x/wk using separate VAS scales.

|       | **Specific strength training:** Subjects completed supervised strength training for the neck and shoulder muscles with 5 dumbbell exercises (1-arm row, shoulder abduction, shoulder elevation, reverse flies, and upright rows). 3 exercises were performed during each session (only shoulder elevation was performed at every session). The training load for each exercise was progressed from 3 sets of 12 repetitions at 70% of maximum to 3 sets of 8 repetitions at 80% of maximum. Con contractions included both concentric (raising) and eccentric (lowering). | **Results:**

  **Prolonged effect of training.** Only the SST group had a significant decrease in pain (p<0.0001) after the 10 wk intervention (general pain, 28±15 to 8±9; worst pain, 44±25 to 10±10). At the 10-wk follow-up, pain level for the SST group rose slightly but remained significantly lower than pre-intervention (worst pain, 19±18; general pain, 16±14) and significantly lower than the GFT and control groups (p<0.001).

  **Acute effect of training.** During the 10 wk intervention, the GFT group showed a significant decrease in trapezius muscle pain immediately after cycling exercise (p<0.01), but this effect was not significant by 2 hrs post-exercise. The average decrease in pain immediately post-exercise was 5 mins, less than the 10 mins threshold for clinical relevance. In contrast, the SST group had a significant increase in pain immediately after exercise (p<0.05), which also was not significant by 2 hrs post-exercise. The increase was also about 5 mins and not considered clinically significant. However, after 5 wks of intervention, the SST group no longer showed a pain increase after exercise.

| Groups: |       | **General fitness training:** Subjects performed 20 mins on a cycle ergometer with relaxed shoulder position (not using handlebars). Workload was progressed from 50-70% of estimated maximum HR. | **Conclusions:** Substantial pain reduction was obtained with the use of specific strengthening exercises to the painful

| Duration: | The length of the exercise intervention was 10 wks. Assessments were completed before training, during training (3x/wk) and 10 wks | **Control:** The control group participated in counseling sessions on topics promoting good health (e.g., relaxation, diet, workplace ergonomics). |   |

1) Andersen, 2008
muscles. The authors concluded that “supervised high intensity (8–12 repetitions) strength training of the painful muscle 3 x/wk for 20 mins should be recommended in the treatment of trapezius myalgia.”

### Hypothesis/Aim

Hypothesis/Aim: To determine the effect of therapeutic exercise vs sleeping neck support in patients with chronic neck pain

### Subjects

Subjects: 151 adults (61 male; 90 female) meeting the following criteria: 18-70 yrs; unresolved neck pain (with or without radiating symptoms to UE) for at least 2 mo but not more than 12 mo; and without systemic inflammatory joint disease, neoplasm, infection, neurological disease, serious disability, or radiographic evidence of cervical subluxation or spinal fracture.

### Groups

1. Active control (Control, n=37)
2. Sleeping neck support + control (Support, n=38)
3. Exercise + control (Exercise, n=38)
4. Sleeping neck support + exercise + control (Support + Exercise n=38)

### Duration

Duration: The length of intervention was 6 wks. Outcome assessments were completed at baseline, 3, 6, 12, and 24 wks, and 12 mos.

All groups received 7-10 visits with a physical therapist (2x/wk for the first 3 wks, 1x/wk for the second 3 wks, and a follow-up at 10 wks). All subjects received the control treatment.

**Control:** Subjects received a moist hot or cold pack (patient preference) for 20 min to the back and side of neck and upper scapular area and 5 min of effleurage massage. A hot or cold pack was also provided for home use.

**Support:** Subjects received and were instructed on the use of a neck support pillow to be used during sleep. Pillow use was reviewed at follow-up visits. Two types of pillows, similar in design but differing in firmness, were randomly distributed.

**Exercise:** Subjects completed a program of active neck and postural exercise. Postural exercise was a seated relaxed mid-position taught by mirror feedback. Active neck exercise included reciprocal, manually-resisted isometric exercise for muscles of the head, neck and shoulder girdle. Exercises were performed 2x/day for 5-10 min.

### Outcome Measure

**Pain:** Northwick Park Neck Pain Questionnaire, with the primary assessment being at 12 wks. Questions are rated from 0 to 4 and relate to pain level, sleep, and functional ability.

**Results:** Pain decreased in all groups over the duration of the 12 wk intervention (compared at 3, 6 and 12 wks), indicating time to be an important factor. However, the pain score at 12 wks was significantly less for the Support+Exercise group compared to the other 3 groups (p=0.006).

### Conclusions

Conclusions: The combination of exercise and sleeping neck support should be used, rather than either in isolation, in the treatment of chronic neck pain.
Hypothesis/Aim: To evaluate the efficacy of specific exercises for the treatment of chronic neck pain

Subjects: 145 adults (45 male; 100 female) meeting the following criteria: 20-70 yrs; chronic neck pain >3 mos; and without previous injury or surgery to the neck, inflammatory condition, or concurrent treatment for neck pain

Groups:
1. Exercise (n=67)
2. Control (n=78)

Duration: The length of the exercise intervention was 6 wks. Assessments were completed at baseline, 6 wks and 6 mos.

Exercise: Subjects performed neck exercises 2x/wk for 6 wks, including activation of deep neck muscles and dynamic strengthening. Activation exercises were performed in the supine position with a pressure sensor inflated to 20 mm Hg. Subjects performed repetitions of 10 sec activation followed by 15 sec rest for 10 min. Strengthening exercises were performed with a Multi Cervical Rehabilitation Unit (MCRU). Subjects performed 15 repetitions of flexion-extension at 20% of peak isometric strength (PIS), followed by 3 sets of 8-12 repetitions of flexion-extension at variable resistance (starting at 30% PIS and increasing in 5% increments as tolerated).

Control: The control group received infrared irradiation (superficial heat) to the back of the neck 2x/wk for 6 wks for 20 min. The exercise group also received the control treatment (before the exercise program).

Outcome Measure:
1. Disability: Disability was the primary outcome and was assessed by the Northwick Park Neck Pain Questionnaire (Chinese version).
2. Pain: Pain was a secondary outcome and was measured with the Verbal Numeric Pain Scale (VNPS).

Results:
Disability. Both groups showed significant percentage improvement in disability scores after 6 wks of treatment (28.8% exercise, p<0.001; 18.4% control, p<0.001), with exercise group showing significantly greater improvement than the controls (p=0.03). At the 6 mo follow-up, the significant improvement was maintained within each group (28.5% exercise, p<0.001; 14.6% control, p=0.01), but there was no longer a significant difference between the groups (p=0.08).

Pain. Only the exercise group showed a significantly improved pain score after 6 wks (34.9% exercise, p<0.001; 11.7% control, p=0.06). The mean difference in pain scores at 6 wks was also greater among the exercise group (p=0.01). At the 6 mo follow-up, the improvement in pain among the exercise group remained significant (33.7% exercise, p<0.001), and the mean difference in scores remained greater in the exercise group (p<0.001).

Conclusions: Following a 6 wk treatment program involving specific neck muscle activation and strengthening exercises, disability and pain among persons with chronic neck pain were significantly reduced compared to baseline, as well as to those receiving only superficial heat.

Hypothesis/Aim: To evaluate effectiveness of 2 types of neck exercise, strength and endurance, among women with chronic, nonspecific neck pain

Subjects: 179 women meeting the following criteria:

Both exercise groups completed 9 practice sessions with a physical therapist and completed the exercise routine at home 3x/wk. Only the neck exercises differed between groups (see below). Exercises for shoulder and upper extremity included dumbbell shrugs, presses, curls, bent-over rows, and seated rows.

Outcome Measure:
1. Disability: Disability was measured with the modified neck and shoulder pain and disability index, and the Vernon neck disability index.
2. Pain: Pain in general was assessed with a visual analog scale (0-100) and the effect of training on pain was measured on a 6 point scale (much more pain to complete relief from pain).

Results:
Disability. After 12 mos, both exercise groups showed significantly lower disability scores compared to the control group.
Ylinen, 2003

Groups:
1. Strength (n=60)
2. Endurance (n=59)
3. Control (n=60)

Duration: The length of the exercise intervention was 12 mos. Assessments were completed at baseline and 12 mos. Follow-up visits to check exercise technique and intensity were conducted at months 2 and 6.

Exercise:
- Dumbbell shrugs, presses, curls, bent-over rows, flys, and pullovers with the endurance group doing 3 x 20 with 2kg dumbbells and the strength group doing 1 x 15 at the highest load possible. Trunk and leg exercises included squats, sit ups, back extension and were performed using the individual’s body weight. Stretching was done for 20 min for neck, shoulder and upper extremity muscles. Subjects were also advised to do aerobic exercise 3x/wk for 30 min.
- Strength: Participants completed neck flexion in forward, oblique R and L, and backward directions using a Theraband while seated (15 repetitions at 80% of maximum).
- Endurance: Participants completed 3 sets of 20 repetitions of neck flexion while in supine.
- Control: Subjects were advised to do aerobic exercise 3x/wk and received the same stretching program as the exercise groups.

Outcome Measure:
1. Disability: Measured by the Neck Disability Index (lower score indicates less disability)
2. Pain: Rated on an 11-box scale from no symptoms to highest severity of pain

Results:
Disability. Compared to baseline values, all 3 treatment groups showed decreased ratings of neck disability after the 11 wk treatment. Despite slight increases, these values were mostly maintained by the 12 mo time point. There were no significant differences in disability among the treatment groups at either 11 wks (p=0.48) or 12 mos (p=0.13).

Pain. Similarly, there were decreases in reported pain by the end of treatment in all 3 groups, and this was mostly maintained by

Hypothesis/Aim: To compare neck exercise and spinal manipulation for patients with chronic neck pain

Subjects: 191 adults (77 male; 114 female) meeting the following criteria: 20-65 yrs; mechanical neck pain >12 wks; and without conditions such as referred neck pain, osteopenia, progressive neurologic deficits, vascular disease of neck or upper extremity, or previous surgery to the

Exercise: Patients completed supervised sessions that included stretching, upper body strengthening, stationary cycling, and progressive resistance exercise on the MedX cervical extension and rotation machine. Using the MedX machine, about 20 repetitions were performed of each exercise for the cervical extensors and rotators.

Spinal manipulation: At each visit, patients received 15 min of short-lever, low force spinal manipulation. Three year follow-up (see reference 4a): Among the exercise groups, there was no change in any of the pain or disability measures between the 1 and 3 yr follow-up, and there was also no difference between the 2 training groups. The control group did not complete the long term follow-up, so it is uncertain if there was still a significant benefit of exercise. The percentage of participants who reported doing the specific neck exercises during the month prior to the 3 yr follow-up was 25% for endurance and 17% for strength, and the percentage who reported doing no exercise was 35% and 40%. Based on these findings, the authors suggest that “specific training is not necessarily a lifelong procedure to eradicate chronic neck pain.”

5)
Bronfort, 2001  

Summary 8: Chronic neck pain  

April 2009  

Groups:  

1. Exercise (n=63)  
2. Spinal manipulation (n=64)  
3. Spinal manipulation + exercise (n=64)  

Duration: The length of the intervention was 11 wks. Assessments were completed at baseline and after treatment at 5 and 11 wks and 3, 6 and 12 mos.  

Patients received 15 min of short-lever, low amplitude, high-velocity spinal manipulation to the cervical and thoracic spine. Patients also received an additional 45 min of sham microcurrent therapy to make treatment time comparable to other groups.  

Spinal manipulation + exercise: Patients received 15 min of spinal manipulation therapy as described above and also completed a 45 min supervised session of strengthening exercises for the neck and upper body. Exercises (2 sets of 15-30 repetitions each) included pushups, dumbbell exercises for the shoulder, and cervical strengthening using a weighted headgear (1.25-10 lbs).  

There were no significant differences found between groups at the 11 wk assessment (p=0.12), yet by the 12 mo follow-up, the 2 exercise groups showed a greater decrease in pain compared to the group receiving manipulation only (p=0.02).  

Conclusions: The authors concluded that the use of strengthening exercise in combination with spinal manipulation or in the form of the MedX program is of greater benefit than spinal manipulation alone.  

Two year follow-up (see reference 5a): The differences between groups shown at 12 mo were maintained at the 2 yr follow-up. There was a significant difference in pain among the groups at 24 mos, with both of the exercise groups having significantly lower pain compared to the manipulation only group (p=0.04). There was no significant difference in disability among the treatment groups at 24 mos.  

Table 2: Additional Exercises from VHI Exercise Kits  

The exercises included in this newsletter are intended only as a sampling of exercises from the different VHI exercise collections that might be relevant to the topic discussed. Their inclusion in this newsletter does not represent any rehabilitation protocol or any suggested exercise progression that could be used with patients. Using the order of the exercises to create a rehabilitation program for patients is inappropriate and could result in serious injury.  

<table>
<thead>
<tr>
<th>Level: Beginning-Intermediate</th>
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<tbody>
<tr>
<td><strong>Kit</strong></td>
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<td>Orthopedic</td>
<td>Cervical Spine</td>
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Summary 8: Chronic neck pain

Exercise for Rehabilitation and Treatment: Summary of Research

April 2009

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References


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1 PubMed database was used to identify peer-reviewed research publications that addressed the specific clinical question (population, diagnosis, treatment, and outcome). For inclusion, studies must be a randomized controlled trial (RCTs) and published in English. A maximum of 10 RCTs were reviewed, with strength of design and publication year determining which studies to include.

2 No study footnotes needed.

3 Statistical definitions: 1) P-value (p) denotes the level of significance, where p<0.05 indicates a statistically significant result. 2) 95% Confidence Interval (95% CI): a range that contains the true population estimate 95% of the time. A smaller range indicates an estimate that is more precise. 3) Relative Risk (RR) is a ratio of proportions (ProportionTreatment / ProportionControl). RR less than 1.0 indicates the treatment group has a decreased risk of developing the condition/disease compared to the control group, while RR greater than 1.0 indicates the treatment group has an increased risk. 4) Incidence Risk Ratio (IRR) is the ratio of two incidence rates; the incidence rate among the treatment group divided by the incidence rate in the control group. IRR gives a relative measure of the effect of a given treatment with values less than 1.0 favoring the treatment. 5) Hazard Ratio (HR) is the relative likelihood of experiencing a particular event; an HR of 0.5 indicates that one group has half the risk of the other group. HR is broadly equivalent to RR, but is useful when the risk is not constant with respect to time as it uses information collected at different times. 6) Odds Ratio (OR) is the odds of an event happening in the treatment group expressed as a proportion of the odds of an event happening in the control group and can be interpreted similar to the RR. 7) Likelihood Ratio (LR) is the likelihood that a given test result would be expected in a patient with the target disorder compared to the likelihood that the same result would be expected in a patient without that disorder. The LR is used to assess how good a diagnostic test is and to help in selecting an appropriate diagnostic test(s) or sequence of tests.