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Neck stabilization exercises compared to physical therapy modalities to decrease insidious neck pain in adults treated in an outpatient setting

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Neck stabilization exercises compared to physical therapy modalities to decrease insidious neck pain in adults treated in an outpatient setting

Disciplines

Physical Therapy

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Title: Neck stabilization exercises compared to physical therapy modalities to decrease insidious neck pain in adults treated in an outpatient setting

Brief Introduction: For the purposes of my clinical question, I want to know what the research says about the efficacy of neck stabilization exercises when compared to physical therapy modalities for the treatment of insidious neck pain. In my current hospital-based outpatient orthopedic setting, patients who present with neck pain as their chief complaint are often only administered physical therapy modalities. The modalities include heat or cold compresses, transcutaneous electrical nerve stimulation (TENS), and ultrasound. I would like to know if the use of neck stabilization exercises is supported by the literature as an evidence-based practice to decrease insidious neck pain, and if so, how its efficacy compares to modalities.

Clinical Scenario: There have been several patients who led me to pursue this clinical question. One example is a 28-year-old female who works part-time in a bakery. She works most of the time in a seated position. She reported an insidious onset of neck pain three months prior to seeking physical therapy. Her neck pain is worst in the morning, greatest on the left side, and does not peripheralize into her upper extremities. Her BMI is 23.5 kg/m² and she has no known comorbidities. Her physical therapy plan of care includes: hot compresses, TENS, and ultrasound. I would like to know if she would benefit from neck stabilization exercises.

My Clinical Question: Are neck stabilization exercises more efficacious than physical therapy modalities in decreasing insidious neck pain?

Clinical Question PICO:

Population: Adults with insidious neck pain seen in the outpatient setting

Intervention: Neck stabilization exercises

Comparison: Physical therapy modalities

Outcome: Visual analog scale (VAS) for neck pain

Overall Clinical Bottom Line: Based on the articles by Chiu *et al.* and Dusunceli *et al.*, there is strong evidence to support the use of neck stabilization exercises to reduce the report of insidious neck pain in adults. The article by Chiu *et al.* concluded that 4 hours of neck exercises over 6 weeks produced statistically and clinically significant improvements in neck pain that were maintained over 6 months. These were statistically significantly improvements compared to the group that received only a physical therapy modality. In the article by Dusunceli *et al.*, 10 hours of neck stabilization exercises over 3 weeks and a home exercise program for the rest of the year produced statistically and clinically significant improvements in neck pain over 12 months. It is unclear if the improvements were statistically significantly more efficacious than an intervention of only physical therapy modalities. Further research should include subject with cervical

radiculopathy since this is a common symptom associated with insidious neck pain. The treatment intervention should consist of only neck stabilization exercises to confirm their efficacy in decreasing neck pain when no physical therapy modalities or dynamic strengthening exercises are used.

Search Terms: Physical therapy, physiotherapy, neck pain, stabilization exercises, modalities, and randomized controlled trial

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Rationale for chosen articles: The search for articles pertaining to my clinical question was conducted by combining the previously specified search terms in the online research databases MEDLINE and CINAHL. I skimmed the titles and abstracts of the articles. I selected the 3 articles with a PICO that most closely matched my clinical PICO for a more in-depth analysis. Physiotherapy Evidence-Based Database (PEDro) scores were attained or independently calculated for the 3 articles listed in Table 1. The article PICO and PEDro score were both taken into consideration when selecting the 2 articles used to answer my clinical question.

(1) Chiu T, Lam T, Hedley A. A randomized controlled trial on the efficacy of exercise for patients with chronic neck pain. *Spine*. 2004; 30(1): E1-E7.¹

PEDro Score: 8/10 (Scored by Emily Nichol)

Patient: 145 adult outpatients with neck pain for at least 3 months

Intervention: Activation of the deep neck muscles and dynamic strengthening of the neck muscles plus infrared irradiation

Comparison: Infrared irradiation

Outcome: Verbal numerical pain scale (VNPS), peak isometric strength of neck muscles, Chinese version of the Northwick Park Neck Pain Questionnaire, sick leave, patient satisfaction, and medication

(2) Dusunceli Y, Ozturk C, Atamaz F, Hepguler S, Durmaz B. Efficacy of neck stabilization exercises for neck pain: a randomized controlled study. *Journal of Rehabilitation Medicine*. 2009; 41: 626-631.²

PEDro Score: 6/10 (Scored by PEDro database)

Patient: 60 outpatients with non-specific neck pain for at least 6 weeks

Intervention: Neck stabilization exercises plus physical therapy modalities

Comparison: Physical therapy modalities; isometric and stretching exercises plus physical therapy modalities

Outcome: VAS for neck pain, cervical AROM, Neck Disability Index, Beck Depression Scale, and medication

(3) Ylinen J, Takala E, Nykänen M, *et al.* Active neck muscle training in the treatment of chronic neck pain in women: a randomized controlled trial. *JAMA.* 2003; 289(19): 2509-2516.³

PEDro Score: 7/10 (Scored by PEDro database)

Patient: 180 female office workers with chronic non-specific neck pain for at least 6 months

Intervention: Isometric neck strengthening and stabilization exercises

Comparison: Written instructions to perform neck stretches and aerobic exercise

Outcome: VAS for neck pain, cervical AROM, maximal isometric neck strength, Vernon neck disability index, neck and shoulder pain and disability index, and short depression inventory

Table 1. Comparison of PEDro Scores

	Chiu <i>et al.</i>	Dusunceli <i>et al.</i>	Ylinen <i>et al.</i>
Random	Yes	Yes	Yes
Concealed allocation	Yes	No	No
Baseline comparability	Yes	Yes	Yes
Blind Subjects	No	No	No
Blind Therapists	No	No	No
Blind Assessors	Yes	Yes	Yes
Adequate Follow-up	Yes [†]	Yes	Yes
Intention-to-Treat	Yes	No	Yes
Between Group	Yes	Yes	Yes
Point Estimates & Variability	Yes	Yes	Yes
Total Score	8/10*	6/10**	7/10**

*Scored by Emily Nichol

**Scored by PEDro database

†Score disagreement between Emily Nichol and PEDro database

Based on the above comparisons, I have chosen to write my critically appraised topic on the articles by Chiu *et al.* and Dusunceli *et al.* The article by Ylinen *et al.* was not selected because the patient population only represented a small sample of my proposed clinical population, the intervention included isometric strengthening along with neck stabilization exercises, and the comparison did not include physical therapy modalities.

The article by Chiu *et al.* was selected because it has good internal validity with a PEDro score of 8/10. The article PICO closely matches my clinical PICO. The only variations in the article PICO compared to my clinical PICO are the specificity of the patient population, the addition of dynamic strengthening exercises to the neck stabilization intervention, and a slight difference in outcome measurement since the VNPS does not provide a visual representation for quantifying pain like the VAS. The comparison treatment that served as the control in the article is infrared irradiation. It meets my clinical comparison criteria of physical therapy modalities, but it is a different heating modality than those I have more commonly seen during my internship.

The article by Dusunceli *et al.* was also selected. It has good internal validity with a PEDro score of 6/10. The article PICO very closely approximates my clinical PICO.

The only variation in the article PICO is the specificity of the patient population, which represents part of my clinical population. The article's comparison treatment parallels my clinical comparison treatment of physical therapy modalities. It only differs slightly from my observation of physical therapy modalities used clinically during my internship since, in addition to TENS and ultrasound, the authors also used infrared irradiation. Overall, the articles by Chiu *et al.* and Dusunceli *et al.* serve as high quality references to answer my clinical question.

Article: Chiu T, Lam T, Hedley A. A randomized controlled trial on the efficacy of exercise for patients with chronic neck pain. *Spine*. 2004; 30(1): E1-E7.

Clinical Bottom Line: Based on the results of this single-blind randomized controlled trial with 145 adults, there is strong evidence to support the use of neck stabilization and dynamic strengthening exercises to decrease insidious neck pain. In a group of 67 adults, a total of 4 hours of neck exercises over a period of 6 weeks resulted in statistically and clinically (20% improvement over baseline measures) significant mean improvements in the report of neck pain on the VNPS at 6 weeks and 6 months. The results also demonstrated statistically significant improvements when compared to an infrared irradiation only intervention with a small effect size at both time points. The exercises as performed in this study would not be cost-effective if performed using the equipment the authors did (MCRU). The benefits would outweigh the costs if more readily available equipment could be used for the dynamic strengthening exercises, though it is not known if the benefits could be gained without using the MCRU. The study has good internal/external validity and can be generalized to a greater population. Based on this study alone, I would recommend an intervention including neck stabilization and dynamic strengthening exercises to treat insidious neck pain as long as readily available equipment was utilized. Further research should test the use of more commonplace equipment for dynamic neck strengthening. Another option is for further research to focus on neck stabilization exercises without dynamic strengthening to determine if improvements can be solely attributed to the stabilization exercises. Subjects with neck pain and accompanying neurological symptoms should be included in these studies to determine if this population would also benefit from neck stabilization exercises, since subjects with this clinical presentation were excluded from this study.

Article PICO:

Population: 145 adult outpatients with neck pain for at least 3 months

Intervention: Activation of the deep neck muscles and dynamic strengthening of the neck muscles plus infrared irradiation

Comparison: Infrared irradiation

Outcomes: Verbal numerical pain scale (VNPS), peak isometric strength of neck muscles, Chinese version of the Northwick Park Neck Pain Questionnaire, sick leave, patient satisfaction, and medication

Blinding: This was a single-blind study. An independent assessor was blinded to group allocation. The subjects and therapists who participated in the interventions were not blinded to the group allocations. Potential bias existed for the subjective report of pain since the subjects were not blinded. However, the subjects were not aware of the authors' hypothesis and may have thought the infrared irradiation was the experimental intervention. Overall, since the therapists were not blinded they may have given more

motivating cues to the intervention group, which could have created a bias for all outcome measurements.

Controls: This was a controlled trial. The trial had a comparison group that received the same infrared irradiation treatment protocol as the intervention group. The comparison group served as an appropriate control because the only difference between the groups was the addition of neck exercises in the intervention group. Both groups received the infrared irradiation. The authors indicated that infrared irradiation gives only superficial heating at a depth of approximately 2.5 mm and the effect is not long-lasting.

Randomization: Subjects were randomly allocated to an intervention group or a comparison group by using a computer-generated minimization method based on age, gender, and level of disability due to neck pain. The minimization method randomly yields the smallest imbalance between groups based on baseline data.¹ This stratified randomization technique was successful since there were no statistically significant differences between group baseline demographics or baseline outcome measures.

Study: This was a single-blind randomized controlled trial. Subjects who met the inclusion and exclusion criteria were recruited between September 2000 and March 2002 from two physical therapy outpatient departments in different regions of Hong Kong. Inclusion criteria were adults with chronic neck pain that lasted longer than 3 months, age 20-70 years old, and who could read Chinese. Exclusion criteria were a history of previous injury to the neck or upper back T1-T6, neck surgery, inflammatory conditions, malignancies, congenital spinal abnormalities, work-related injuries, neurological symptoms such as muscle weakness or changes in lower motor neuron reflexes, other musculoskeletal problems at the same time, contraindications to infrared irradiation such as loss of skin sensation, and concurrent treatment such as chiropractic, physical therapy manipulations, or training because of neck pain within the previous 6 months. One hundred forty-five subjects were included (67 in the intervention group; 78 in the comparison group). The groups received treatments twice a week for 6 weeks. The intervention group performed specific stabilization exercises to activate the deep neck flexors for 10 minutes, dynamic strengthening of the neck muscles using a Multi Cervical Rehabilitation Unit (MCRU) for approximately 10 minutes, and infrared irradiation at the level of the C4 spinous process for 20 minutes; yielding a single treatment session of 40 minutes. Thus, the total treatment time for the intervention group during the course of the study was 8 hours (12 sessions X 40 minutes). The subjects were required to actively participate in 4 of the 8 hours of the total treatment time. The comparison group only received the 20-minute infrared irradiation protocol. Thus, the total treatment time for the comparison group was 4 hours (12 sessions X 20 minutes), of which no active participation was required.

Study Losses: The authors presented a flow diagram that clearly showed why and when subjects dropped out. At 6 weeks, 12% of the intervention group and 21% of the comparison group dropped out. At 6 months, another 16% of the intervention group and 1% of the comparison group dropped out. Overall, 28% of the intervention group and 22% of the comparison group dropped out. Although a higher percentage of subjects

dropped out of the intervention group, it did not appear that the drop-outs were due to the exercise intervention. The authors performed an appropriate intention-to-treat (ITT) analysis and reported that the results were not different from the subjects who completed the study. The authors clearly defined their method of ITT analysis and appropriately took into account the fact that some subjects withdrew due to improvements or dissatisfaction with their group assignment.

Outcome Measures: The outcome measure most relevant to my clinical question is the VNPS. The VNPS is a scale from 0-10, with 0 representing no pain and 10 representing worst pain. It can be assumed that a decrease in neck pain will increase function; therefore a separate measurement of function is not being included. The outcome measure was taken at baseline, 6 weeks, and 6 month follow-up. The validity and reliability of the VNPS were not addressed in the article, but are cited in the literature. The VNPS has moderate test-retest reliability (interclass correlation coefficients [ICC] 0.67 to 0.96) and a high convergent validity (0.79 to 0.95) when compared to the VAS. Both the VNPS and the VAS are commonly used measures of perceived pain intensity.⁴

Summary of Internal Validity: This study had good internal validity (PEDro score 8/10). I identified only one minor threat: the lack of patient and therapist blinding. It would be difficult to blind the patients to exercise interventions since active participation was required. The authors did not suggest that the subjects were aware of the hypothesis of the study; therefore, it may be just as likely that the subjects assumed the infrared irradiation was the experimental treatment. Likewise, it is difficult to blind therapists to the interventions since they must also actively participate in delivery of the treatment protocols. Therefore, the limited blinding is only a minor threat.

Evidence: The VNPS is the primary outcome measure that is related to my clinical question. The authors defined statistical significance to be 5% and clinical significance to be a 20% improvement over baseline measures.

To answer my clinical question of whether neck stabilization exercises are more efficacious than physical therapy modalities in decreasing insidious neck pain, first it must be determined if there was a statistically and/or clinically significant improvement within each group. Without significant improvements within either group, any difference between groups would be irrelevant. There was a statistically significant improvement in the intervention group at 6 weeks and 6 months. There was an absence of statistically significant improvements in the comparison group at 6 weeks and 6 months. In addition, there was a clinically significant improvement in the intervention group at both time points. In Table 2, I presented the authors' within-group mean percent improvement (with 95% CI) on the VNPS from baseline to 6 weeks and baseline to 6 months for the intervention group.

Table 2. Within-group mean percent improvement (95% CI) on the VNPS

	6 Weeks	6 Months
Intervention Group	34.9 (14.6 to 55.2)	33.7 (14.1 to 53.2)

According to the authors' definition of clinical significance – a 20% improvement over baseline scores, the intervention produced a clinically significant mean improvement at both 6 weeks and 6 months. However, the low end of the 95% CI is 14.6 at 6 weeks and 14.1 at 6 months. This means that if this same intervention were applied to the population who met the inclusion criteria, we could anticipate that not everyone would experience clinically meaningful improvements. However, the range of the 95% CI is mostly above the 20% MCID, so we could anticipate that the majority of the population would experience clinically meaningful improvements with the experimental intervention.

Since the mean percent improvement on the VNPS was statistically and clinically significant in the intervention group, the between-groups comparison was analyzed. There was significantly more improvement in pain in the intervention group versus the control group at both 6 weeks and 6 months. In order to measure the magnitude of the significance in improvement, I calculated a between group treatment effect size. In Table 3, I present the effect size that I calculated between groups.

Table 3. Treatment Effect Size (95% CI)

	6 Weeks	6 Months
Effect size	0.35 (0.02 to 0.68)	0.34 (0.01 to 0.67)

At both 6 weeks and 6 months, the effect sizes were small, yet the low ends of the 95% CIs were positive. This means that 95% of the population that meets the study inclusion criteria and performs the intervention group's protocol will have improvements in pain that are at least slightly significantly better than if they were to follow the comparison group's protocol.

Applicability of Study Results:

Benefits vs. Costs: The benefits of the intervention exercises were demonstrated by the statistically and clinically significant improvement in neck pain levels compared to the group that simply received infrared irradiation. The improvements were noted after the 6-week intervention period and remained at the 6-month follow-up.

The costs associated with the exercises include the financial cost of the equipment, the therapist's time, and the subject's time. The equipment requirements include an air-filled pressure sensor for the neck stabilization exercises and the MCRU for dynamic strengthening. The price of the air-filled pressure sensor is unsubstantial since a blood pressure cuff, readily available in outpatient clinics, can be used in place of the pressure sensor. The MCRU is expensive: estimates range from \$30,850 remanufactured to \$41,650 new (L. Shaw, personal communication, March 6, 2012). Therapists would also need some initial training time to learn how to use the MRCU. The necessity of the MCRU in contributing to the improvement in neck pain needs further research. The possibility of substituting elastic resistance bands in place of the MCRU

would greatly reduce financial costs. If elastic resistance bands were used for the dynamic strengthening exercises, then the therapists would not require any additional training time. The total treatment time for the intervention with exercises is 8 hours, of which the subjects must actively participate in 4 of the hours. The total treatment time for the infrared irradiation only intervention is 4 hours, of which no active participation on the part of the subject is required. There were no adverse events associated with either treatment protocol.

Overall, the costs of the intervention with exercises would outweigh the benefits if the MRCU is used for the dynamic strengthening component. Using the MRCU is financially costly in terms of equipment and therapist training time. But, the benefits would outweigh the costs if readily available equipment is used in place of the specific equipment used in the study. Although the total treatment time would require 4 hours of active subject participation for the intervention with exercises compared to the comparison intervention, it is within reasonable limits for an outpatient orthopedic setting and likely reasonable timeframe to gain clinically meaningful improvements in neck pain.

Feasibility of Treatment: The intervention with exercises outlined in this study would be feasible to perform in an outpatient clinical setting. The study protocol was described well enough to be reproduced. The protocol was specific with regards to treatment frequency and duration. The exercise interventions were thoroughly described and the number of sets, repetitions, and resistance loads were listed. The application of infrared irradiation was also clearly outlined. The requirements for clinical expertise and the total treatment time of 8 hours are all reasonable for an outpatient setting. The equipment demands can be made feasible by substituting common physical therapy equipment for the specific items used in this study. Lastly, neck stabilization and dynamic strengthening exercises are feasible for subjects with neck pain to perform as noted by the authors' indication that no adverse effects occurred. It is reasonable to require active subject participation during half of the treatment intervention.

Summary of External Validity: This study has good internal validity that allows generalization of the results to adults with neck pain who meet the specified inclusion and exclusion criteria. My clinical question inquired about neck stabilization exercises and this study combined the intervention with dynamic strengthening. It is impossible to tease out the effects of the separate exercises, yet it was demonstrated that the combined effect of the exercises decreases neck pain. Subjects who present with neck pain also commonly report neurological symptoms such as upper extremity muscle weakness, decreased sensation, or decreased lower motor neuron reflexes. The presence of neurological symptoms was an exclusion criterion and greatly reduces the applicability of the intervention to the general population of subjects with neck pain. It is not possible to extrapolate the results from this study to a larger population than those that meet the inclusion and exclusion criteria. A broader range of subjects needs to be studied to identify whether neck stabilization exercises alone can reduce neck pain.

Article: Dusunceli Y, Ozturk C, Atamaz F, Hepguler S, Durmaz B. Efficacy of neck stabilization exercises for neck pain: a randomized controlled study. *Journal of Rehabilitation Medicine*. 2009; 41: 626-631.

Clinical Bottom Line: Based on the results of this single-blind randomized controlled trial with 60 adults, there is strong evidence to support the use of neck stabilization exercises to decrease insidious neck pain. In a group of 19 adults, a total of 10 hours of supervised neck exercises over a period of 3 weeks, and a subsequent HEP, resulted in statistically and clinically significant improvements in the report of neck pain on the 10-point VAS at 1, 3, 6, 9, and 12 months compared to baseline. It is unclear whether these improvements were statistically significantly better than the comparison treatment of physical therapy modalities. Overall, the study has good internal/external validity and the benefits of the exercise interventions outweigh the costs (10 hours of supervised exercises and a HEP). Based on this study alone, I would recommend a neck stabilization intervention to treat insidious neck pain. Further research should include subjects who are older and also have scapular or shoulder pain, or accompanying neurological signs/symptoms to determine if these populations would also benefit from neck stabilization exercises, since subjects with these clinical presentations were excluded from this study. It may also be of interest to compare neck stabilization intervention outcomes in individual versus group treatment sessions since these subjects were treated in a group in this study.

Article PICO:

Population: 60 adult outpatients with non-specific neck pain for at least 6 weeks

Intervention: Neck stabilization exercises plus physical therapy modalities

Comparison: Physical therapy modalities (Group 1) isometric and stretching exercises plus physical therapy modalities (Group 2)

Outcomes: VAS for neck pain, cervical AROM, Neck Disability Index, Beck Depression Scale, and medication

Blinding: This was a single-blind study. An independent assessor was blinded to group allocation. The subjects and therapists who participated in the interventions were not blinded. Potential bias existed for the subjective report of pain since the subjects were not blinded. The authors specified that the subjects were informed about the study, but not whether the information included the authors' hypothesis about which intervention/s may be more beneficial. Additionally, since the therapists were not blinded they may have given more motivating cues to either group, which could have created a bias for all outcome measurements.

Controls: This was a controlled trial. The trial had a comparison group that received the same physical therapy modality treatment protocol as the intervention groups. The

comparison group served as an appropriate control because the only difference between the groups was the addition of neck stabilization exercises in the intervention groups.

Randomization: Subjects were randomly allocated to an intervention group or a comparison group by using a computer-generated minimization method based on age, gender, and level of neck pain as assessed by the VAS. This stratified randomization technique was successful since there were no statistically significant differences between group baseline demographics or baseline outcome measures.

Study: This was a single-blind randomized controlled trial conducted in Turkey. The inclusion criteria were adults with neck pain of at least 6 weeks duration who were between the ages 18 to 55 years old. The exclusion criteria were a history of cervical spine injury or surgery, neck pain secondary to other conditions, neurological deficits from a radiculopathy, poor general health, pain in the scapula, shoulders, upper extremity, or lumbar spine that prevented stabilization of these structures, and if they had received physical therapy within 6 months of the study. Sixty subjects were included (20 in the intervention group; 20 in the comparison [Group 1]; 20 in another comparison [Group 2] that I did not analyze to answer my clinical question). Both the intervention group and the comparison group received physical therapy modalities 5 times/week for 3 weeks. The physical therapy modalities included: infrared irradiation for 20 minutes, TENS for 30 minutes, and ultrasound for 10 minutes; yielding a single treatment session of 60 minutes. Thus, the total treatment time for the comparison group during the course of the study was 15 hours (15 sessions X 60 minutes), of which no active participation was required.

In addition to the physical therapy modalities, the intervention group also performed a neck stabilization exercise protocol 3 times/week for the duration of the study. The neck stabilization exercise protocol required an average of 67.5 minutes per session, which were performed in a group setting (4-5 subjects/group) for the first 3 weeks, then performed as an independent home exercise program (HEP) for the remainder of the 12-month study. The total treatment time for the neck stabilization exercise protocol was approximately 10 hours for the first 3 weeks (9 sessions X 67.5 minutes). Thus, the total treatment time for the intervention group was 25 hours for the first 3 weeks (15 hours physical therapy modalities + 10 hours neck stabilization exercises), of which 10 hours of active participation were required. The overall treatment time for the intervention group increased monthly during the follow-up period. The HEP required 13.5 hours of active participation a month.

Study Losses: The authors presented a flow diagram that clearly showed why and when subjects dropped out. Overall, 5% of the subjects in the intervention group and 15% of the subjects in the comparison group dropped out of the study. The authors did not perform an intention-to-treat (ITT) analysis. The authors stated that no complications occurred as a result of any of the treatments and there was no indication of non-compliance with the neck stabilization HEP. The lack of an ITT analysis does create a moderate threat to the internal validity of the study, especially since the authors stated that they had a low power due to the limited number of subjects in the study.

Outcome Measures: The outcome measure most relevant to my clinical question is the VAS. The VAS is a scale from 0-10, with 0 representing no pain and 10 representing worst pain. The outcome measure was taken at 6 time points: baseline, 1 month, 3 months, 6 months, 9 months, and 12 months. The validity and reliability of the VAS were not addressed in the article, but are cited in the literature. The VAS has high test-retest reliability (interclass correlation coefficients [ICC] 0.71 to 0.99) and moderate concurrent validity (0.71 to 0.78) when compared to the VNPS.⁴ There is not a gold standard for measuring pain, which prevents any conclusive criterion validity. The VAS is considered a strong, clinically useful, reliable and valid measure of pain intensity.

Summary of Internal Validity: This study had good internal validity (PEDro score 6/10). I identified four minor threats: lack of patient and therapist blinding, lack of an ITT analysis, limited power from small group sizes, and lack of an HEP logbook to track adherence to prescribed exercise program. Of these, the strongest threat is the latter. Without knowing how compliant the subjects were with the HEP, it is unknown how critical this component is or is not to the outcomes reported.

Evidence: The VAS is the primary outcome measure that is related to my clinical question. The authors defined statistical significance to be 5%. Clinical significance on the 10-point VAS has been cited in the literature to be a 14% improvement in an outpatient population.⁶

To answer my clinical question regarding whether neck stabilization exercises are more efficacious than physical therapy modalities in decreasing insidious neck pain, first it must be determined if there was a statistically and/or clinically significant improvement within each group. There was a statistically significant improvement in the intervention group at all the measured time points. There was a statistically significant improvement in the comparison group at 1, 3, and 6 months, but not at 9 or 12 months. In addition, there was a clinically significant mean improvement in the intervention group at all the time points. There was a clinically significant mean improvement in the comparison group at 1 month, but not thereafter. In Table 4, I calculated the within-group mean percent improvement (with 95% CI) on the VAS from baseline to each time point for the intervention group and the comparison group when statistical significance was achieved.

Table 4. Within-group mean percent improvement compared to baseline (95% CI) on VAS

	Neck stabilization exercises Group	Physical therapy modalities Group
1 Month	50.7 (40.3 to 61.2)	23.2 (13.0 to 33.3)
3 Months	50.7 (40.3 to 59.7)	18.8 (4.3 to 33.3)
6 Months	46.3 (34.3 to 56.7)	15.9 (4.3 to 24.6)
9 Months	38.8 (23.9 to 52.2)	†
12 Months	46.3 (32.8 to 58.2)	†

†Not Statistically Significant

According to the 14% MCID, the intervention produced a clinically significant mean improvement at all the time points. In addition, the low end of the 95% CIs are also above the MCID at all the time points. This means that if the intervention were applied to

the population who met the inclusion criteria, we could anticipate that at least 95% of the subjects would experience clinically meaningful improvements throughout the first year. The comparison treatment produced a clinically significant mean improvement at 1 month with the low end of the 95% CI that encompasses the MCID. The comparison treatment did not produce a clinically significant mean improvement at 3 or 6 months; however, the high ends of the 95% CIs are above the 14% MCID. This means that if this same comparison treatment were applied to the population who met the inclusion criteria, we could anticipate that at least 95% of the subjects would experience clinically meaningful improvements at 1 month, and the benefit would remain in only a percentage of the subjects at 3 and 6 months.

It was unclear whether the authors performed a between-group analysis. The authors stated that a Bonferroni *post hoc* test was used to determine the change between groups when indicated, although, the aforementioned indications were not further discussed. The authors suggested that there were significant differences between the groups at 9 and 12 months. I calculated a between-group treatment effect size at 9 and 12 months. In Table 5, I present the effect sizes that I calculated between groups.

Table 5. Treatment Effect Size (95% CI)

	Effect size
9 Months	1.92 (1.13 to 2.72)
12 Months	3.35 (2.34 to 4.37)

At 9 and 12 months, the effect sizes were large and the low ends of the 95% CIs were large. If in fact there was a statistical difference between groups at 9 and 12 months, then the size of the treatment effect (that is, the effect of the neck stabilization exercises) would be of a large magnitude.

Applicability of Study Results:

Benefits vs. Costs: The benefits of the intervention exercises were demonstrated by the statistically and clinically significant improvement in neck pain levels within the group at all the time points. The decrease in neck pain was not only apparent while receiving clinical treatments, but carried forward for the rest of the year when the HEP was included. The benefits of the intervention treatment over the comparison treatment were unclear, and inasmuch do not credit nor discount the exercise intervention.

The costs associated with the exercises include the financial cost of the equipment, the therapist's time, and the subject's time. The equipment requirements were minimal and within typical means of an outpatient orthopedic clinical setting. There was no indication in the article that the subjects had to purchase any equipment for the HEP. The therapist's time was also reasonable. No extra training was required to administer the interventions and providing the intervention exercises in a group setting reduced the therapist's time requirement. During the first 3 weeks, the total treatment time for the intervention with exercises is 25 hours, of which they must actively participate in 10 of the hours. The total treatment time for the physical therapy modality only intervention is 15 hours, of which no active participation on the part of the subject is required. Thereafter, the total treatment time for the intervention with exercises increases by 13.5 hours/month due to active participation in a HEP.

Overall, the benefits of the intervention with exercises outweigh the costs. The goal of all physical therapy treatments is to provide long-term benefits that remain after the conclusion of the supervised sessions. The statistically and clinically significant improvement in the intervention group during all the follow-up periods clearly demonstrate the benefits of the intervention exercises. The total treatment time required 10 hours of active participation for the intervention exercises during the 3 weeks of supervised treatments, and the requirement of active participation continued during the 12-month follow-up period. Ten hours is within reasonable limits for an outpatient orthopedic setting and likely reasonable timeframe to gain clinically meaningful improvements in neck pain.

Feasibility of Treatment: The intervention with exercises outlined in this study would be feasible to perform in an outpatient clinical setting. The study protocol was described well enough to be reproduced. The protocol was specific with regards to treatment frequency and duration. The exercise interventions were thoroughly described and the number of sets, repetitions, rests, and resistance loads were listed. The applications of the physical therapy modalities were also clearly outlined. The requirements for clinical expertise and equipment are reasonable. The total treatment time of 25 hours is excessive for an outpatient setting. This study demonstrated that 15 hours of physical therapy modality application did not contribute to long-term decrease in neck pain. Therefore, only the 10 hours of supervised exercise interventions would be required to decrease neck pain and is a feasible time requirement for an outpatient setting. Lastly, neck stabilization exercises are feasible for subjects with neck pain to perform as noted by the authors' indication that no adverse effects occurred.

Summary of External Validity: This study has good internal validity that allows generalization of the results to adults with neck pain who meet the specified inclusion and exclusion criteria. My clinical question inquired about neck stabilization exercises versus physical therapy modalities and this study clearly addressed the comparison. The exercise intervention was conducted in a group setting, which is not what I most commonly see in my clinical setting, but it is feasible. Subjects who present with neck pain also commonly have neurological deficits from radiculopathy and accompanying pain in the scapula and/or shoulder. The presence of such signs and symptoms was an exclusion criterion and greatly reduces the applicability of the intervention to the general population of subjects with neck pain. I also see subjects with insidious neck pain who are older than age 55 – the age range in the study was 18-55 years old. It is not possible to extrapolate the results from this study to a larger population than those that meet the inclusion and exclusion criteria. A broader range of subjects needs to be studied to identify whether neck stabilization exercises can reduce neck pain.

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