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| **CRITICALLY APPRAISED TOPIC** |

**FOCUSED CLINICAL QUESTION**

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| In a 68-year-old male patient with chronic neck and radiating upper extremity pain from cervical radiculopathy, is therapeutic exercise more effective than anterior cervical fusion for reducing pain? |

**AUTHOR**

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**CLINICAL SCENARIO**

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| The patient is a 68-year-old male who was presented with neck pain radiating through right shoulder, arm, and thumb. He has had these symptoms for several years and the symptoms have progressed. He was recently diagnosed with C5 cervical radiculopathy by his neurologist. At initial PT evaluation, he had limited cervical ROM and was positive on distraction and Spurling’s tests, which was also consistent with cervical radiculopathy. Closing movements on his right caused greater pain. His surgeon talked to him about possibly performing anterior cervical fusion; however, the patient has significant anxiety of receiving medical procedures (although was willing to try physical therapy) and did not wish to undergo surgery at the time, especially since the patient was also concerned about the potential success of the surgery as the surgeon noted that there is a probability that the surgery will not improve his symptoms. He was subsequently seen by a PTA after initial evaluation for a couple of treatments. His treatment included therapeutic exercise such as neck and upper extremity stretching and strengthening exercises, but the patient did not yet have an improvement in pain. Cervical fusion may be a common option for patients with cervical spine conditions and physical therapists will likely see many patients who have received or are considering cervical spine surgery. If the patient’s symptoms do not significantly improve, cervical fusion may be an intriguing option if the patient agrees to the procedure. It will be important for therapists to understand the possible benefits of cervical fusion because this could guide referral decisions. |

**SUMMARY OF SEARCH**

[Best evidence appraised and key findings]

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| * 8 studies were found that met the inclusion/exclusion criteria, which included 7 randomized controlled trials and 1 systematic review and meta-analysis of RCTs. * All of the studies demonstrated level 1 or 2 evidence and two of the studies were highly relevant to the above clinical “PICO” question. * In general, based on the two highly relevant RCTs, both cervical spine surgery (i.e. anterior cervical decompression and fusion) and physical therapy interventions may produce statistically, but not clinically, significant improvements in neck and arm pain in individuals with chronic symptoms from cervical radiculopathy. These improvements may remain at short- and long-term follow-up. However, neither intervention is expected to produce significantly greater benefits than the other intervention over short-term or long-term follow-up. |

**CLINICAL BOTTOM LINE**

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| For a 68-year-old patient with chronic neck and upper extremity pain from cervical radiculopathy, either cervical fusion or a physical therapy intervention can be implemented to aim to reduce symptoms. Neither intervention is associated with large risks or possibilities of exacerbated symptoms, so a decision can be made according to individual patient and clinician preference and the presence of other co-morbidities and background factors. For the above patient, a physical therapy intervention may be implemented first due to the patient’s anxiety and surgery will be considered if limited improvement occurs. |

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| ***This critically appraised topic has been individually prepared as part of a course requirement and has been peer-reviewed by one other independent course instructor*** |

*The above information should fit onto the first page of your CAT*

**SEARCH STRATEGY**

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| **Terms used to guide the search strategy** | | | |
| **P**atient/Client Group | **I**ntervention (or Assessment) | **C**omparison | **O**utcome(s) |
| Cervical radiculopathy  Cervical disc | Exercise\*  Stretch\*  Strength\* | Cervical fusion  Cervical discectomy  Cervical decompression | Pain |

**Final search strategy (history):**

*Show your final search strategy (full history) from PubMed. Indicate which “line” you chose as the final search strategy.*

1. Cervical AND (radiculopathy OR disc)
2. Exercise\* OR stretch\* OR strength\*
3. Fusion OR discectomy OR decompression
4. Pain
5. #1 AND #2 AND #3 AND #4 **[79 results]**
6. “Therapeutic exercise\*” OR “physical therapy”
7. Cervical AND (fusion OR discectomy OR decompression)
8. #1 AND #6 AND #7 AND #4 **[33 results]**
9. #1 AND #6 AND #7 AND #4 [Filters: Meta-analysis, RCTs, systematic reviews] **[9 results]**
10. #1 AND (#6 OR #7) AND #4 **[1433 results]**
11. **#1 AND (#6 OR #7) AND #4 [Final search + filters below]**

*In the table below, show how many results you got from your search from each database you searched.*

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| **Databases and Sites Searched** | **Number of results** | **Limits applied, revised number of results (if applicable)** |
| **PubMed**  **CINAHL**  **Web of Science** | **1433**  **999**  **1235** | **58 –** **Meta-analysis, RCTs, systematic reviews, Aged 65+**  **21 - Meta-analysis, RCTs, systematic reviews, Aged 65+**  **6 – Search for lines #1, #7, and #4 in Title and #6 in Topic Search** |

## INCLUSION and EXCLUSION CRITERIA

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| **Inclusion Criteria** |
| Focus on randomized controlled trials, systematic reviews, and meta analyses  Studies including older adults (>65)  Subjects with chronic neck or upper extremity radiating pain  Preference for an exercise-only intervention group and a cervical fusion group  Published in English |
| **Exclusion Criteria** |
| Abstracts, case reports, case series  Studies not published in English |

**RESULTS OF SEARCH**

**Summary of articles retrieved that met inclusion and exclusion criteria**

*For each article being considered for inclusion in the CAT, score for methodological quality on an appropriate scale, categorize the level of evidence, indicate whether the relevance of the study PICO to your PICO is high/mod/low, and note the study design (e.g., RCT, systematic review, case study).*

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| **Author (Year)** | **Risk of bias (quality score)\*** | **Level of Evidence\*\*** | **Relevance** | **Study design** |
| **Engquist (2017)1** | **PEDro Score: 8/10** | **Level 1b** | **High** | **RCT** |
| **Persson (1997)2** | **PEDro Score: 8/10** | **Level 1b** | **High** | **RCT** |
| **Hisey (2015)3** | **PEDro Score: 7/10** | **Level 2b (<80% follow-up)** | **Mod** | **RCT** |
| **Radcliff (2016)4** | **PEDro Score:**  **8/10** | **Level 1b** | **Mod** | **RCT** |
| **Salt (2011)5** | **AMSTAR Score: 7/11** | **Level 1a** | **Low** | **Systematic Review and Meta-analysis of RCTs** |
| **Wirth (2000)6** | **PEDro Score: 8/10** | **Level 2b (<80% follow-up)** | **Mod** | **RCT** |
| **Zigler (2016)7** | **PEDro Score: 8/10** | **Level 1b** | **Mod** | **RCT** |
| **Kuijper (2009)8** | **PEDro Score: 7/10** | **Level 1b** | **Mod** | **RCT** |

\*Indicate tool name and score

\*\*Use Portney & Watkins Table 16.1 (2009); if downgraded, indicate reason why

**BEST EVIDENCE**

The following 2 studies were identified as the ‘best’ evidence and selected for critical appraisal. Rationale for selecting these studies were:

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| **Engquist (2017)1**   * This study compares a physical therapy intervention with an anterior cervical decompression and fusion intervention plus therapy (including therapeutic exercise), which is highly relevant to my research question. Both groups include a similar PT intervention, which may limit the direct comparison, but it could be likely that my patient would receive PT if he chose to undergo surgery. * Higher level of evidence (1b) * Lower risk of bias as evident by PEDro score (8/10) * Long follow-up period (5-8 years) and a small lost to follow-up even after 5 years (data for >85% of subjects after 5 years). * There was group crossover but an intention to treat analysis was performed * Long duration/chronicity of symptoms among subjects (mean >1 year)   **Persson (1997)2**   * This study compares a surgery intervention (anterior cervical decompression and fusion) with PT (including therapeutic exercises), which is highly relevant to my research question. It also compares a cervical collar group that is not as relevant but can serve as an active control. * Higher level of evidence (1b) * Lower risk of bias as evident by PEDro score (8/10) * Long term follow-up of 1 year with a small lost to follow-up (data for >85% of subjects at 1 year) * Like above, there was crossover but an intention to treat analysis was performed * Long duration of symptoms among subjects (mean >2 years) |

**SUMMARY OF BEST EVIDENCE**

**(1) Description and appraisal of A 5- to 8-year randomized study on the treatment of cervical radiculopathy: anterior cervical decompression and fusion plus physiotherapy versus physiotherapy alone by Engquist M, Lofgren H, Oberg B, Holtz A, Peolsson A, Soderlund A, Vavruch L, Lind B (2017)1**

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| **Aim/Objective of the Study/Systematic Review:** |
| The purpose of the study was to compare the long-term effects of an intervention that consisted of anterior cervical decompression and fusion (ACDF) and subsequent physical therapy (PT) to an intervention that only consisted of PT in individuals with cervical radiculopathy. |
| **Study Design**  [e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]  Note: For systematic review, use headings ‘search strategy’, ‘selection criteria’, ‘methods’ etc. For qualitative studies, identify data collection/analyses methods. |
| * Randomized controlled trial * Subjects were randomized and allocation was concealed using sealed envelopes * Two total groups were incorporated: an ACDF and PT, or “surgery,” intervention and a PT-only, or “non-surgery,” intervention (pg. 20) * Assessors were blinded to the subjects’ treatment group * Unspecified if subjects or therapists were blinded * Outcomes in this study were assessed at 5-8-year follow-up periods (average of 70 months after the subjects were included in the original study) based on a previous study conducted by the investigators that examined shorter-term follow-up periods.9 * These follow-up data would be compared to baseline data within and between groups, using paired, 2-sided samples t-tests set to a significance level of p<0.05 * Although not an emphasis of the study, data at 5-8-year follow-up was also compared to data at 2-year follow-up based on data from the previous study.9 |
| **Setting**  [e.g., locations such as hospital, community; rural; metropolitan; country] |
| Surgical interventions were performed at three spine specialty clinics in Sweden (cities not specified). PT interventions performed at PT clinics in Sweden.  . |
| **Participants**  [N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]  Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article. |
| * This study included 59 total subjects during the 5-8-year follow-up, although 63 subjects were initially included at the start of the original interventions. The other four subjects did not respond to outcome measures that were administered at the long-term follow-up and so are drop-outs, although they completed outcomes at 2-year follow-up * Subjects had arm pain and possibly other neuromuscular symptoms related to nerve root impairment that was diagnosed through an MRI (Magnetic Resonance Imaging) * Subjects had to be 18-65 years old and have the above symptoms that are related to one or two spinal segments for at least 8 weeks and up to 5 years * Recruitment of subjects not specified in study, but individuals who chose to undergo surgery at the three spine specialty clinics were selected in the sample * 30 subjects were randomized into the surgery group and 29 subjects were randomized into the non-surgery group. * The average age of the subjects in the overall study was 46 years (SD, 9) * Total, 30 subjects were male and 29 subjects were female. 13/30 subjects in the surgery group were male and 17/29 subjects in the non-surgery group were male. * The average duration of neck symptoms in the surgery group was 15 months (SD, 12) and non-surgery group, 21 months (SD, 19) * The average duration of arm symptoms in the surgery group was 13 months (SD, 10) and non-surgery group, 16 months (SD, 16) * No significant differences were found in any of the baseline demographic data between the two groups, including the above factors in addition to reported pain intensity, health state, and number of smokers * Seven subjects in the non-surgery group elected to receive surgery after the physical therapy-only intervention. Three of these subjects received surgery after 2-year follow-up. * No participants dropped out of the study. Data collected for all other subjects. |
| **Intervention Investigated**  [Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| Non-surgery group receiving PT-only   * Detailed description of the activities performed during the PT intervention as well as the goals of each program segment is discussed on pg.301 from a different article.10 * The program was a total of 33 weeks:10 * During the first 6 weeks of the program, subjects focused on improving posture and relaxation.10 * During the next 14 weeks, subjects performed exercises twice per week and received information related to topics such as pain, posture, stress, breathing, and self-efficacy.10 * During the last 13 weeks, subjects performed exercises at home and were encouraged to continue general physical activity independently, although a PT would be available to contact for any concerns.10 * Duration of sessions not specified * PTs administered the full intervention at a PT clinic (locations not specified)10 * Cognitive-behavioural elements were incorporated with the intervention10 * Medical exercise therapy elements were also incorporated into the intervention:10 * Improving neck motion and muscular strength and endurance10 * Improving scapular muscle motion and strength10 |
| *Experimental* |
| Surgery group receiving ACDF and PT   * An “experienced” surgeon (number of years of experience not specified but surgeons were “specialized” in performing surgeries at the cervical spine) performed the ACDF surgery (pg. 20). Four total surgeons were involved in performing an ACDF in the study. * Specific location of surgeries not provided but surgeries performed in Sweden, as noted above * 26 subjects received ACDF at one spinal level through the use of titanium implants, while 4 subjects received ACDF at two spinal levels through the use of metal cages and an anterior plate * Subjects received PT education on post-operative care while still in hospital. Topics included stretches to avoid loss of neck and shoulder motion and maintaining proper posture.10 * Subjects later participated in the PT intervention, which was identical to the PT intervention described above, no less than three months after surgery |
| **Outcome Measures**  [Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| An assessor who was blinded to treatment allocation administered the outcome measures at an unspecified location.  Primary Outcome:  Neck Disability   * Neck Disability Index: consists of 10 items in which the scores range from 0 to 5 for each item.11 Lower scores indicate less disability and higher scores indicate higher disability.11   Secondary Outcomes:  Pain Intensity **(Directly related to PICO question outcome)**   * Visual Analogue Scale (VAS): Scores range from a minimum of 0 to a maximum of 100 mm, where lower scores indicate less pain and higher scores indicate greater pain * Neck and arm pain were measured through separate measurements of the VAS * The Minimum Clinically Important Difference (MCID) for the VAS, based on patients who reported having adequate pain control in the acute setting, was considered a reduction of 30 mm.12   Patient Global Assessment   * Subjects responded to a statement related to the severity of their neck and arm symptoms, indicating that their symptoms improved, worsened, or remained the same.   Health State   * EQ-5D (Euro QOL13) questionnaire: consists of 5 questions that can be converted to a numerical score between -0.584 and 1.0. Higher scores indicate a better health state and lower scores indicate a worse health state * EQ-VAS: Similarly to the pain VAS above, scores range from 0 to 100, where lower scores indicate worse health states and better scores indicate better health states |
| **Main Findings**  [Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. You may summarize results in a table but you must explain the results with some narrative.] |
| **Pain Intensity:**   * At 5-8-year follow-up, compared to baseline, subjects in the surgery group reduced neck pain intensity on the VAS by 39 mm (95% CI, 26-53 mm) and arm pain intensity by 33 mm (95% CI, 18-49 mm). By contrast, subjects in the non-surgery group reduced both neck and arm pain intensity by 19 mm each (95% CI, 7-30 mm and 7-32 mm, respectively).   + Both intervention groups had a significant improvement in pain intensity as measured by the VAS * Likewise, the difference between groups for neck pain intensity was 21mm (95% CI, 4-37 mm) and for arm pain intensity was 14 mm (95% CI, 5-32 mm)   + Change in neck, but not arm, pain intensity was significantly different between the two intervention groups, such that the surgery group had a larger reduction in reported neck pain than the non-surgery group. * Between 5-8-year follow-up and 2-year follow-up, subjects in the surgery group reduced neck pain intensity by 4 mm (95% CI, -1 to 10 mm) and arm pain intensity by 11 mm (95% CI, 2 to 20 mm). On the other hand, subjects in the non-surgery group reduced neck pain intensity by 3 mm (95% CI, -5 to 11 mm) and arm pain intensity by 1 mm (95% CI, -9 to 12 mm)   + Only arm pain (but not neck pain) intensity significantly improved, and only within the surgery group. * Nevertheless, when comparing the changes between groups, no significant differences were found related to neck pain, which was a difference of 2 mm (95% CI, -8 to 11 mm) between groups, or arm pain, which was a difference of 9 mm (95% CI, -4 to 23 mm) between groups.   Other outcomes between 5-8-year follow-up and baseline:   * Neck Disability:   + Both groups significantly improved NDI scores, but subjects in the surgery group had a significantly better reduction in NDI scores than subjects in the non-surgery group * Patient Global Assessment:   + Significantly more subjects in the surgery group responded that their neck and arm symptoms improved rather than worsened or remaining the same * Health State:   + Both groups significantly improved EQ-5D and EQ-VAS scores from baseline to long-term follow-up, but the differences between groups were not significant   Overall, complications related to the ACDF were not observed in the study and no subject received a second surgery. |
| **Original Authors’ Conclusions**  [Paraphrase as required. If providing a direct quote, add page number] |
| In the long-term, “ACDF combined with physiotherapy reduced neck disability and neck pain more effectively than physiotherapy alone,” although both strategies may result in similar differences in arm pain (pg. 26). Also, “it is reasonable to recommend a trial of structured physiotherapy in the early phase of cervical radiculopathy before making any surgical decision (pg. 26).” |
| **Critical Appraisal** |
| **Validity**  [Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.] |
| PEDro Scale Score: 8/10:   * Random and concealed allocation to groups, similar baseline characteristics among groups, blinded assessors, key outcomes obtained from >85% of subjects initially randomized, intention-to-treat analysis explicitly performed, between-groups comparisons reported, point measures and variability reported * However, subjects and therapists who administered the therapy were not blinded   Strengths of study:   * Randomized controlled trial * Mostly even gender distribution across groups * Long duration PT intervention (33 weeks) and intervention was specifically structured but also allowed flexibility * Assessed outcomes at very long term time periods (5-8 years) * Imaging used to confirm spinal origin of symptoms * Small lost-to-follow-up * Additional data from short-term periods (i.e. 2-year) available from previous study   Limitations of study:   * Smaller sample size (59 total subjects); power analysis not performed before study. Post hoc power ranged from 30% to over 80% depending on the outcomes, but it may not be as accurate as a true power analysis * No true control group * Subjects and therapists/surgeons were not blinded but it would not be realistically possible to blind the subjects and providers based on the very large differences in the characteristics of the intervention groups * Subjects and interventions only located in Sweden * Some patient crossover from the PT-only intervention to receiving surgery * According to the authors, individuals who did not participate in the study had reported significantly less pain but longer duration of neck symptoms, which may indicate bias on individuals who participated in the study. Also, the individuals who were selected in the study were planning to undergo surgery.   Overall evidence quality:   * The main limitations appear to be sample size and the lack of a true control group, but the study has fairly high quality as it is a randomized controlled trial with long follow-up and small lost to follow-up. |
| **Interpretation of Results**  [This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.] |
| Pain intensity was not the “primary” outcome, but will be the outcome of focus for the interpretation. The other outcomes relate more to function and health status rather than pain, but the surgery group had a slight advantage in reported disability and health status, but not likely enough to influence pain implications.  Both the ACDF plus PT and the PT-only interventions appeared to produce statistically significant benefits in pain, with the surgery group having a possible advantage in improving neck pain, which is in agreement with the authors. Interestingly, only arm pain seemed to significantly improve between 2 year and long term follow-up, but not enough to create any large differences between groups. An improvement of at least 30 mm on the VAS is needed to produce clinically significant results based on the MCID. The MCID derived from the above discussed study is based on acute pain and not chronic pain as in this study, so interpretation of clinical significance using this value may not be as accurate.  The surgery group reduced neck and arm pain by greater than 30 mm at 5-8-year follow-up compared to baseline, which suggests clinical significance. The non-surgery group only reduced neck and arm pain by 19 mm each so this reduction is not likely clinically significant. The differences between groups are also <30 mm. Therefore, the ACDF plus PT may lead to clinically significant improvements in neck and arm pain over a long-term period but it should not necessarily be preferred over administering PT-only since between-group differences are smaller.  Some limitations may have mitigated the within-group and between-group effects. A larger sample size, in particular, may lead to increased power to detect change. Still, the high-quality nature of the study strengthens its conclusions.  Overall, it is not likely that negative results related to pain will occur after these interventions. Also, no adverse effects or secondary surgeries were noted in the surgery group, so high risk may not be associated with ACDF. It may not fully expected that the surgery or PT intervention will lead to clinically meaningful results, but either intervention may potentially lead to positive effects with little risks. |
| **Applicability of Study Results**  [Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.] |
| The patient in the PICO question is a 68 year old male with chronic symptoms related to cervical radiculopathy. Subjects in the study were aged 18 to 65 years old with a mean age of 46 years, which is much lower than the patient. This may decrease the generalizability of the results to the patient since it is not known if older adults may respond similarly to the surgery or PT interventions. The average duration of neck and arm symptoms in the subjects was around 15 months, which reflects a chronic nature, though it is still shorter than the several years that the patient has had symptoms. 27 of the 59 subjects in the study had symptoms related to C4-5 or C5-6 spinal segments, which is similar to the possible C5 origin of the patient. This study was performed in Sweden which may not generalize to a patient in an American clinic.  The PICO question directly compares a surgical intervention with therapeutic exercise, while this study compares surgical and PT intervention to only PT intervention. Therefore, the study cannot compare surgery or PT independently to a control group to help understand the individual effects of the intervention. Still, it would likely be expected that a patient would receive PT after a spinal surgery, so these results could relate to a likely possibility for the patient.  The PT intervention, which was individualized to the subject, included activities such as neck and scapular stretching and strengthening in addition to posture and relaxation exercises. The patient is already performing neck and upper extremity stretching and strengthening exercises in his current program, so most of the activities in this intervention could likely be applied to the patient. The PT intervention also incorporated cognitive-behavioural elements which would be interesting to consider in the clinic, but may require specialized training.  Overall, the study is still highly relevant to the PICO question and the results may be applied to some of the aspects of the patient’s scenario, but the results may not produce clinically meaningful results as discussed above. |

**(2) Description and appraisal of Long-lasting cervical radicular pain managed with surgery, physiotherapy, or a cervical collar. A prospective, randomized study by Persson LC, Carlsson CA, Carlsson JY (1997)2**

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| **Aim/Objective of the Study/Systematic Review:** |
| The purpose of the study was to examine and compare the effects of surgery, physical therapy, and cervical collar interventions administered to patients with cervical radiculopathy. |
| **Study Design**  [e.g., systematic review, cohort, randomised controlled trial, qualitative study, grounded theory. Includes information about study characteristics such as blinding and allocation concealment. When were outcomes measured, if relevant]  Note: For systematic review, use headings ‘search strategy’, ‘selection criteria’, ‘methods’ etc. For qualitative studies, identify data collection/analyses methods. |
| * Randomized controlled trial * Subjects were randomized and allocation was concealed through the use of sealed envelopes * Subjects were randomized into one of three intervention groups: surgery, PT, or cervical collar * Blinded assessor who was not involved with any of the interventions * Unspecified if subjects or therapists were blinded * Outcomes in this study were assessed at baseline (“control 1”), at 14-16 weeks after the start of treatment (“control 2”), and at 1 year after treatment (“control 3”) * Statistical significance was set at p<0.05 |
| **Setting**  [e.g., locations such as hospital, community; rural; metropolitan; country] |
| Surgeries and Assessments primarily conducted at the Neurosurgical Department of the University Hospital of Lund in Sweden. PT interventions conducted at outside outpatient clinics. |
| **Participants**  [N, diagnosis, eligibility criteria, how recruited, type of sample (e.g., purposive, random), key demographics such as mean age, gender, duration of illness/disease, and if groups in an RCT were comparable at baseline on key demographic variables; number of dropouts if relevant, number available for follow-up]  Note: This is not a list of the inclusion and exclusion criteria. This is a description of the actual sample that participated in the study. You can find this descriptive information in the text and tables in the article. |
| * 81 total subjects in the study (29 other patients did not meet all of the eligibility criteria listed below and 6 other patients refused to participate) * Subjects had to be between 18 and 65 years old and had neck and/or arm pain that lasted at least 3 months. Imaging was used to confirm nerve root compression that was related to the individual’s location of pain symptoms * Recruitment of subjects not specified in study, but the subjects were patients of the outpatient clinic of the neurosurgical department mentioned above due to cervicobrachial pain * All three intervention groups consisted of 27 subjects * The average age of the subjects in the overall study was 47.5 ± 7.9 years * 46% of the total subjects were female * The mean duration of cervicobrachial symptoms was between 28 ± 21 months and 40 ± 31 months * Statistical comparisons in baseline demographic data were not provided; however, the baseline data were visually similar according to the given information. Baseline pain data was not significantly different between groups. * Three subjects in the surgery group elected to not receive surgery due to improvement in symptoms. All subjects in other two groups received treatment as allocated. However, between control 2 and control 3, eight subjects in the surgery group received a second surgery due to continual or worsening symptoms, 11 subjects in the surgery group received PT, and 12 subjects in the collar group received PT. Also, one subject in the PT group and five subjects in the cervical collar group received surgery. * Two subject dropouts at control 3: one dropout in the surgery group and one in the collar group due to moving away or full recovery |
| **Intervention Investigated**  [Provide details of methods, who provided treatment, when and where, how many hours of treatment provided] |
| *Control* |
| Cervical collar intervention:   * Subjects tried on and selected a rigid collar that would be worn in the daytime for the following three months. It was not specified if the collar could be removed at certain times of the day. Two subjects received a new collar as they had problems with their original collar   + Types of rigid collars listed on pg. 753 and include *Lundakrage*, *Miami J Collar*, *Necky (rigid*), *Ortho-collar*, and *Philadelphia Collar* * If desired, subjects also selected a soft collar that they would wear at night   + Types of soft collar listed on pg. 753 and include *Adam*, *Camp*, and *Necky* (soft) * It is unspecified if a particular professional or staff member helped the subjects choose a collar and unclear where the subjects tried on the collars |
| *Experimental* |
| Surgery intervention:   * Subjects received ACDF, based on the “Cloward” approach.14 Any osteophytes or parts of a protruded disc were removed and purified bone served as the material for fusion * Surgery was performed at a single spinal level * The experience or specialization of the surgeons who performed the surgeries was not specified. The surgeries were performed at the University Hospital of Lund * One subject received a laminectomy by a posterior approach * Subjects would begin movement on post-op day one * Some subjects received a collar after surgery and would wear it for one or two days * None of the subjects received PT from the surgery until control 2 time period   PT intervention:   * Subjects attended one or two sessions each week for over 3 months and a total of 15 sessions. Each session was 30-45 minutes. * One of 25 PTs with experience in neck, shoulder, and arm pain administered the intervention to each subject * Subjects would receive the intervention at a clinic near their living area * Interventions were individualized to the subject. Activities included:   + Neck stretching and strengthening exercises   + Shoulder stretching exercises   + Aerobic exercises to improve endurance   + Relaxation and postural exercises   + Modalities such as heat, cold, massage, and transcutaneous electrical nerve stimulation (TENS)   + Cervical spine mobilization   + Traction |
| **Outcome Measures**  [Give details of each measure, maximum possible score and range for each measure, administered by whom, where] |
| Outcome measures were administered by a physical therapist and were completed at the above hospital or at home and mailed in a sealed envelope  Outcomes:  Pain Intensity **(Directly related to PICO question outcome)**   * Visual Analogue Scale (VAS): Scores range from a minimum of 0 to a maximum of 100 mm, where lower scores indicate less pain and higher scores indicate greater pain * Present and worse pain (no differentiation between neck and upper extremity pain) were measured through separate measurements of the VAS * The Minimum Clinically Important Difference (MCID) for the VAS, based on patients who reported having adequate pain control in the acute setting, was considered a reduction of 30 mm.12   Sickness Impact Profile (SIP)   * Measures health status based on 136 statements that are divided into 12 categories and an overall SIP score. Several of the categories are grouped into a physical dimension and a psychosocial dimension. * The physical and psychosocial dimension scores as well as the overall SIP score range from 0 to 100. Lower scores indicate better health status and higher scores indicate worse health status.   Mood Adjective Check List (MACL)   * Measures mood or mental status based on selections made on scales ranging from 1-4 that describe positive and negative mood statuses. Higher scores indicate a more positive mood status. |
| **Main Findings**  [Provide summary of mean scores/mean differences/treatment effect, 95% confidence intervals and p-values etc., where provided; you may calculate your own values if necessary/applicable. Use a table to summarize results if possible.] |
| **Pain Intensity:**  Within-group comparisons of mean reported scores:  Present Pain   |  |  |  |  | | --- | --- | --- | --- | | Intervention group | Control 1 VAS score mean (SEM) | Control 2 VAS score mean (SEM) | Control 3 VAS Score mean (SEM) | | Surgery | 47 mm (4.90) | 27 mm (4.43)\* | 30 mm (5.98) | | PT | 50 mm (3.98) | 41 mm (5.50) | 39 mm (4.96) | | Cervical Collar | 49 mm (3.83) | 48 mm (4.46) | 35 mm (4.83)\* |   \* indicates significant difference (p<0.05) in comparison to previous time period   * The only within-group significant differences were found in the surgery group at control 2 compared to control 1 and in the cervical collar group at control 3 compared to control 2.   Worst Pain   |  |  |  |  | | --- | --- | --- | --- | | Intervention group | Control 1 VAS score mean (SEM) | Control 2 VAS score mean (SEM) | Control 3 VAS Score mean (SEM) | | Surgery | 72 mm (4.10) | 43 mm (6.94)\* | 42 mm (6.07) | | PT | 70 mm (3.53) | 51 mm (5.62)\* | 53 mm (5.50) | | Cervical Collar | 68 mm (3.18) | 64 mm (4.18) | 52 mm (5.43)\* |   \* indicates significant difference (p<0.05) in comparison to the previous time period   * The only within-group significant differences were found in the surgery group at control 2 compared to control 1, in the PT group at control 2 compared to control 1, and in the cervical collar group at control 3 compared to control 2.   Between-group comparisons:   * + Present Pain     - At control 2, the surgery group reported significantly less present pain than the cervical collar group:       * Surgery group: 27 mm (SEM 4.43)       * Cervical Collar group: 48 mm (SEM 4.46)     - At control 3, there were no significant differences found between the groups in mean reported score   + Worst Pain     - At control 2, the surgery group also reported significantly lower worst pain than the collar group:       * Surgery group: 43 mm (SEM 6.94)       * Cervical Collar group: 64 mm (SEM 4.18)     - At control 3, there were no significant differences found between the groups in mean reported score   + Overall, a few significant differences were noted between the groups when comparing the change between time periods, but the above results focus on the differences in mean pain score.   SIP   * Within-group significant improvements:   + Surgery group- physical and psychosocial dimension, overall SIP at control 2; overall SIP at control 3 compared to baseline   + PT group- physical dimension and overall SIP at control 2; no significant improvements at control 3 compared to baseline   + Cervical collar group- no significant improvements in the dimensions or overall SIP at any time period * Between-group comparisons:   + There were no significant differences between groups at control 3 but the surgery and PT groups had significantly improved overall SIP scores compared to the cervical collar group at control 2   MACL   * No significant improvements were found within the three groups and no significant differences were found between the groups   Subjects who crossed-over to other groups or received a second surgery did not significantly differ from the other subjects in any of the outcomes  At control 2, 11 of the 12 categories of the SIP significantly correlated with pain intensity on the VAS |
| **Original Authors’ Conclusions**  [Paraphrase as required. If providing a direct quote, add page number] |
| Surgery, physical therapy, or use of a cervical collar were shown to produce similar benefits in pain, function, and mood status in subjects with cervical radiculopathy, especially at long-term |
| **Critical Appraisal** |
| **Validity**  [Summarize the internal and external validity of the study. Highlight key strengths and weaknesses. Comment on the overall evidence quality provided by this study.] |
| PEDro Scale Score: 8/10:   * Random and concealed allocation to groups, similar baseline characteristics among groups (although only described qualitatively by the authors), blinded assessors, key outcome obtained from >85% of subjects initially randomized (only two dropouts), intention-to-treat analysis explicitly performed (although numerous subjects crossed-over), between-groups comparisons reported, point measures and variability reported * However, subjects and therapists who administered the therapy were not blinded   Strengths of study:   * Randomized controlled trial that had a fairly large sample size of 81 subjects that had a mostly even gender distribution * Assessed outcomes at both short and long term (1 year) time periods. PT and cervical collar interventions were at least 3 months in duration * Imaging used to confirm spinal origin of symptoms * Few subject dropouts (2/81)   Limitations of study:   * No true control group, although subjects in the cervical collar group did not receive significant direct care. A waitlist or inactive control may better depict if improvements were due to the interventions or through the natural course of cervical radiculopathy * Subjects and therapists/surgeons were not blinded but it would not be realistically possible to blind the subjects and providers based on the very large differences in the characteristics of the intervention groups * Subjects and interventions only located in Sweden. Recruitment limited to patients of a single hospital clinic and were naturally already seeking treatment which could produce a bias * High crossover between groups after control 2. No significant differences were found in the subjects who crossed-over, but the crossover indicates possible dissatisfaction of a particular intervention. * No quantitative analysis provided comparing baseline characteristics although the characteristics seem similar qualitatively   Overall evidence quality:   * Quality of study is relatively strong as it is a fairly large randomized controlled trial that incorporated several methods to improve validity. Patient crossover and the lack of a true control group are likely the two largest limitations and may impact interpretation of results, but most of the limitations of the study do not appear to greatly impact the results. |
| **Interpretation of Results**  [This is YOUR interpretation of the results taking into consideration the strengths and limitations as you discussed above. Please comment on clinical significance of effect size / study findings. Describe in your own words what the results mean.] |
| Focusing on pain intensity, it appears that the three interventions all demonstrated small benefits in present and worst pain with a few reductions depicting statistical significance. Due to the few between-group differences, none of the interventions can be particularly recommended over the others. None of the groups showed a significant increase in pain at any time period, so all three interventions should likely produce positive or at least neutral results. Surgery may have some short-term benefits but 8 of 27 subjects in the surgery group underwent a second surgery, which suggests that adverse effects or undesired outcomes were likely.  A few within-group and between-group differences were found in SIP (health status) and most of the categories of the SIP interestingly had some correlations with reported pain in the short term. Still, none of these differences appear large enough to change the interpretation of the pain results.  An improvement of at least 30 mm on the VAS is needed to produce clinically significant results based on the MCID. Although this MCID again may not be fully applicable to patients with chronic pain, the pain reductions found in this study were not typically more than 15-20 mm. Only worst pain reported in the surgery group achieved an overall decrease of 30 mm (from control 1 to control 3) and could potentially be considered a clinically significant difference. Therefore, the independent improvements found in this study should largely not be considered clinically significant. Still, the fairly high quality of the study elicits confidence that the statistically significant benefits in pain are likely associated with the interventions. Reproducing relatively large benefits in the clinic may not be as readily expected. |
| **Applicability of Study Results**  [Describe the relevance and applicability of the study to your clinical question and scenario. Consider the practicality and feasibility of the intervention in your discussion of the evidence applicability.] |
| The male patient in the PICO question is 68 years old with chronic neck and upper extremity pain from cervical radiculopathy. The study includes both males and females, but the mean age of the subjects was around 48 years, which is much lower than the patient. 65 years was the maximum eligible age for the study, so the results of this study may not necessarily generalize to older adults. The subjects had cervical radiculopathy for at least 3 months and on an average of a couple of years, which resembles the chronicity of the patient in the PICO question, since he has had the symptoms for several years. The affected spinal levels were not specified in the study so it is not known how many subjects had C5 radiculopathy. Like the first study, the study was performed in Sweden and only included patients from a hospital in Sweden, so the results may not generalize to patients in American clinics.  Two of the three groups are highly relevant to the PICO question: ACDF and PT intervention. The ACDF is likely similar to the cervical fusion that the patient would receive. The PT intervention was individualized to the patient and seemed to include a wide variety of exercises to stretch and strengthen the neck and upper extremities and other modalities and manual techniques. The patient already began performing neck and upper extremity stretching and strengthening exercises which relate to many of the exercises performed in the intervention. No specific protocol was used in the study, which should improve the generalizability of the results, since a variety of activities may produce beneficial results. The potential activities listed in the study largely appear to be appropriate to conduct with the patient.  Overall, the results may apply to many aspects of the patient’s scenario, although the results may not be clinically significant to produce large change. The above study directly compares ACDF and a PT intervention, which is very similar to the PICO question and will aid the applicability of the study. |

**SYNTHESIS AND CLINICAL IMPLICATIONS**

[Synthesize the results, quality/validity, and applicability of the two studies reviewed for the CAT. Future implications for research should be addressed briefly. Limit: 1 page.]

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| Both studies analysed in the CAT have several similarities. Both were fairly high-quality and highly relevant randomized controlled trials that assessed long-term outcomes, although the study by Engquist et al. used a much longer follow-up.1,2 Overall, the results of both studies would suggest that ACDF and PT interventions can improve neck or arm pain in the short or long term, but the results may not be clinically meaningful. Neither intervention can be specifically recommended over the other intervention in improving pain and the choice in treatment may be based on the specific clinical scenario.  One of the largest challenges in the patient scenario in the PICO question is that the patient has anxiety of many medical treatments, including surgery. While he is willing to try physical therapy, it is not known if he would commit to a long duration intervention, such as the 33 weeks intensive PT intervention in the Engquist et al. study.1 He is certainly hesitant about undergoing surgery and is concerned about potential successes and risks of ACDF. There was a higher risk of second surgery in the Persson et al. study,2 but the overall risk of adverse effects of ACDF or PT intervention appears low.  Similar to a conclusion made by Engquist et al., it would likely be appropriate to try a PT intervention before undergoing surgery.1 If surgery is implemented, a PT intervention after surgery should likely be initiated since the surgery plus PT intervention in the first study seemed to produce slightly better reduction in pain than the independent surgery intervention in the second study.1,2 Continuing PT treatment for the patient before strongly considering surgery may be even more appropriate as he was not very comfortable in currently electing surgery. If PT does not improve his neck and upper extremity symptoms after a couple of months, resembling the length of the above studies, then surgery may be considered.  Future research should focus on more direct comparisons between ACDF and PT interventions. Only the above two studies were found that compared these types of interventions, although a major limitation in both studies was the lack of a true control group.1,2 If these interventions could be independently compared to a true waitlist or inactive control group, then the study may better depict if improvements were due to the interventions or through the natural course of cervical radiculopathy.2 Studies with larger sample sizes from more diverse geographical areas and age groups could also help improve the generalizability of the results. Both studies had sample sizes of less than 100 subjects and were conducted in Sweden, and neither study included older adults. The parameters of the interventions appear appropriate and blinding of the subject and provider will not be realistically possible. In general, more high-quality randomized controlled trials (and systematic reviews and meta-analyses when appropriate) related to comparing cervical spine surgery and PT interventions can help determine if there is a potentially more effective treatment and if there are optimal characteristics or structures of the treatment. |

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[List all references cited in the CAT]

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