The effect of minimally invasive posterior cervical approaches versus open anterior approaches on neck pain and disability

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The effect of minimally invasive posterior cervical approaches versus open anterior approaches on neck pain and disability

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Abstract

Background: The choice of surgical approach to the cervical spine may have an influence on patient outcome, particularly with respect to future neck pain and disability. Some surgeons suggest that patients with myelopathy or radiculopathy and significant axial pain should be treated with an anterior interbody fusion because a posterior decompression alone may exacerbate the patients’ neck pain. To date, the effect of a minimally invasive posterior cervical decompression approach (miPCD) on neck pain has not been compared with that of an anterior cervical disectomy or corpectomy with interbody fusion (ACF).

Methods: A retrospective review was undertaken of 63 patients undergoing either an miPCD (n = 35) or ACF (n = 28) for treatment of myelopathy or radiculopathy who had achieved a minimum of 6 months’ follow-up. Clinical outcomes were assessed by a patient-derived neck visual analog scale (VAS) score and the neck disability index (NDI). Outcomes were analyzed by use of (1) a threshold in which outcomes were classified as success (NDI < 40, VAS score < 4.0) or failure (NDI > 40, VAS score > 4.0) and (2) perioperative change in which outcomes were classified as success (ΔNDI ≥ −15, ΔVAS score ≥ −2.0) or failure (ΔNDI < −15, ΔVAS score < −2.0). Groups were compared by use of χ² tests with significance taken at P < .05.

Results: At last follow-up, the percentages of patients classified as successful using the perioperative change criteria were as follows: 42% for miPCD group versus 63% for ACF group based on neck VAS score (P = not significant [NS]) and 33% for miPCD group versus 50% for ACF group based on NDI (P < .05). At last follow-up, the percentages of patients classified as successful using the threshold criteria were as follows: 71% for miPCD group versus 82% for ACF group based on neck VAS score (P = NS) and 69% for miPCD group versus 68% for ACF group based on NDI (P = NS).

Conclusions: In this small retrospective analysis, miPCD was associated with similar neck pain and disability to ACF. Given the avoidance of cervical instrumentation and interbody fusion in the miPCD group, these results suggest that further comparative effectiveness study is warranted.

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Keywords: Cervical spine; Fusion; Minimally invasive; Neck pain; Outcome; Spine
a retrospective chart review of 63 patients who underwent surgery for cervical myelopathy or cervical radiculopathy and had a minimum of 6 months of clinical follow-up. The indication for surgical intervention was based on the presence and severity of myelopathy and/or radiculopathy. No patient underwent surgery specifically for neck pain. The following data were abstracted from the medical records:

1. Demographics: age (in years), sex (male or female), weight (in pounds), height (in inches), and body mass index (in kilograms per square meter)
2. Medical factors: indication for surgery (radiculopathy or myelopathy), self-reported medical comorbidities (type), number of medical comorbidities, Charlson index, type of surgery (description), and preadmission medications (type and dose)
3. Social factors: tobacco use (yes/no), alcohol use (daily, weekly, monthly, annually, never), highest educational degree (none, high school, undergraduate, graduate), and work status (employed, unemployed, retired, disabled)
4. Psychiatric factors: self-reported psychiatric comorbidities (name), number of psychiatric comorbidities, and use of psychiatric medication (yes/no, type)
5. Surgical factors: date of surgery, type of surgery (description), tube length (in centimeters), tube diameter (in millimeters), level of decompression (C1–C7), number of levels decompressed, side (right, left, bilateral), foraminotomy (yes/no), estimated blood loss (in milliliters), blood transfusion (yes/no), intraoperative fluids (in milliliters), intraoperative urine output (in milliliters), and operative time (in hours)

6. Complications: length of stay (in days), disposition (home, inpatient rehabilitation, long-term nursing facility), neurologic deficit (yes/no, type), cerebrospinal fluid leak (yes/no), wound complication (yes/no), medical complication (name), need for readmission (yes/no, reason), and need for further surgery (yes/no, reason)
7. Patient-derived clinical outcome measures (measured preoperatively and postoperatively): neck disability index (NDI) (0–100), neck visual analog scale (VAS) score (0–10), Short Form 12 physical component scale (SF-12 PCS) (0–60), Short Form 12 mental component scale (SF-12 MCS) (0–60), Prolo scale (0–5), and patient satisfaction index (1–5)

Analysis of clinical outcomes

The primary outcome measures of this analysis are neck VAS score and NDI. The datasets were analyzed by 1 of 2 methods: a threshold analysis and a change analysis.

In the threshold method the outcome measures at 6 months, 12 months, and last contact were dichotomized as either success or failure for both neck VAS score (success, <4.0; failure, ≥4.1) and NDI (success, <40.0; failure,
The percentage of patients achieving success was then compared between the groups. In the change method the outcome measures at 6 months, 12 months, and last contact were dichotomized as either success or failure for both neck VAS score (success, ≥2.1; failure, <2.0) and NDI (success, ≥21; failure, <20). The percentage of patients achieving success was then compared between the groups.

Secondary outcome measures were also noted for SF-12 PCS (0–60), SF-12 MCS (0–60), Prolo scale (0–5), and patient satisfaction index (1–5). In this analysis means ± standard deviations are reported and compared.

Statistical methods

All data are reported as means ± standard deviations as well as percentages. Categorical variables were compared by use of χ² tests, and continuous variables were compared by use of t tests. Statistical significance was taken at P < .05.

Results

Baseline characteristics

Data regarding demographics, work status, medical history, and medications are presented in Tables 1 through 4. No statistically significant differences were identified at baseline. Preoperative outcome scores are shown in Table 5, with no statistical differences identified between the groups.

Surgical factors, length of stay, and disposition

Surgical factors are summarized in Table 6. The results showed anticipated statistical differences with respect to the number of levels decompressed, the use of fusion, the use of foraminotomy, and the use of spinal instrumentation. It should be noted that the patient who received a blood transfusion did so on the basis of a low preoperative hematocrit level and a history of coronary artery disease, not on the basis of intraoperative blood loss. Whereas length of stay did not differ significantly between the groups (Table 7), the percentage of patients requiring inpatient rehabilitation was statistically higher in the group undergoing the minimally invasive posterior cervical decompression approach, likely because of a greater number of patients with moderate and severe myelopathy at baseline (data not shown).

Analysis of clinical outcomes

The clinical outcomes are summarized in Table 5 and Tables 8 through 14. Baseline VAS, NDI, SF-12 PCS, and SF-12 MCS scores were statistically similar between the 2 groups (Table 5). The results of the threshold analysis are summarized in Tables 9 and 11. A statistical difference was
noted between the groups with respect to 2-year NDI outcome. The results of the perioperative change analysis are summarized in Tables 8 and 10. A statistical difference was noted between the groups with respect to 2-year NDI outcomes. No statistically significant differences were noted between the groups with respect to patient satisfaction, SF-12 PCS score, or SF-12 MCS score.

Discussion

Study limitations

This analysis is a small retrospective analysis from a single surgeon’s experience and suffers from all the traditional shortcomings of such studies. The cohort is nonrandomized, includes patients with both radiculopathy and myelopathy, and has incomplete follow-up and incomplete patient-derived outcome data. Despite these limitations, the study does use appropriate patient-derived outcome measures as recommended by evidence-based reviews\(^4\) and attempts to address a deficiency within the literature by comparing outcomes for patients having 2 different surgical approaches to their cervical spine pathology.\(^1-3\) At baseline, the groups were well matched especially with respect to depression, which may have a significant effect on patient-reported outcome.\(^5\)

Does fusion help improve neck pain?

Many surgeons suggest that patients with myelopathy or radiculopathy and significant axial pain should be treated...
with an anterior interbody fusion, because a posterior de-
compensation alone may exacerbate the patients’ neck pain,
yet there is little evidence-based literature on which to base
this suggestion. Indeed, in a follow-up to the original article
by Smith and Robinson, it was noted, “There was no clear
 correlation after operation between absence of fusion at the
interspaces and the clinical result.” The foundation for this
suggestion is likely based on expert opinion or studies with
a low level of evidence, rather than adequate analysis of
clinical outcomes. Recent evidence-based reviews have pro-
vided no evidence to support or refute this suggestion. The
reviews also note a paucity of comparative outcomes data,
especially given the number of cases performed each year in the United States. In our study no patient
underwent surgery for axial complaints alone, and in all
cases the patient manifested a neurologic concern as the
indication for surgery.

This study suggests that a minimally invasive approach
that largely preserves muscular and ligamentous attach-
ments may result in similar clinical outcomes to an open
anterior cervical approach that uses interbody fusion and
instrumentation. Accordingly, our results suggest the need
for further comparative effectiveness study. Indeed, we are
in the process of extending our observations and collecting
hospital resource use data to further address the question of
clinical outcomes. Recent evidence-based reviews have pro-
vided no evidence to support or refute this suggestion. The
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especially given the number of cases performed each year in the United States. In our study no patient
underwent surgery for axial complaints alone, and in all
cases the patient manifested a neurologic concern as the
indication for surgery.

Several studies have shown the effectiveness of a mini-
mally invasive approach to posterior foraminotomy in pro-
viding relief of radiculopathy. One study has compared
the effectiveness of a minimally invasive approach for pos-
terior foraminotomy with an open approach. Using non-
validated outcome measures, the authors suggested equiva-
 lent outcomes. Thus it appears that a minimally invasive
approach to posterior cervical foraminotomy can provide
relief from cervical radiculopathy.

Few studies have provided comparative data between an
anterior cervical approach and a posterior cervical approach
for the treatment of degenerative cervical spine disease. The
2 studies that have provided data for a comparison between
anterior and posterior cervical surgery did not use a mini-
mally invasive approach to foraminotomy, did not use valid-
ated outcome tools, and accordingly, were thought to
represent class III data. Our study, though retrospective,
does use validated outcome tools and does make an attempt
to compare 2 commonly applied surgical approaches in
terms of their effect on neck disability and pain.

Future implications

No surgical approach can replace sound clinical diagno-
sis and surgical decision making. Indeed, it is unlikely that
the technical factors of surgery for cervical radiculopathy or
myelopathy would contribute to clinical outcome more than
the surgical decision-making process. Despite this caution,
there is mounting evidence to suggest that minimally invasive surgery may have advantages over an open surgical alternative. These advantages may include a lower risk of infection,12–14 a lower risk of symptomatic cerebrospinal fluid leak, a lower risk of new perioperative neurologic deficit,15 and a lower overall complication rate.16 These potential advantages do not necessarily guarantee similar short- or long-term clinical outcomes, and to date, there is little evidence to support the use of a minimally invasive approach over an open approach. Unfortunately, the approach recommended to the patient may rest more upon the comfort level of the treating surgeon or, more cynically, the financial motive of the treating surgeon, rather than clinical outcome data. Ideally, the decision should not be limited by either the surgeon’s expertise or the associated reimbursement. The decision should be directed at affording the patient the best possible clinical outcome. If, however, 2 procedures can provide similar clinical outcomes, then the relative healthcare resource utilization and cost should be taken into account. At this juncture, the comparative effectiveness of the 2 techniques should be taken into account and the more effective technique applied as often as appropriate, thus also affording a potential societal benefit.

### Table 12

<table>
<thead>
<tr>
<th>Follow-up period</th>
<th>miPCD</th>
<th>ACF</th>
<th>Statistical significance</th>
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</thead>
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<tr>
<td>No. of patients</td>
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<td>Patient satisfaction index (mean ± SD)</td>
<td>3.80 ± 1.20</td>
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<tr>
<td>No. of patients</td>
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<td>Patient satisfaction index (mean ± SD)</td>
<td>3.92 ± 1.49</td>
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<td>Length (mean ± SD) (y)</td>
<td>2.7 ± 1.0</td>
<td>2.6 ± 0.8</td>
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</tbody>
</table>

**Abbreviations:** ACF, anterior cervical diskectomy or corpectomy with interbody fusion; miPCD, minimally invasive posterior cervical decompression; NS, not significant.

### Table 13

<table>
<thead>
<tr>
<th>Follow-up period</th>
<th>miPCD</th>
<th>ACF</th>
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</tr>
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<tr>
<td>No. of patients</td>
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<tr>
<td>SF-12 PCS (mean ± SD)</td>
<td>7.4 ± 9.9</td>
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<tr>
<td>No. of patients</td>
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<tr>
<td>SF-12 PCS (mean ± SD)</td>
<td>2.8 ± 10.7</td>
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<td>No. of patients</td>
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<td>4.8 ± 8.4</td>
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<tr>
<td>Mean ± SD</td>
<td>3.9 ± 9.3</td>
<td>5.7 ± 10.4</td>
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<tr>
<td>Length (mean ± SD) (y)</td>
<td>1.7 ± 1.2</td>
<td>1.4 ± 0.9</td>
<td>P = NS</td>
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</table>

**Abbreviations:** ACF, anterior cervical diskectomy or corpectomy with interbody fusion; miPCD, minimally invasive posterior cervical decompression; NS, not significant.

### Table 14

<table>
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<th>ACF</th>
<th>Statistical significance</th>
</tr>
</thead>
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<td></td>
<td></td>
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<tr>
<td>No. of patients</td>
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<td>10</td>
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<tr>
<td>SF-12 MCS (mean ± SD)</td>
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<tr>
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<td>1.7 ± 1.3</td>
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<td>P = NS</td>
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</tbody>
</table>

**Abbreviations:** ACF, anterior cervical diskectomy or corpectomy with interbody fusion; miPCD, minimally invasive posterior cervical decompression; NS, not significant.

References


