INTERNATIONAL JOURNAL of SPINE SURGERY

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

Jeffrey A. Steinberg and John W. German

Int J Spine Surg 2012, 6 () 55-61
doi: https://doi.org/10.1016/j.ijsp.2011.11.003
https://www.ijssurgery.com/content/6/55

The International Journal of Spine Surgery
2397 Waterbury Circle, Suite 1,
Aurora, IL 60504, Phone: +1-630-375-1432

Available online at www.sciencedirect.com

SciVerse ScienceDirect

International Journal of Spine Surgery 6 (2012) 55–61

INTERNATIONAL SOCIETY for the ADVANCEMENT of SPINE SURGERY
www.sasjournal.com

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

Jeffrey A. Steinberg, BS, John W. German, MD *

Division of Neurosurgery, Albany Medical Center, Albany, NY

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 diskectomy 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 χ^2 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.

Keywords: Cervical spine; Fusion; Minimally invasive; Neck pain; Outcome; Spine

The choice of surgical approach to the cervical spine may have an influence on patient outcome, particularly with respect to 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. The basis for such a recommendation may be predicated on expert opinion or low-evidence studies and not an analysis of comparative clinical outcomes. Indeed, large evidence-based reviews have not been able to conclude that either a dorsal or ventral approach is superior to the other with respect to clinical outcome.[1–3] These reviews have also underscored the need for improved comparative outcome information regarding techniques used to surgically address cervical spinal pathology. Moreover, these reviews have specifically suggested the use of validated patient-reported outcome questionnaires, which have been largely lacking in the literature.[4] To date, no study has been published that has compared the effect of a minimally invasive dorsal approach with that of a ventral approach. This study presents the senior author's experience.

Methods

This study was approved by the Institutional Review Board of Albany Medical Center, Albany, New York. It is

* Corresponding author: John W. German, MD, Division of Neurosurgery, Albany Medical Center, 47 New Scotland Ave, MC 61-NE, Albany, NY 12208; Tel: 518-262-5088; Fax: 518-262-5400.

E-mail address: GermanJ@mail.amc.edu

2211-4599 © 2012 ISASS - International Society for the Advancement of Spine Surgery. Published by Elsevier Inc. All rights reserved.
10.1016/j.ijsp.2011.11.003

Table 1
Demographics

	miPCD (n = 35)	ACF (n = 28)	Statistical significance
Sex	24 M and 11 F	14 M and 14 F	*P* = NS
Age (mean ± SD) (y)	53. 4 ± 14.9	50.2 ± 8.1	*P* = NS
BMI (mean ± SD) (kg/m^2)	27.9 ± 4.0	30.1 ± 5.78	*P* = NS

Abbreviations: ACF, anterior cervical diskectomy or corpectomy with interbody fusion; BMI, body mass index; F, female; M, male; miPCD, minimally invasive posterior cervical decompression; NS, not significant.

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)

Table 2
Work status

	miPCD (n = 35)	ACF (n = 28)	Statistical significance
Employed (n)	16 (46%)	13 (46%)	*P* = NS
Not employed (n)	5 (14%)	8 (29%)	*P* = NS
Disabled (n)	7 (20%)	3 (11%)	*P* = NS
Retired (n)	7 (20%)	4 (14%)	*P* = NS

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

Table 3
Medical history

	miPCD (n = 35)	ACF (n = 28)	Statistical significance
No. of comorbidities (mean ± SD)	2.9 ± 2.6	2.7 ± 1.6	*P* = NS
Charlson index (mean ± SD)	1.9 ± 1.9	1.6 ± 1.3	*P* = NS
Depression (n)	6 (17%)	9 (32%)	*P* = NS
Anxiety (n)	3 (8.5%)	2 (7%)	*P* = NS
Other psychiatric illness (n)	2 (6%)	1 (3.5%)	*P* = NS
Tobacco use (n)	14 (40%)	10 (36%)	*P* = NS
Ethanol use (n)	18 (51%)	9 (32%)	*P* = NS
Drug allergies (n)	11 (31%)	9 (43%)	*P* = NS

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

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, $\geq$4.1) and NDI (success, $<$40.0; failure,

Table 4
Medications

	miPCD (n = 35)	ACF (n = 28)	Statistical significance
Narcotics (n)	9 (26%)	6 (21%)	*P* = NS
NSAIDs (n)	21 (60%)	18 (64%)	*P* = NS
Acetaminophen (n)	7 (20%)	3 (11%)	*P* = NS
Muscle relaxants (n)	7 (20%)	8 (29%)	*P* = NS
Anticonvulsants (n)	4 (11%)	6 (20%)	*P* = NS
Psychiatric medications (n)	10 (29%)	11 (39%)	*P* = NS

Abbreviations: ACF, anterior cervical diskectomy or corpectomy with interbody fusion; miPCD, minimally invasive posterior cervical decompression; NS, not significant; NSAIDs, nonsteroidal anti-inflammatory drugs.

Table 5
Preoperative outcome index scores

	miPCD	ACF	Statistical significance
NDI (mean ± SD)	42.70 ± 21.34 (n = 27)	47.32 ± 16.68 (n = 22)	*P* = NS
Neck VAS score (mean ± SD)	4.93 ± 2.98 (n = 24)	5.24 ± 2.32 (n = 19)	*P* = NS
SF-12 PCS (mean ± SD)	32.33 ± 8.73 (n = 23)	31.85 ± 7.91 (n = 15)	*P* = NS
SF-12 MCS (mean ± SD)	43.38 ± 12.71 (n = 23)	41.90 ± 11.66 (n = 15)	*P* = NS

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

≥41.0). 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 χ^2 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

Table 6
Operative data

	miPCD (n = 35)	ACF (n = 28)	Statistical significance
No. of levels decompressed (mean ± SD)	2.1 ± 0.9	1.5 ± 0.8	*P* <.05
Fusion (n)	1 (3.0%)	28 (100%)	*P* <.05
Foraminotomy (n)	14 (40%)	17 (61%)	*P* = NS
Instrumentation (n)	1 (3.0%)	27 (96%)	*P* <.05
IVF (mean ± SD) (mL)	2377 ± 693	2330 ± 724	*P* = NS
Urine output (mean ± SD) (mL)	384 ± 243	400 ± 309	*P* = NS
Estimated blood loss (mean ± SD) (mL)	98 ± 131	103 ± 127	*P* = NS
Blood transfusion (n)	1 (3.0%)	0 (0.0%)	*P* = NS
CSF leak (n)	0 (0.0%)	0 (0.0%)	*P* = NS
Procedure time (mean ± SD) (min)	187 ± 80 (n = 32)	164 ± 56 (n = 27)	*P* = NS
Case time (mean ± SD) (min)	270 ± 85 (n = 32)	243 ± 59 (n = 27)	*P* = NS
Wound complications (n)	0 (0.0%)	1 (3.5%)	*P* = NS
Need for further surgery (n)	0 (0.0%)	2 (7.0%)	*P* = NS

Abbreviations: ACF, anterior cervical diskectomy or corpectomy with interbody fusion; CSF, cerebrospinal fluid; IVF, intravenous fluid; miPCD, minimally invasive posterior cervical decompression; NS, not significant.

Table 7
Length of stay and disposition

	miPCD (n = 35)	ACF (n = 28)	Statistical significance
Length of stay (mean ± SD) (d)	2.0 ± 1.7	1.9 ± 1.2	P = NS
Discharge home (n)	24 (68.5%)	26 (93%)	$P < .05$

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

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]

Table 9
Threshold analysis for NDI

Follow-up period	miPCD	ACF	Statistical significance
6 mo			P = NS
No. of patients	21	18	
NDI (mean ± SD)	26.47 ± 24.56	27.55 ± 17.29	
Success rate	71%	72%	
1 y			P = NS
No. of patients	28	18	
NDI (mean ± SD)	34.28 ± 24.22	35.00 ± 21.50	
Success rate	61%	61%	
≥2 y			$P < .05$
No. of patients	15	13	
NDI (mean ± SD)	41.06 ± 21.26	20.61 ± 14.77	
Length (mean ± SD) (y)	2.6 ± 1.1	2.5 ± 0.8	
Success rate	60%	92%	
Last			P = NS
No. of patients	35	28	
NDI (mean ± SD)	32.48 ± 21.06	31.51 ± 21.18	
Length (mean ± SD) (y)	1.7 ± 1.2	1.7 ± 1.0	
Success rate	69%	68%	

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

Does fusion help improve neck pain?

Many surgeons suggest that patients with myelopathy or radiculopathy and significant axial pain should be treated

Table 8
Perioperative change in NDI

Follow-up period	miPCD	ACF	Statistical significance
6 mo			P = NS
No. of patients	18	13	
Change in NDI (mean ± SD)	−15.10 ± 14.90	−11.76 ± 16.73	
Success rate	44%	31%	
1 y			P = NS
No. of patients	21	13	
Change in NDI (mean ± SD)	−9.42 ± 15.96	−10.69 ± 18.98	
Success rate	38%	31%	
≥2 y			$P < .05$
No. of patients	12	11	
Change in NDI (mean ± SD)	−10.41 ± 14.65	−24.36 ± 15.76	
Length (mean ± SD) (y)	2.9 ± 1.0	2.4 ± 0.7	
Success rate	42%	72%	
Last			P = NS
No. of patients	27	22	
Change in NDI (mean ± SD)	−9.22 ± 13.45	−14.77 ± 18.57	
Length (mean ± SD) (y)	1.8 ± 1.2	1.7 ± 1.0	
Success rate	33%	50%	

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

Table 10
Perioperative change in neck VAS score

Follow-up period	miPCD	ACF	Statistical significance
6 mo			P = NS
No. of patients	16	10	
Neck VAS score (mean ± SD)	−2.03 ± 2.64	−2.29 ± 1.65	
Success rate	62.5%	70%	
1 y			P = NS
No. of patients	20	11	
Neck VAS score (mean ± SD)	−1.93 ± 3.14	−2.39 ± 3.14	
Success rate	45%	45%	
≥2 y			P = NS
No. of patients	11	7	
Neck VAS score (mean ± SD)	−1.08 ± 3.73	−3.68 ± 3.37	
Length (mean ± SD) (y)	2.8 ± 1.0	2.2 ± 0.4	
Success rate	45%	85%	
Last			P = NS
No. of patients	24	19	
Neck VAS score (mean ± SD)	−1.65 ± 3.11	−2.67 ± 3.00	
Length (mean ± SD) (y)	1.8 ± 1.2	1.4 ± 0.8	
Success rate	42%	63%	

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

with an anterior interbody fusion, because a posterior decompression 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,[6] it was noted, "There was no clear correlation after operation between absence of fusion at the interspaces and the clinical result."[7] The foundation for this suggestion is likely based on expert opinion or studies with a low level of evidence[3,8] rather than adequate analysis of clinical outcomes. Recent evidence-based reviews have provided no evidence to support or refute this suggestion. The reviews also note a paucity of comparative outcomes data,[1–3] 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 attachments 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 comparative effectiveness.

Several studies have shown the effectiveness of a minimally invasive approach to posterior foraminotomy in providing relief of radiculopathy.[9,10] One study has compared the effectiveness of a minimally invasive approach for posterior foraminotomy with an open approach.[10] Using nonvalidated outcome measures, the authors suggested equivalent 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 minimally invasive approach to foraminotomy, did not use validated outcome tools, and accordingly, were thought to represent class III data.[8,11] 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 diagnosis 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,

Table 11
Threshold analysis for neck VAS score

Follow-up period	miPCD	ACF	Statistical significance
6 mo			P = NS
No. of patients	20	17	
Neck VAS score (mean ± SD)	2.77 ± 2.98	2.23 ± 2.47	
Success rate	70%	82%	
1 y			P = NS
No. of patients	28	18	
Neck VAS score (mean ± SD)	2.70 ± 2.80	2.36 ± 2.37	
Success rate	75%	78%	
≥2 y			P = NS
No. of patients	15	12	
Neck VAS score (mean ± SD)	3.28 ± 3.15	1.37 ± 2.05	
Length (mean ± SD)	2.7 ± 0.9 y	2.6 ± 0.8 y	
Success rate	66%	91%	
Last			P = NS
No. of patients	35	28	
Neck VAS score (mean ± SD)	2.62 ± 2.81	2.21 ± 2.46	
Length (mean ± SD)	1.7 ± 1.1 y	1.6 ± 1.0 y	
Success rate	71%	82%	

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

Table 12
Patient satisfaction index

Follow-up period	miPCD	ACF	Statistical significance
6 mo			P = NS
No. of patients	17	16	
Patient satisfaction index (mean ± SD)	4.29 ± 0.98	4.0 ± 0.96	
1 y			P = NS
No. of patients	28	17	
Patient satisfaction index (mean ± SD)	3.80 ± 1.20	3.76 ± 1.25	
≥2 y			P = NS
No. of patients	14	12	
Patient satisfaction index (mean ± SD)	3.92 ± 1.49	4.25 ± 0.86	
Length (mean ± SD) (y)	2.7 ± 1.0	2.6 ± 0.8	
Last			P = NS
No. of patients	35	28	
Patient satisfaction index (mean ± SD)	4.00 ± 1.18	3.82 ± 1.18	
Length (mean ± SD) (y)	1.7 ± 1.1	1.6 ± 1.0	

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

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

Table 13
Perioperative change in SF-12 PCS

Follow-up period	miPCD	ACF	Statistical significance
6 mo			P = NS
No. of patients	10	10	
SF-12 PCS (mean ± SD)	7.4 ± 9.9	3.6 ± 9.3	
1 y			P = NS
No. of patients	17	6	
SF-12 PCS (mean ± SD)	2.8 ± 10.7	6.3 ± 7.2	
≥2 y			P = NS
No. of patients	9	8	
SF-12 PCS (mean ± SD)	4.8 ± 8.4	5.0 ± 10.3	
Length (mean ± SD) (y)	2.9 ± 1.2	2.0 ± 0.8	
Last			P = NS
No. of patients	23	15	
Mean ± SD	3.9 ± 9.3	5.7 ± 10.4	
Length (mean ± SD) (y)	1.7 ± 1.2	1.4 ± 0.9	

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

Table 14
Perioperative change in SF-12 MCS

Follow-up period	miPCD	ACF	Statistical significance
6 mo			P = NS
No. of patients	10	10	
SF-12 MCS (mean ± SD)	5.85 ± 14.72	2.34 ± 12.79	
1 y			P = NS
No. of patients	17	6	
SF-12 MCS (mean ± SD)	6.0 ± 11.07	5.48 ± 17.6	
≥2 y			P = NS
No. of patients	9	8	
SF-12 MCS (mean ± SD)	7.83 ± 11.25	10.28 ± 11.53	
Length (mean ± SD) (y)	2.9 ± 1.2	2.3 ± 0.4	
Last			P = NS
No. of patients	23	15	
SF-12 MCS (mean ± SD)	5.14 ± 10.99	8.70 ± 12.11	
Length (mean ± SD) (y)	1.7 ± 1.3	1.5 ± 0.9	

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

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.

References

1. Bono CM, Ghiselli G, Gilbert TJ, et al. An evidence-based clinical guideline for the diagnosis and treatment of cervical radiculopathy from degenerative disorders. *Spine J* 2011;11:64–72.
2. Heary RF, Ryken TC, Matz PG, et al. Cervical laminoforaminotomy for the treatment of cervical degenerative radiculopathy. *J Neurosurg Spine* 2009;11:198–202.
3. Matz PG, Holly LT, Groff MW, et al. Indications for anterior cervical decompression for the treatment of cervical degenerative radiculopathy. *J Neurosurg Spine* 2009;11:174–82.
4. Holly LT, Matz PG, Anderson PA, et al. Functional outcomes assessment for cervical degenerative disease. *J Neurosurg Spine* 2009;11:238–44.

5. Daubs MD, Patel AA, Willick SE, et al. Clinical impression versus standardized questionnaire: the spinal surgeon's ability to assess psychological distress. *J Bone Joint Surg Am* 2010;92:2878–83.
6. Smith GW, Robinson RA. The treatment of certain cervical-spine disorders by anterior removal of the intervertebral disc and interbody fusion. *J Bone Joint Surg Am* 1958;40:607–24.
7. Robinson RA, Walker AE, Ferlic DC, Wiecking DK. The results of anterior interbody fusion of the cervical spine. *J Bone Joint Surg Am* 1962;44:1569–87.
8. Herkowitz HN, Kurz LT, Overholt DP. Surgical management of cervical soft disc herniation: a comparison between the anterior and posterior approach. *Spine (Phila Pa 1976)* 1990;15:1026–30.
9. Adamson TE. Microendoscopic posterior cervical laminoforaminotomy for unilateral radiculopathy: results of a new technique in 100 cases. *J Neurosurg* 2001;95:51–7.
10. Fessler RG, Khoo LT. Minimally invasive cervical microendoscopic foraminotomy: an initial clinical experience. *Neurosurgery* 2002; 51(Suppl 5):S37–45.
11. Korinth MC, Kruger A, Oertel MF, Gilsbach JM. Posterior foraminotomy or anterior discectomy with polymethylmethacrylate interbody stabilization for cervical soft disc disease: results in 292 patients with monoradiculopathy. *Spine (Phila Pa 1976)* 2006;31:1207–16.
12. O'Toole JE, Eichholz KM, Fessler RG. Surgical site infection rates after minimally invasive spinal surgery. *J Neurosurg Spine* 2009;11: 471–6.
13. Parker SL, Adogwa O, Witham TF, Aaronson OS, Cheng J, McGirt MJ. Post-operative infection after minimally invasive versus open transforaminal lumbar interbody fusion (TLIF): literature review and cost analysis. *Minim Invasive Neurosurg* 2011;54:33–7.
14. Smith JS, Shaffrey CI, Sansur CA, et al. Rates of infection after spine surgery based on 108,419 procedures: a report from the Scoliosis Research Society Morbidity and Mortality Committee. *Spine (Phila Pa 1976)* 2011;36:556–63.
15. Hamilton DK, Smith JS, Sansur CA, et al. Rates of new neurological deficit associated with spine surgery based on 108,419 procedures: a report of the Scoliosis Research Society Morbidity and Mortality Committee. *Spine (Phila Pa 1976))* 2011;36:1218–28.
16. Fu KM, Smith JS, Polly DW Jr, et al. Morbidity and mortality in the surgical treatment of 10,329 adults with degenerative lumbar stenosis. *J Neurosurg Spine* 2010;12:443–6.