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Clinical Study

The duration of symptoms and clinical outcomes in patients undergoing anterior cervical discectomy and fusion for degenerative disc disease and radiculopathy

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Abstract

BACKGROUND CONTEXT: There have been controversial reports published in the literature on the duration of symptoms (DOS) and clinical outcome correlation in patients undergoing anterior cervical discectomy and fusion (ACDF) for painful degenerative disc disease and radiculopathy.

PURPOSE: The primary purpose of this study was to analyze if the DOS has any effect on clinical outcomes.

STUDY DESIGN/SETTING: A post hoc analysis was performed on an original prospective clinical study analyzing clinical outcomes and cervical sagittal alignment correlations.

PATIENTS SAMPLE: Fifty-eight patients undergoing one- or two-level ACDF surgeries for cervical degenerative radiculopathy were analyzed.

OUTCOME MEASURES: Standardized questionnaires were used to evaluate clinical outcomes. Neck and arm pain was evaluated using (Visual Analog Scale [VAS]). Two scales of Health-Related Quality-of-Life Questionnaire (Short-Form 36 Health Survey [SF-36]) were used for this study: the physical component summary (PCS) and mental component summary (MCS). Neck disability index (NDI) was used to evaluate chronic disability in activities of daily living. The patients completed a self-reported Patient Satisfaction with Results Survey.

METHODS: Patients who had previous or redo surgeries, were diagnosed with myelopathy or had more than two-level ACDF surgeries were excluded, leaving a total of 58 patients. The mean follow-up was 37.2 months (range 12–54). Patients were divided into two groups for clinical outcome analyses according to the DOS: patients who had surgery within 6 months (n=29) or more than 6 months (n=29) after becoming symptomatic.

RESULTS: There were no statistically significant differences in any demographic or clinical parameters among the patient groups. Controlling for preoperative scores, the patients who had surgery within 6 months reported significantly higher reduction (p=.04) in arm pain scores compared with the patients who waited more than 6 months. No significant differences were detected in postoperative neck pain VAS (p=.3), NDI (p=.06), SF-36 PCS (p=.08), and MCS (p=.8) scores.

FDA device/drug status: Not applicable.

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CONCLUSIONS: Neck and upper extremity pain can be successfully treated conservatively. In those cases, when surgical intervention is pursued, patients with shorter DOS have better improvement in radiculopathy symptoms that is statistically significant.

Keywords: Anterior cervical discectomy and fusion; Clinical outcomes; Duration of symptoms; Prospective clinical study; Radiculopathy; Degenerative disc disease

Introduction

Anterior cervical discectomy and fusion (ACDF) surgery is quite effective in relieving radiculopathy symptoms in patients suffering from symptomatic cervical spondylosis. However, the optimal timing for surgical treatment has not been clearly defined. Insurance companies require at least a 6-week trial of conservative treatment before approving this procedure. The systematic reviews that analyzed if timing of surgery had any effect on clinical outcomes found insufficient evidence to make any recommendations [1–3].

On the contrary, the vast majority of reports published in the literature on the duration of symptoms (DOS) and clinical outcome correlation in patients undergoing lumbar surgeries for painful degenerative disc disease and radiculopathy agree that shorter DOS before surgery resulted in improved clinical outcomes [4–10]. The primary purpose of this study was to analyze if the DOS has any effect on clinical outcomes and resolution of radicular symptoms in patients undergoing ACDF for cervical radiculopathy because of degenerative disc disease.

Materials and methods

A post hoc analysis was performed using the data of a prospective clinical study that analyzed clinical outcomes and cervical sagittal alignment correlations [11]. We have selected a total of 58 out of 122 patients for this analysis. All patients had cervical radiculopathy symptoms. The patients who had previous surgeries, were diagnosed with cervical myelopathy or had more than 2-level ACDF surgeries were excluded from this analysis (n=64). The distinction between radiculopathy and myelopathy was based on clinical symptoms and imaging findings. All patients included in this study failed at least 6 weeks of conservative therapy before surgery unless they required immediate surgical intervention.

Standardized questionnaires were used to analyze clinical outcomes. Clinical evaluations were performed preoperatively, postoperatively at 3, 6, and 12 months, and then annually. Two separate scales (Visual Analog Scale [VAS]) to evaluate the severity of neck and arm pain were used. Functional outcomes were assessed using the Health-Related Quality-of-Life Questionnaire (Short-Form 36 [SF-36]). Two scores within the scoring algorithm were analyzed: the physical component summary (PCS) and mental component summary (MCS). Neck disability index (NDI) was used to evaluate chronic disability and activities of daily living. Preoperative and postoperative neurological examinations were performed, which included motor strength, sensory function, and reflexes. In addition, the patients completed a self-reported Patient Satisfaction with Results Survey. A sample of the patient satisfaction survey is presented in Fig. 1. Answers were scored on a scale from 0 to 100: 100, definitely true; 75, mostly true; 50, do not know; 25, mostly false; and 0, definitely false. A total score was calculated for each patient by averaging the scores from all 6 responses, and the means were compared between the patient groups. The patients were divided into two groups for clinical outcome analyses according to the DOS: patients who had surgery within 6 months (n=29) or more than 6 months (n=29) after becoming symptomatic (Table 1).

Statistical analyses

The comparison between groups was made using Student *t* tests for all independent continuous quantitative variables. Categorical values were compared using χ^2 analysis. Logistic regression analyses were performed to examine clinical outcome scores between the patients who had surgery within 6 months (coded in the analyses as 0) or more than 6 months (coded in the analyses as 1) after becoming symptomatic, while controlling for respective preoperative scores and number of surgical levels.

Results

There were 30 male (51.7%) and 28 (48.3%) female patients. The average age was 48.4 (range 27–73) years. The mean follow-up time was 37.2 (range 12–54) months. There were no statistically significant differences in any demographic, surgical (Table 1), or preoperative clinical (Fig. 2 and Table 2) parameters among the patient groups.

Postoperatively, the patients who had surgery within 6 months had significantly decreased mean VAS (arm and neck), NDI, and increased mean SF-36 PCS scores at the last follow-up, indicating improvement in almost all clinical outcome measures (Fig. 3, Left). The only not quite statistically significant improvement (p=.08) in SF-36 MCS scores was observed for this group of patients. Neck pain and NDI scores were the only statistically significant

improvements for the patient group who waited more than 6 months to have surgery (Fig. 3, Right). Visual Analog Scale arm and SF-36 (PCS and MCS) scores did not reach statistical significance.

Logistic regression analyses of postoperative clinical outcome scores were performed controlling for preoperative scores and number of surgical levels, which showed that patients who had surgery within 6 months reported significantly higher reduction in arm pain scores compared with patients who had waited more than 6 months (p=.04). Although the differences in neck pain (p=.3) and postoperative SF-36 MCS (p=.8) scores were not statistically significant, there was a trend toward improved SF-36 PCS (p=.08) and NDI (p=.06) scores in patients who had surgery within 6 months (Table 3).

The mean satisfaction scores did not reach statistical significance (p=.6) and were 73.8 (range 5–100) and 69.0 (range 4.2–100) for the patients who had surgery within 6 or more than 6 months after becoming symptomatic, respectively. Improvement in neurological symptoms experienced was observed in 22 out of 29 (76%) and 20 out of 29 (69%) patients in the patient group who had surgery within 6 or more than 6 months after becoming symptomatic, respectively.

Much wider DOS variations were present in the patient group who waited for surgery more than 6 months; therefore, linear regression calculations were performed to see if any significant relationships existed between DOS and clinical outcomes within this group. Interestingly, the only significant correlation was observed between longer DOS and neck pain VAS scores (p=.04).

Discussion

The most important finding in this study was that a statistically significant (p=.04) improvement was observed in arm pain VAS scores for the patients who underwent ACDF surgery within 6 months of symptoms' manifestation. Also, this group of patients had better overall clinical outcome scores compared with the patients who waited longer to undergo surgery. The later group had a statistically

EVIDENCE & METHODS

Context

There is concern that prolonged duration of symptoms may lead to inferior outcomes following spine surgery in the setting of neurologic compression. While this issue has been investigated to a moderate degree for lumbar disc herniations, much less information is available regarding cervical disc herniation and lumbar radiculopathy. The authors sought to address this through post-hoc analysis, evaluating data obtained as part of a different prospective study.

Contribution

A total of 58 patients were included in the analysis. Twenty-nine individuals were each included in the early (within 6 months of symptom onset) and late (greater than 6 months from symptom onset) surgical groups. Patients who received surgery within 6 months of symptom onset had statistically superior surgical outcomes.

Implications

The results presented here are comparable to what has recently been elucidated for patients with lumbar disc herniations and lumbar radiculopathy. Thus, it enjoys a certain amount of face validity. It should be recognized, however, that as a post-hoc analysis of data collected for other purposes this work provides no better than level III evidence. There is also substantial clinical heterogeneity between the cohorts and wide variation in terms of surgical times that could adversely impact the study's findings. This is exemplified in differences in the median date of surgery between the two groups. While median symptom duration approximates only 2 months in the early surgical group, it is 2 years for the late surgical cohort. Therefore, further study of the six-month cut-point advocated by the authors is required to establish validity.

—The Editors

The following are statements that people make about what they expect following a spinal surgery. For each statement indicate how true or false you think it is.

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
01. I can do the things I thought I would be able to after surgery.	○	○	○	○	○
02. I was helped as much as I though I would be by my surgery.	○	○	○	○	○
03. My pain was reduced as much as I expected it to be after surgery.	○	○	○	○	○
04. The benefits of my care outweight the setbacks it caused me.	○	○	○	○	○
05. Overall I am happy with the care I am receiving for my neck and/or arms.	○	○	○	○	○
06. All things considered, I would have the surgery again for the same condition.	○	○	○	○	○

Fig. 1. Patient Satisfaction with Results Survey.

Table 1
Selected demographic and surgical parameters

Parameters	≤6-mo DOS	≥6-mo DOS	p Value
N	29	29	
Sex (F/M)	15/14	13/16	1
Age (y)	47.3 (27–72)	49.4 (27–73)	.4
DOS, median (range)	1.8 (0.5–6)	24 (7–288)	
One-level ACDF			
C3–C4	—	1	.1*
C4–C5	2	3	
C5–C6	11	5	
C6–C7	7	3	
C7–T1	—	1	
Two-level ACDF			
C4–C5, C5–C6	5	6	
C5–C6, C6–C7	4	10	
EBL (mL)	78.5 (25–200)	94.8 (25–500)	.4
OR time (min)	83.6 (40–155)	93.2 (55–154)	.2
LOS (h)	24.3 (4–72)	21.3 (3–48)	.3

ACDF, anterior cervical discectomy and fusion; DOS, duration of symptoms; EBL, estimated blood loss; F, female; LOS, length of stay; M, male; OR, operating room.

Note: Values are presented as means (ranges) when appropriate. Student *t* tests were used for calculations except when noted (*), in which case the Fisher exact test was performed.

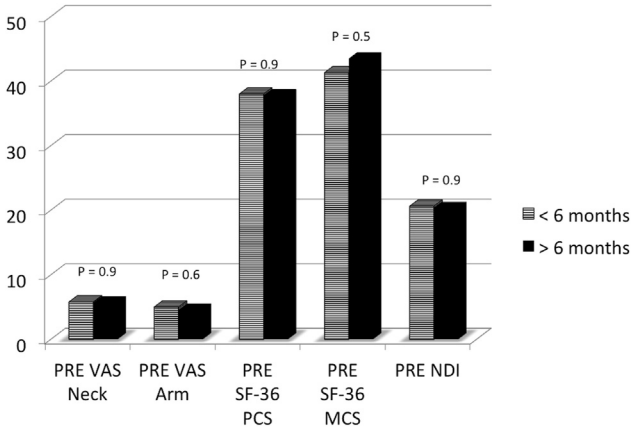

Fig. 2. Preoperative clinical score comparison between the patient groups.

significant improvement in their neck pain VAS and NDI scores only compared with the preoperative values, and improvement in arm pain VAS scores did not quite reach quite statistical significance. Although, the linear regression analysis within this group showed that extremely long DOS has adversely affected postoperative neck pain VAS scores, it also demonstrated that no such correlations existed for arm pain VAS scores. This potentially indicates that an optimal timing for surgery may be shorter for radicular and longer for discogenic neck pain, but prospective trials with larger patient samples would be needed to verify this finding.

The determination and consideration of preoperative predictive factors are of great importance, and timing of surgery could be one of these factors affecting clinical outcomes. We are not advocating to perform fusion surgeries sooner or without exhausting all conservative treatment options. Up to 90% of patients with cervical radiculopathies will improve without surgery [12,13]. This report could help to guide the optimal timing of surgical interventions if surgery is indicated, especially in cases of definite cervical nerve root compressions and before irreversible nerve damage occurs. The same principles could also apply to conservative treatments: an early diagnosis and treatment initiation may reduce the need for surgical treatments. In a study that reported on the clinical course of new neck and shoulder pain episodes, patients who were symptomatic for more than 1 month before consulting a general practitioner were more likely to have an unfavorable prognosis in terms of recovery [14].

Radicular pain is caused by mechanical compression of the spinal nerve roots (especially the dorsal root ganglion) and a subsequent inflammatory response, which lead to irreversible structural changes in the affected nerve [15]. Foraminal encroachment as a result of decreased disc height or degenerative changes of the uncovertebral and zygapophyseal joints are responsible for up to 75% of radiculopathy cases in the cervical spine [16]. Because of a lack of perineurium, less-developed epineurium, and hypovascularization, the spinal nerve roots are particularly susceptible to mechanical compression. Less than 6 months of radiculopathy symptoms seem to be a significant cut point for the changes to be reversed based on the results of our study.

The results of our study are consistent with some of the previously published reports. Bertalanffy and Eggert [17] retrospectively analyzed clinical outcomes of 164 patients undergoing one-to four-level anterior microdiscectomies without interbody fusion for cervical degenerative disc disease and reported that the shorter DOS (< 4 vs. >12 months) was associated with improved clinical outcomes. However, the authors noted that patients with myelopathy symptoms had the worst clinical outcomes and significantly longer DOS (mean 34 months, p<.001) compared with the patients diagnosed with radiculopathy. Based on these results, the conclusion that the DOS influences clinical outcomes in radiculopathy patients should be taken cautiously as this correlation may not be sufficient to establish a cause and effect relationship. In a similar study, Eriksen et al. [18]

Table 2
Preop clinical outcome scores

Clinical outcomes	≤6-mo DOS	≥6-mo DOS	p Value
PREOP VAS (neck)	5.8 (0–10)	5.7 (1–10)	.9
PREOP VAS (arm)	5.0 (0–10)	4.5 (0–10)	.6
PREOP SF-36 PCS	38 (21.7–57.4)	37.8 (16.4–56.2)	.9
PREOP SF-36 MCS	41.3 (10.2–60.5)	43.5 (19.2–65.6)	.5
PREOP NDI	20.6 (0–41)	20.3 (3–45)	.9

DOS, duration of symptoms; MCS, mental component summary; NDI, neck disability index; PCS, physical component summary; PREOP, preoperative; SF-36, short-form health survey; VAS, visual analog scale.

Note: Values are presented as means (ranges). Student *t* tests were used for calculations comparing two groups.

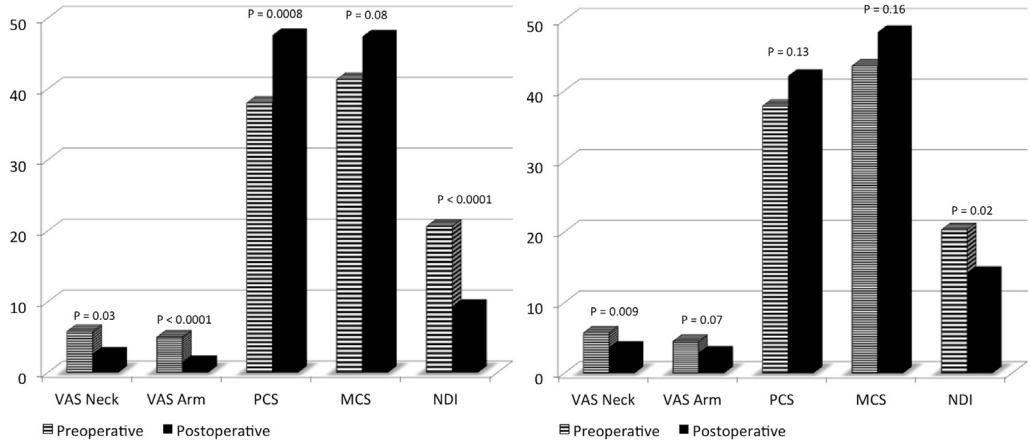

Fig. 3. Clinical outcomes in patients who had surgery (Left) within 6 months after becoming symptomatic and (Right) after 6 months of becoming symptomatic. MCS, mental component summary; NDI, neck disability index; PCS, physical component summary; VAS, visual analog scale.

stated that the short DOS is essential for good clinical outcomes and based on the study findings concluded that 3 months after the onset of symptoms is the optimal time for operation. A more recent study by Hamburger et al. [19] investigated 249 patients who had ventral discectomy and polymethyl-methacrylate interbody fusion for pure radicular symptoms only. Although this was a retrospective study and Odom criteria were used to access clinical outcomes, the DOS of less than 3 months was associated with significantly better results at the mean follow-up of about 12 years.

There were also some reports that did not find the longer DOS to be a negative prognostic factor [20,21]. A study performed by Peolsson and Peolsson [21] prospectively analyzed 95 patients undergoing ACDF for degenerative radiculopathy and neck pain. The patients were symptomatic for at least 6 months with a mean duration of 26 months before surgery, and it was concluded that the DOS has minor importance for clinical outcomes. Another study by Lied et al. [20] included not only patients with radiculopathy symptoms lasting at least 3 months but also some patients with mainly neck pain or myelopathy symptoms.

The most often encountered limitations for the previously reported studies were a retrospective study design [17,18], inclusion of heterogeneous patients, for example, with myelopathy symptoms [17,20], and the use of nonvalidated tools for clinical outcome assessments [18,20]. Contrary to the previously mentioned studies [17,20], our study excluded patients with myelopathy symptoms. Although patients who are diagnosed with myelopathy often have radicular symptoms, the rate of successful surgical outcomes is much lower compared with the patients having radiculopathy symptoms only.

Table 3
Postop clinical outcome scores

Clinical outcomes	≤6-mo DOS	≥6-mo DOS	p Value
POSTOP VAS (neck)	2.7 (0–8)	3.6 (0–8)	.3
POSTOP VAS (arm)	1.5 (0–6)	2.9 (0–10)	.04
POSTOP SF-36 PCS	47.6 (19.7–63.2)	42.1 (16.5–57.3)	.08
POSTOP SF-36 MCS	41.3 (10.2–60.5)	48.3 (21.1–60.8)	.8
POSTOP NDI	9.4 (0–32)	14.2 (0–30)	.06

DOS, duration of symptoms; MCS, mental component summary; NDI, neck disability index; PCS, physical component summary; POSTOP, postoperative; SF-36, short-form health survey; VAS, visual analog scale.

Note: Values are presented as means (ranges).

Although we were able to avoid the limitations listed previously, the study was nonrandomized and performed as a post hoc analysis using the data of a prospective clinical study. As with any retrospective or post hoc analysis study, the possibility of patient selection bias exists. The only way to completely eliminate this selection bias is to design a prospective randomized trial. Our findings and conclusions must be viewed in the light of this, but the observation of improved outcomes with shorter DOS is still valuable and is consistent with our prior knowledge of radicular injury secondary to disc herniations. Most likely, both the duration and the degree of radicular compression contribute to the severity and the recoverability of the injury.

In addition, this study was not designed to measure or control for morphology-based variables that could potentially affect differences in clinical outcomes. There are multiple morphologic changes that may be contributing to radicular symptoms including the size and position of the herniated disc, osteophytes causing foraminal narrowing, decreased disc height, and degeneration of the uncovertebral and facet joints. Although analyzing these differences would be valuable, it is not ideal given the sample size of this study. A much larger sample size would be needed to detect any significant differences that might potentially exist.

Conclusions

Neck and upper extremity pain can be successfully treated conservatively. In those cases, when surgical

intervention is pursued, patients with shorter DOS have better improvement in radiculopathy symptoms that is statistically significant. These findings of the value of earlier surgery apply only to patients with prevailing radiculopathy symptoms and undergoing one- or two-level ACDF with no previous fusion surgeries.

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