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## Radiographic Analysis Comparison of Cervical Alignment After Variable Level of Anterior Cervical Discectomy and Fusion (ACDF)

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### Abstract

**Background:** To compare the radiographic cervical lordosis alignment between pre-operative and post-operative surgery after variable level of anterior cervical discectomy and fusion (ACDF). In the current review, the standard surgical treatment of cervical spondylotic myelopathy is ACDF the restoration and maintenance of cervical lordosis alignment is an important clinical parameter after single level or multilevel anterior cervical discectomy and fusion. The increase or decrease cervical lordosis alignment is affected by the sagittal vertical axis and balance. **Methods:** This study was performed a retrospective radiographic analysis of 147 patients who underwent single to multilevel ACDF (Total N= 147; 1-level (N=36), 2-level (N=60), 3-level (N=42) and 4-level (N=9)) by orthopedic spine surgeons and neurosurgeons between 2016 and 2018. The authors measured the cervical lordosis alignment of the cervical spine using the Cobb method (Inferior endplate of C2 to inferior endplate of C7) at pre-operative and post-operative surgery. Radiographs were measured by three orthopedic doctor viewers. Statistical analysis were performed using R software. **Results:** The radiographic analysis comparison of cervical alignment after ACDF was showed the results that cervical lordosis alignment had no significantly change of decreased cervical lordosis alignment at pre-op mean 14.88°(± 8.66) and initial post-op mean 13.01°(±7.65) in all level of ACDF. **Conclusions:** The radiographic analysis of variable level anterior cervical discectomy and fusion in single to multilevel (1-level, 2-level, 3-level and 4-level) has no significantly change in cervical lordosis alignment after initial postop surgery.

**Keywords:** Cervical spondylotic myelopathy, Cervical lordosis alignment, ACDF.

### INTRODUCTION

Degenerative cervical myelopathy (DCM) is a broad term introduced in 2015 in an effort to standardize the terminology [1]. Currently, cervical spondylotic myelopathy (CSM) is one of the common spinal problems [2-4], especially in elderly patients. There are a variety of surgical options available for treating cervical spondylotic myelopathy patients, each of which has advantages and disadvantages. The treatment for single or multiple level cervical spondylosis with myelopathy have many options for treatment, both anterior and posterior bring about successful outcomes [3,4].

Nowadays, favorable surgical treatment for cervical spondylotic myelopathy is anterior cervical discectomy and fusion. The preoperative Japanese Orthopaedic Association (JOA) score [5] was the best predictor of outcomes after anterior cervical discectomy and fusion (ACDF). This predictors of outcomes may aid surgical decision making and facilitate counseling [6]. In previous studies, the standard surgical treatment of cervical spondylotic myelopathy was ACDF. The restoration and maintenance of cervical lordosis alignment was an important clinical parameter after single level or multilevel anterior cervical discectomy and fusion. The increase or decrease cervical lordosis alignment is affected by the sagittal vertical axis and balance.

However, the ACDF in single to multiple levels of surgery is concerned about post-operative cervical alignment change after operation, the cervical kyphosis deformity or loss of cervical lordosis curve may affect the regional sagittal balance and may lead to sagittal or global imbalance after ACDF. The objective of this study is to analyze the radiographic change, both pre-operative and post-operative in variable level of anterior cervical discectomy and fusion (ACDF) in patients.

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## MATERIALS AND METHODS

Institutional ethical board review was obtained before the study was started and this study initiated in May of 2018. This is a retrospective case-control study. All records came from adult patients who were diagnosed with cervical spondylosis with myelopathy and had been treated by multilevel posterior cervical laminectomy without instrumentation at Nakornping Hospital between January 2016 and December 2018.

### Inclusion criteria

1. Patients who were adult (>18years old).
2. Patients were diagnosed with either.
3. Cervical spondylosis myelopathy.
4. Cervical spondylosis myeloradiculopathy. Patients who had undergone ACDF.
5. The surgery was performed by either an orthopedic surgeon or neurosurgeon.

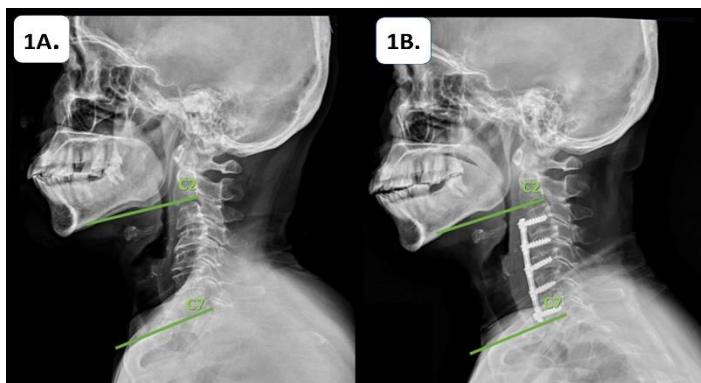
### Exclusion criteria

1. Patients who had incomplete data of radiographic findings.
2. Traumatic cervical spondylitis myelopathy.
3. Infected cervical spondylitis myelopathy.
4. Congenital cervical spine disease.
5. Previous cervical spine surgery or revision cervical spine surgery.

The records of patients who underwent ACDF as inclusion and exclusion criteria by orthopedic spinal surgeons and neurosurgeons, these records measured the cervical lordosis alignment of the cervical spine by using the Cobb's method [7] at pre-operatively and post-operatively. The radiographs were measured by three orthopedic surgeons.

### Measurement technique

Patient radiographs were reviewed from the following time points: pre-operative and post-operative 4 weeks by Cobb C2- C7 method (Measured the angle between inferior endplate of C2 to the inferior endplate of C7) as Figure 1.



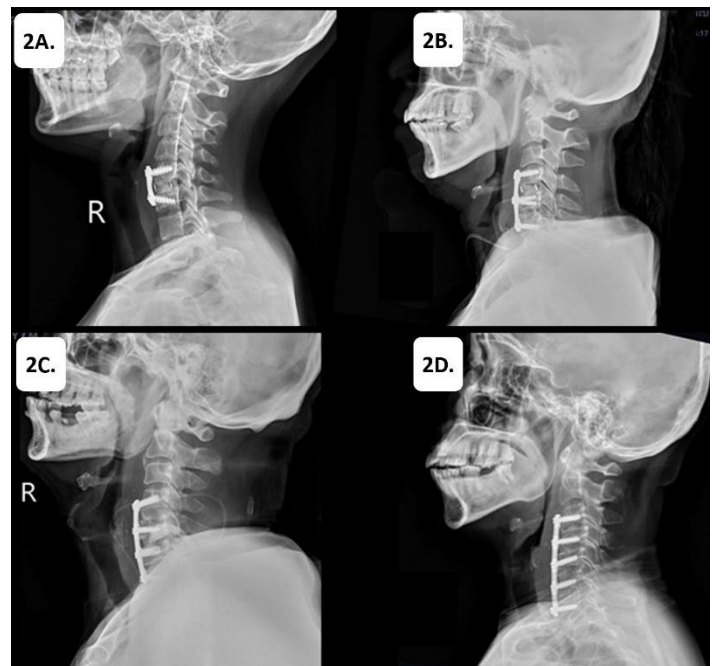
**Fig. 1:** Case example patient was surgery by anterior cervical discectomy and fusion (4 levels): Lateral Cervical x-rays obtained at pre-operative (1A.) and post-operative (1B.) C2-C7 lordosis alignment using the Cobb angle in neutral standing position.

### Statistical analysis

The analyses were performed by using the R version 3.1.0 software by R Foundation for statistical computing Vienna, Austria. The summary statistics were calculated for demographic and radiographic measurements. Pre-operative and post-operative cervical lordosis Cobb angle means were compared using ANOVA (P-values < 0.05 were considered statistically significant).

## RESULTS

There was a demographic data (Table 1) of retrospective radiographic analysis of 147 patients who have a diagnosis of cervical spondylosis with myelopathy that were treated by variable level of anterior cervical discectomy and fusion (ACDF). The result shows 147 patients who underwent single to multilevel ACDF (Total N= 147; 1-level (N=36), 2-level (N=60), 3-level (N=42) and 4-level (N=9)) by orthopedic spine surgeons and neurosurgeons between 2016 and 2018.



**Fig. 2:** Post-operative single to multilevel ACDF; 1-level (2A.), 2-level (2B.), 3-level (2C.) and 4-level (2D.)

The radiographic analysis comparison of cervical alignment after ACDF was showed the results that cervical lordosis alignment had change of decreased cervical lordosis alignment at pre-operative mean  $14.88^\circ$  ( $\pm 8.66$ ) and post-operative mean  $13.01^\circ$  ( $\pm 7.65$ ) in all of level of ACDF as Table 2.

There was no significant change in cervical lordosis alignment after comparison of the cervical lordosis between pre-operative and post-operative in variable level of ACDF by ANOVA using the R-statistical program for analysis.

## DISCUSSION

Cervical myelopathy was chronic progressive atraumatic spinal cord compression that, over time, may cause a decline in physical function and quality of life [8] Cervical spondylotic myelopathy (CSM) was the most common form of spinal cord dysfunction in the world and is more common in men than women [8,9]. In the current, cervical spondylosis was common in people aged 55 years or older age. The incidence was cervical spondylosis myelopathy estimated at 4.04 per 100 000 person/years that patients undergoing surgical treatment [10-12].

**Table 1:** Demographic data; values are presented as mean  $\pm$  standard deviation (SD) or number (n)

Characteristic	Age (Mean $\pm$ SD)	Sex (Male/Female); n (%)	N- Level of ACDF; n (%)
Demographic data of patient	56 years $\pm$ 20	Male: 80 (54.4 %) Female : 67 ( 45.5 % )	1 – Level : 36 ( 24.4 % ) 2 – Level: 60 ( 40.8 % ) 3 – Level : 42 ( 28.5 % ) 4 – Level: 9 ( 6.1 % )

**Table 2:** The radiographic analysis compared between pre-operative and post-operative Cobb angle after ACDF

Level of ACDF	Patients(n)	Pre-operative – Cobb angle Mean $\pm$ (SD)	Post-operative – Cobb angle Mean $\pm$ (SD)	P-Value
1 – Level of ACDF	36	17.03° $\pm$ (8.74°)	13.92° $\pm$ (8.18°)	0.113
2 – Level of ACDF	60	13.97° $\pm$ (8.86°)	13.017° $\pm$ (7.71°)	0.531
3 – Level of ACDF	42	13.67° $\pm$ (8.47°)	13.62° $\pm$ (7.58°)	0.977
4 – Level of ACDF	9	18.00° $\pm$ (6.52°)	14.56° $\pm$ (5.75°)	0.253
Total	147	14.88° $\pm$ (8.66)	13.01° $\pm$ (7.65°)	0.051

\*P-Value < 0.05 that statically significant change.

The previously studied outcome was significant improvement pre-operative scores when compared with post-operative scores after ACDF [13]. Long-term outcomes demonstrate maintained improvements in JOA scores [5] and a change in the disease course of cervical myelopathy [14]. The goals of management for CSM was cord decompression, stabilization, preservation, improvement of cord vascularity, and restoration of normal sagittal alignment [15-17].

Systematic review and meta-analysis by Oitment C. *et al* [17] was reported as ACDF was reduction in axial neck pain by treated specifically for myelopathy or radiculopathy [17]. This influences in the pre-operative discussions that surgeons may have with patients regarding their expectations for surgery. The effects seen are stable over time and represent a clinically significant reduction in axial neck pain [17]. However, the common complications of ACDF encountered were post-operative dysphagia, dural injury, and hoarseness. The previous review by Epstein NE., [18] reported the complications after ACDF such as dysphagia, CSF leaks, hematoma, recurrent laryngeal nerve palsy, and pseudarthrosis rates increased with the number of ACDF levels, ranging from 0 - 4.3% for 1 level up to 56% for 4 level fusions [18]. The surgeon's experience was able to prevent and decrease complication as Nanda A. *et al.* showed ACDF was a relatively safe procedure with very low morbidity and almost no mortality [19].

However, the limitation and complication were reported after ACDF in the ossification of the posterior longitudinal ligament. In patients of Asian origin, ossification of the posterior longitudinal ligament (OPLL) may cause myelopathy. The posterior approach was technically easier and allows decompression of the entire cervical spine [13]. In the multiple levels of cervical spondylosis with myelopathy patients who fail with conservative treatment, the choices of operative treatment may be anterior or posterior surgical management [20]. The spinal surgeons should be concerned about post-operative cervical kyphosis or post-operative loss of lordosis.

This current review showed sagittal axis parameters of the cervical spine. The cervical spine was related to the global sagittal axis of the spine. The global sagittal axis was possible implications for long term clinical outcomes in patients following subaxial cervical spine surgery. Bolcha M. *et al.* [21] reported no clearly determined procedures and specifications for surgical correction of the sagittal axis of the cervical spine. As it turns out, multi-stage procedures are more appropriate to achieve changes of the cervical sagittal axis [21]. It is also gradually becoming apparent that any local change of the cervical spine may affect the sagittal axis of the entire spine.

The authors' reason that patients who diagnosis with CSM the pre-operative cervical ligament had abnormal or decrease cervical lordosis from normal alignment before surgery. The decrease of pre-operative cervical lordosis curve was effected to post-operative cervical lordosis. ACDF operation is able to improve the cervical disc highly by bone graft or polyetheretherketone (PEEK) but anterior cervical plate will decrease the cervical lordosis by plate without pre-bending. However, this study only in the regional of cervical alignment. The future study is needed to analyze the global balance and the clinical outcome to complete this research.

## CONCLUSION

In the study of radiographic analysis between pre-operative and post-operative single to multilevel (1-level ACDF, 2-level ACDF, 3-level ACDF and 4-level ACDF), there was no significant change in the cervical lordosis alignment after post-operative surgery. However, the cervical ligament is a regional curve that future study is needed with the global ligament for global balance to complete this research.

## Ethical statement

The Nakormping Hospital Institutional Review Board provided its approval to publish the details.

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**Conflicts of interest**

The authors declare no conflicts of interest.

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None.

**REFERENCES**

- Nouri A, Tetreault L, Singh A, Karadimas SK, Fehlings MG. Degenerative Cervical Myelopathy: Epidemiology, Genetics, and Pathogenesis. *Spine*. 2015 Jun 15;40(12):E675-693.
- Toledano M, Bartleson JD. Cervical spondylotic myelopathy. *Neurol Clin*. 2013 Feb;31(1):287-305.
- Iyer A, Azad TD, Tharin S. Cervical Spondylotic Myelopathy. *Clin Spine Surg*. 2016;29(10):408-14.
- Nouri A, Cheng JS, Davies B, Kotter M, Schaller K, Tessitore E. Degenerative Cervical Myelopathy: A Brief Review of Past Perspectives, Present Developments, and Future Directions. *J Clin Med*. 2020 Feb 16;9(2).
- Kato S, Oshima Y, Oka H, Chikuda H, Takeshita Y, Miyoshi K, et al. Comparison of the Japanese Orthopaedic Association (JOA) score and modified JOA (mJOA) score for the assessment of cervical myelopathy: a multicenter observational study. *PLoS One*. 2015;10(4):e0123022.
- Goh GS, Liow MHL, Yeo W, Ling ZM, Guo C-M, Yue W-M, et al. Predictors of Outcomes After Single-level Anterior Cervical Discectomy and Fusion for Cervical Spondylotic Myelopathy: A Multivariate Analysis. *Clin Spine Surg*. 2020 Apr 28;
- Zhang J, Buser Z, Abedi A, Dong X, Wang JC. Can C2-6 Cobb Angle Replace C2-7 Cobb Angle?: An Analysis of Cervical Kinetic Magnetic Resonance Images and X-rays. *Spine*. 2019 15;44(4):240-5.
- Anderson PA, Matz PG, Groff MW, Heary RF, Holly LT, Kaiser MG, et al. Laminectomy and fusion for the treatment of cervical degenerative myelopathy. *J Neurosurg Spine*. 2009 Aug;11(2):150-6.
- Ryken TC, Heary RF, Matz PG, Anderson PA, Groff MW, Holly LT, et al. Cervical laminectomy for the treatment of cervical degenerative myelopathy. *J Neurosurg Spine*. 2009 Aug;11(2):142-9.
- Alvin MD, Qureshi S, Klineberg E, Riew KD, Fischer DJ, Norvell DC, et al. Cervical degenerative disease: systematic review of economic analyses. *Spine*. 2014 Oct 15;39(22 Suppl 1):S53-64.
- Klineberg E. Cervical spondylotic myelopathy: a review of the evidence. *Orthop Clin North Am*. 2010 Apr;41(2):193-202.
- Passias PG, Marascalchi BJ, Boniello AJ, Yang S, Bianco K, Jalai CM, et al. Cervical spondylotic myelopathy: National trends in the treatment and peri-operative outcomes over 10years. *J Clin Neurosci Off J Neurosurg Soc Australas*. 2017 Aug;42:75-80.
- An HS, Al-Shihabi L, Kurd M. Surgical treatment for ossification of the posterior longitudinal ligament in the cervical spine. *J Am Acad Orthop Surg*. 2014 Jul;22(7):420-9.
- Li J, Zheng Q, Guo X, Zeng X, Zou Z, Liu Y, et al. Anterior surgical options for the treatment of cervical spondylotic myelopathy in a long-term follow-up study. *Arch Orthop Trauma Surg*. 2013 Jun;133(6):745-51.
- Komotar RJ, Mocco J, Kaiser MG. Surgical management of cervical myelopathy: indications and techniques for laminectomy and fusion. *Spine J Off J North Am Spine Soc*. 2006 Dec;6(6 Suppl):252S-267S.
- Kong W, Yang X, Li Z, Hu B, Song Y. Analysis of the Cervical Sagittal Alignment in Patients with Unstable Hangman Fracture Under C2~3 Anterior Discectomy and Fusion. *World Neurosurg*. 2019 Aug 30;
- Oitment C, Watson T, Lam V, Aref M, Koziarz A, Kachur E, et al. The Role of Anterior Cervical Discectomy and Fusion on Relieving Axial Neck Pain in Patients With Single-Level Disease: A Systematic Review and Meta-Analysis. *Glob Spine J*. 2020 May;10(3):312-23.
- Epstein NE. A Review of Complication Rates for Anterior Cervical Discectomy and Fusion (ACDF). *Surg Neurol Int*. 2019;10:100.
- Nanda A, Sharma M, Sonig A, Ambekar S, Bollam P. Surgical complications of anterior cervical discectomy and fusion for cervical degenerative disk disease: a single surgeon's experience of 1,576 patients. *World Neurosurg*. 2014 Dec;82(6):1380-7.
- Jiang L, Tan M, Yang F, Yi P, Tang X, Hao Q. Comparisons of Safety and Clinical Outcomes Between Multiple-level and Single-level Cervical Disk Replacement for Cervical Spondylosis: A Systematic Review and Meta-analysis. *Clin Spine Surg*. 2016;29(10):419-26.
- Bolcha M, Vachata P, Sameš M. Sagittal profile of cervical and whole spine before and after surgery of subaxial cervical spine. *Rozhl V Chir Mesicnik Ceskoslovenske Chir Spolecnosti*. 2020;99(2):57-66.