

## Functional, Radiological and Sagittal Balance Outcomes in Surgically Treated Degenerative Cervical Disc Diseases

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### ABSTRACT

**Background:** The treatment of degenerative spinal diseases remains focused on dealing with symptoms, using both conservative and surgical methods. Though surgery is considered an effective treatment for many cervical disorders, at times it leads to significant problems including adjacent level disease.

**Objectives:** The aim of this study was to correlate the functional, radiographic and sagittal balance outcome in surgically treated patients for the degenerative cervical disc diseases, outline the advantages, disadvantages and the effect of the sagittal balance on the patient function and activities.

**Patients and Methods:** This study included a total of thirty patients who had degenerative disc disease of the cervical spine at multiple levels treated by microscopic anterior cervical decompression. The average age of participants was  $43.267 \pm 10.780$  years (26– 64). 18 patients (60%) were females and 12 patients (40%) were males. All patients were assessed and classified before and after surgery using the neck disability index and visual analogue scale. This assessment was done for both neck and arm disability.

**Results:** The average neck disability index at the last follow-up was  $17.74 \pm 2.135$ , which was statistically significant ( $P < 0.05$ ) among groups and visual analogue scale improved from  $7.4 \pm 0.926$  to reach  $3.6 \pm 0.35$  six months postoperatively. Full recovery was obtained between three and six months. All patients underwent a rehabilitation protocol and found no postoperative neurological deficit in this series.

**Conclusions:** It could be concluded that cervical sagittal imbalance arising from regional and/or global spinal sagittal malalignment plays an independent role in exacerbating adjacent segment pathomechanics after multilevel fusion and should be considered during cervical fusion surgical planning. Also, it concludes that surgery significantly led to improvement of symptoms three months post operatively.

**Keywords:** Cervical spine, Degenerative diseases, Sagittal balance, PEEK cage, Plate & screw.

### INTRODUCTION

In the last 50 years, advancements in the treatment of cervical spine degenerative disorders have been many. There have been concerted efforts to halt or reverse the degenerative process by means of various biological therapies, although these are still in experimental stages<sup>(1)</sup>. Currently, the treatment of degenerative spinal diseases remains focused on dealing with symptoms, using both conservative and surgical methods<sup>(2)</sup>.

Though surgery is considered an effective treatment for many cervical disorders, at times it leads to significant problems including adjacent level disease.

To minimize the “footprints” arising from surgical interventions on the cervical spine, it is crucial not only to treat the present disorder but also avoid sowing the seeds of future problems. A milieu should also be created that can easily address these problems should they arise<sup>(3)</sup>.

A physiologic sagittal alignment of the head and neck, including the ability to maintain horizontal gaze, is essential to maintaining functionality during activities of daily living. Cervical sagittal malalignment has been linked to poor health-related quality of life and is an area of increasing clinical research interest<sup>(3-7)</sup>.

The long-term goal of our research was to understand

the mechanisms responsible for cervical sagittal malalignment and how malalignment may influence changes in muscle lengths, neuro- foraminal and canal spaces, and load sharing between disc and facets, so as to optimize both manual and surgical treatments. In the current study, and as a first step towards this goal, we developed a novel laboratory model, which allowed us to examine the effects of selective variations in parameters of CSA, including C2-C7 SVA and T1-tilt, on postural compensation in lordosis angles that are necessary to maintain horizontal gaze.

### PATIENTS AND METHODS

This study included a total of 30 patients who had degenerative disc disease of the cervical spine at multiple levels attending at Al-Azhar University Hospitals.

**Approval of the ethical committee and a written informed consent from all the subjects were obtained.**

This study was conducted between October 2015 to May 2018.

All patients were fully evaluated and diagnosed

preoperatively by clinical, plain x-ray and MRI diagnosis. Patients had initially undergone unsuccessful conservative treatment, showing persistent moderate or severe pain, consequently leading to loss of function. The surgical indication agreed with patient demand based on symptom severity, and neurological deficits (motor, sensory, autonomic) as evaluated by clinical score. The main diagnosis was degenerative cervical disc disease. All patients were independently assessed postoperatively using the neck disability index and visual analogue scale at a minimum of six months.

### Surgical technique

The patient was positioned in a neutral supine position. Preoperative fluoroscopy was used to confirm the incision site and adequate visualization of the index level. A standard transverse skin incision over the affected level and exposure of the prevertebral space was performed. Intraoperative fluoroscopy was

used to confirm proper spinal alignment and localization. Discectomy was performed, followed by symmetrical central decompression with resection of the posterior annulus and posterior longitudinal ligament. Following osteophyte excision, the roots or spinal cord were totally decompressed, and the superior and inferior vertebral body end plates were decorticated.

Bone fragments obtained during resection of osteophytes were collected for grafting or using a graft from the iliac bone. The cage was packed with local autologous bone chips, and then inserted into the decompressed disc space.

Immediately after insertion of the cage, a fluoroscopic view was obtained to check the position of the cage and the alignment of the cervical spine. The operation was completed with or without additional cervical plate fixation. All patients were braced in a cervical collar for 4 weeks postoperatively, and early ambulation was encouraged at postoperative day



**Figure 1:** Overall & Segmental lordosis measurement

**Statistical analysis**

Data was analyzed by Microsoft Office 2010 (excel) and Statistical Package for Social Science (SPSS) version 20.

Statistical significance was set at  $p < 0.05$ .

**RESULTS**

Among 30 patients who underwent the surgery, there were 12 males and 18 females.

The average age was  $43.267 \pm 10.780$  years (26– 64). 4 patients (13.3%) had C3-C6 stenosis, 6 patients (20%) had C3-C7 stenosis, 6 patients (20%) had C4-C6 stenosis, 4 patients (13.3%) had C4-C7 stenosis and 10 patients (33.3%) had C5-C7 stenosis.

**Table 1:** Level of stenosis for patients of the study

Level of stenosis	Number of patients	%
Stenosis C3-C6	4	13.3
Stenosis C3-C7	6	20
Stenosis C4-C6	6	20
Stenosis C4-C7	4	13.3
Stenosis C5-C7	10	33.3
<b>Total</b>	<b>30</b>	<b>100</b>

Maximum follow- up was 29 months, with a minimum of 8 months. Most patients achieved good to excellent results postoperatively according to neck disability index and visual analogue scale, with statistically significant differences ( $p < 0.05$ ) (Table 2).

**Table (2):** Comparisons between pre-visual analogue score and post visual analogue score.

	Pre-Operative	End of follow up	P value
<b>NDI</b>			
Min.	25.56	12.74	0.001*
Max.	46.25	31.22	
Mean	36.62	17.74	
S.D.	6.236	2.135	
<b>VAS for neck pain</b>			
Min.	5	2	0.001*
Max.	10	5	
Mean	7.40	3.60	
S.D.	0.926	0.350	
<b>VAS for arm pain</b>			
Min.	4	1	0.001*
Max.	8	4	
Mean	4.60	2.20	
S.D.	0.252	0.123	

There was no postoperative stiffness noted. All basic descriptive parameters per group are expressed as arithmetic mean standard deviation (SD).

## DISCUSSION

Proper global sagittal spinal alignment and balance is critical in maintaining an energy-efficient pain-free upright posture<sup>(8)</sup>. One of the principal goals of spinal reconstructive surgery is restoration or maintenance of the physiologic global sagittal spine profile<sup>(9)</sup>. Numerous reports have demonstrated improper sagittal alignment as a major source of pain, disability, and poor health status<sup>(10-11)</sup>.

Although the focus has been on thoracolumbar and lumbar regional alignment, recent attention to sagittal cervical spine alignment has increased<sup>(12)</sup>.

ACDF using an intervertebral cage is credited with promoting instant stability, restoration of the neural foraminal height and interbody fusion by providing an environment for bone growth. PEEK cages are currently the most preferred. Compared with Titanium and Carbon fiber cages, PEEK cages are more biocompatible and radiolucent, which allows for precise radiological evaluation of bony union. Many surgeons induce bone fusion by filling the cage with autogenous iliac bone graft, others may use a local bone graft to avoid donor site morbidity<sup>(13)</sup>.

In the current study, the results of a thirty patients who had cervical degenerative disc disease at multiple levels treated by microscopic anterior cervical decompression and fusion using cages with or without plate were discussed to describe the patterns, clinical outcomes (functional, radiographic), sagittal balance outcome and outline the advantages, disadvantages and the effect of the sagittal balance on the patient function and activities.

There was significant difference in the VAS score across gender, ( $p=0.035$ ). Male participants had significantly lower change three months post operatively compared to the females. This implies that female participants had better improvement of pain post operatively though the difference was statistically not significant ( $p=0.035$ ).

The study contradicts that done by **Peolsson et al.**<sup>(14)</sup>, who demonstrated that after cervical spine surgery, health status tended to be worse in women than in men. The difference in outcome could be as a result of the difference in operative procedures done, genetic difference as well as presence of co morbidities as most female patients had similar predisposing factors to the males in the **Peolsson et al.**<sup>(14)</sup>, study.

The commonest factor associated with cervical degenerative disc disease in the study was prior history of trauma to the neck that was seen in 60% of the patients. This was followed by cigarette smoking in 33.3%, Family

history of degenerative disc disease in 23.3% of the patients while alcohol intake that was present in 0% of patients.

The commonest associated co morbidity was osteoarthritis that was seen in 23.3% of the patients. 13.3% of the patients had diabetes mellitus. 56.6% of the patients did not have associated co morbidity.

**Ferdinandov et al.**<sup>(15)</sup>, also demonstrated underlying associated factors for CDDD. Among the genetic factors that were associated with degenerative CDD included co morbidities e.g. osteoarthritis and rheumatoid arthritis that affect the integrity of connective tissues that are also present in intervertebral discs. Acquired predisposing factors included cigarette smoking and trauma to the neck that are known to affect the integrity of connective tissues as well as alteration of the biomechanical properties of the cervical spine respectively. **Jäger et al.**<sup>(16)</sup> also, in a case control study, concluded that axial strain of carrying load on the head as seen in manual workers exacerbates degenerative changes in the cervical spine.

In our study the mean pre-operative overall lordosis was  $14.8^\circ \pm 11.288^\circ$ , with a minimum of  $0^\circ$  and a maximum of  $28^\circ$ , while the mean at the end of follow up was  $18^\circ \pm 11.803^\circ$  with a minimum of  $4^\circ$  and a maximum of  $30^\circ$ . The mean pre-operative segmental lordosis was  $8^\circ \pm 5.082^\circ$ , with a minimum of  $0^\circ$  and a maximum of  $18^\circ$ , while the mean at the end of follow up was  $9.93^\circ \pm 8.004^\circ$ , with a minimum of  $2^\circ$ , and a maximum of  $23^\circ$ .

The series of **Gum et al.**<sup>(17)</sup>, reported a mean of overall cervical lordosis of  $6.7^\circ$  pre-operatively and  $7.7^\circ$  at the end of follow up, while the mean of segmental lordosis was  $0.9^\circ$  pre-operatively and  $2.2^\circ$  at the end of follow up. The series of **Wu et al.**<sup>(18)</sup>, reported a mean of overall lordosis of  $11.1^\circ$  pre-operatively and  $14.2^\circ$  at the end of follow up, while the mean of segmental lordosis was  $3.4^\circ$  pre-operatively and  $4.6^\circ$  at the end of follow up.

Overall, the main indication for surgery was failed conservative management with severe pain/radiculopathy that was reported by eight patients (26.7%). This was followed by severe pain/radiculopathy that was reported by seven (23.3%) of the patients. Other indications included severe weakness, myelopathy, failed conservative management, and sphincter anomaly that was observed in three (10%), one patient (3.3%) for each of them respectively.

**Williams et al.**<sup>(19)</sup>, recommended surgery for CDDD in patients having axial neck pain with failure of 6 to 12 months of conservative management, those with persistent radiculopathy unresponsive to 6 to 12 week of trial of conservative management as well as progressive

myelopathy.

## CONCLUSIONS

It could be concluded that cervical sagittal imbalance arising from regional and/or global spinal sagittal malalignment plays an independent role in exacerbating adjacent segment pathomechanics after multilevel fusion and should be considered during cervical fusion surgical planning. Also, it concludes that surgery significantly led to improvement of symptoms three months post operatively.

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