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# Impact of Restoration of Sagittal Balance in Single Level Anterior Cervical Discectomy and Fusion on Clinical and Functional Outcome

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Cervical sagittal balance (CSB) represent the cervical region in normal position support the 7 cervical bone by strong muscle maintain the neck in normal angle and give more flexible to move in flexion an extension and any deformity or pathological change effect the disc lead to more symptoms and restrict of movement and effect on quality of life.this work is aimed to study the effect of restoration of cervical sagittal balance post anterior cervical discectomy and fusion (ACDF) in one level on patient's functional and clinical outcome.Cohort study between 2019-2020 for 30 cases for effect of restoration of cervical sagittal balance post ACDF surgery for degenerative cervical disc in one level using the cervical sagittal parameter to predict and evaluate the amount of lordosis to find out the clinical outcomes. We used the imaging parameters and the functional outcome scores, including the visual analog scale (VAS) and neck disability index (NDI) to provide valuable clinical informations regarding the restoration of CSB in patients treated with single-level ACDF. The procedure was pre and post parameters of CSB and aim of restoration of all parameter and functional outcome without additional complications.In our study, mean age of patients were 44.53±7.61 and regard sex distribution male represent 53.3% and female 46.7%. Level of lesion was distributed as (C3-C4) and (C4-C5) represent 20%,and (C5-C6) and (C6-C7) represent 30% in all cases. Regards change assessment between pre and post-operative, C2-C7angle angle significantly decreased from pre and post with 15% change, and C1-C2 angle angle significantly increased from pre and post with 7% change. There was no significant correlation at postoperative except between VAS and NDI.Maintain the cervical sagittal balance in normal angel post the ACDF procedure gives a significant improvement in the function of the patient post-operatively. The most important cervical sagittal balance is the thelordotic upper angle in restoring the patient active life is recommended. The cornerstone to achieve longterm and excellent results postoperative is to correct the sagittal balance.

**Keywords: Cervical disc, CSB, cervical discectomy and fusion**

## INTRODUCTION

Cervical sagittal balance (CSB) refers to the alignment of the cervical spine in the sagittal plane. Misalignment is associated with headache, cervical pain, and poor health-related quality of life. Recently, there has been increased interest in studying CSB and the relationship of changes in its parameters to cervical pain (Majdawati,2020). Neck pain affects about 5% of people worldwide and causes significant disability (Lau et al.

2019).The cervical spine is the most mobile part of the spinal column. As it supports the weight of the head and maintains it in a normal lordosis position, it is susceptible to pathological changes that affect the physiological lordotic cervical area, cause disabilities, and impair the quality of life (Jang et al.2017). CSB represents the position of the occiput relative to the thoracic inlet and its maintenance is important for the normal lordotic curve of the cervical spine. Any change in CSB, including kyphosis, severe lordosis or spinal reconstruction leads to pain and disability (Smith et al. 2016). Patients diagnosed with a degenerative cervical disorder commonly complain from cervical pain, cervical radiculopathy or cervical myelopathy. Multiple factors affect the progression of degenerative disorders. Loss of intervertebral space, progression of thoracic kyphosis, and facet joint changes can lead to severe compression of neural structures.For example, cervical spondylosis results in a decrease in cervical neuroforaminal regions (McAviney et al. 2005 ; Guo et al. 2011).

Degenerative cervical disc disease can affect the normal cervical lordotic position and lead to cervical deformity, and such patients complain of neck pain and root compression. Disruption of CSB affects the spinal cord due to microvasculopathy and neuronal degenerative changes, resulting in impairment offunction. As the anterior cervical discectomy and fusion are commonly used to treat the degenerative changes in the disc and all its related complications including severe lordotic deformity, kyphosis, and changes in the neural foramen, a study of the restoration of cervical sagittal parameters in this procedure in one level pre and post operatively and the effect of return of CSB to normal parameter becomes crucial to predict the overall improvement (Bess et al. 2016). Most research on CSB relies on analyzing pre- and postoperative cervical spine radiographs and correlating the C1C2 angle C2C7angle and C2C7 axis (SVA) and C7 slope with the clinical symptoms ,others investigated the effect of varying CSB on foraminal areas of cervical spine segments and how can flexion and extension positions can tighten the foramen (Aliaa and Reham,2019).

So, the main purpose of this study was to describe the significance of maintaining CSB in normal parameter which is not less important than the surgical skills itself for the best results. In addition, to evaluate the effect of restoration of cervical sagittal balance post anterior cervical discectomy and fusion (ACDF) in one level on patient's functional and clinical outcome.

## MATERIALS AND METHODS

Cohort study took place in Zagazig University Hospitals, Egypt for 30 cases for effect of restoration of cervical sagittal balance post ACDF surgery for degenerative cervical disc in one level using the cervical sagittal parameter to predict and evaluate the amount of lordosis to find out the clinical outcomes of this study.

### Inclusion and exclusion criteria:

Patients with degenerative cervical disc one level admitted to neurosurgery department for anterior cervical discectomy and fusion. While, age less than 18 years and above 70years, active infections as sepsis, osteomyelitis, discitis and epidural abscess as well as cervical myelopathy were excluded from this study.

### I.Preoperative assessment:

Complete personal history including: age, sex, occupational, handiness, present history and comorbidities. Clinically general examination, neurological examination, motor examination, sensory examination and reflexes were performed. Neck pain assessment by VAS (visual analogue scale) scale and neck disability index (NDI) were applied for each case: a score of less than 4 indicates no disability,5–14 mild disability,15–24 moderate disability,25–34 severe disability, and scores greater than 35 complete disability. Routine labs workup were done preoperatively including: CBC, PT, APTT,INR. Liver function test (bilirubin, alanine transaminase aspartate aminotransferase alkalinephosphatase. Kidney function test (Creatinine, urea).Viral screen (HBV, HCV, and HIV). As well radiological Lateral cervical x-ray assessment was performed to identify the cervical parameters (SVA) (c2 c7 angle) (c7slope).

### II. Operative Assessment:

The patient was asked to extend and flexion the neck voluntarily to assess for any clinical symptoms. In this way, the anesthesiologist could limit their manipulations and not exceed the patient’s own range of motion. The anesthesiologist also used flexible fiber optic intubation when necessary. All patients were subjected to general anesthesia. The operation was performed in the supine position with the extremities padded and protected. The neck was moderately hyperextended with the head placed

in a headrest in the proper lordosis of cervical spine. A roll was placed under the shoulders to obtain greater extension. To identify the level of interest, lateral radiographs were obtained with a bayonetted spinal needle in the disk space or a Caspar distracting pin in an adjacent vertebral body. Once the correct level was identified, the longus coli muscle was dissected laterally off the anterior vertebral body with bipolar cauterization and periostealelevators. For amintomy done by kirrson 1mm and confirmed by blunt nerve hook in the same direction of nerve root. After adequate curettage of endplates carbon cage putted under fluoroscopy and the sized guided by intervertebral disc height of level above and below. Closure of platysma muscle in same pattern of incision by vicryl 3/0 in simple interrupted sutures. Closure of subcutaneous tissue by vicryle 3/0 in simple interrupted inverted sutures.

**III. Post operative assessment:**

Everyone was monitored for vital signs mostly fever, observed for any dyspnea and wound swelling or collection in the first 24 hours. All patients were given pain medications, muscle relaxants and proper triple antibiotics therapy. Instructions were given to patients regarding possibility of dysphagia and return to normal activities. Assessment of improving the brachalgia and motor weakness if present and any new complaint. After consultation of our senior staff members patients discharged on rigid neck collar and instructed for follow up visits and we documented the hospital stay hours.

**Statistical Analysis:**

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software. Data were analyzed using SPSS version 20.0. A quantitative continues group represent by mean ± SD. Difference and association of qualitative variable by Chi square test (X2). Differences between quantitative paired groups by paired t test, correlation by Pearson's correlation. P value was set at <0.05 for significant results &<0.001 for high significant result.

**RESULTS AND DISCUSSION**

The present study showed that the mean age of the included patient was 44.53 ± 7.61 and regard sex distribution male represent 53.3% and female 46.7% (Table 1). Level of lesion was distributed as (C3-C4) and (C4-C5) represent 20% and (C5-C6) and (C6-C7) represent 30% in all cases as shown in (Table 2). VAS and NDI significantly decrease postoperative as VAS changed from 5.93±1.14 to 1.66±0.6 with 72% change and NDI from 28.43±3.03 to 6.96±1.42 with change of 75% (Figure1, 2).

**Table 1: Age and sex distribution among studied group:**

| | | Age | |
|---|---|---|---|
| **Mean± SD** | | 44.53±7.61 | |
| **Median (Range)** | | 45.5 (28-55) | |
| | | N | % |
| **Sex** | **Male** | 16 | 53.3 |
| | **Female** | 14 | 46.7 |
| | **Total** | 30 | 100.0 |

**Table 2: level of disc distribution among studied group:**

| | | N | % |
|---|---|---|---|
| Level | C3-C4 | 6 | 20.0 |
| | C4-C5 | 6 | 20.0 |
| | C5-C6 | 9 | 30.0 |
| | C6-C7 | 9 | 30.0 |
| | Total | 30 | 100.0 |

The obtained results of angle change assessment between pre and post-operative showed that C1-C2angle angle significantly increased from pre and post with 7% change, and C2-C7angle angle significantly decreased from pre and post with 15% change (Table 3). There was no significant correlation at postoperative except between VAS and NDI (Table 4).

This study aimed at study the effect of restoration of cervical sagittal balance post anterior cervical discectomy and fusion in one level on patient's functional outcome. The study included 30 patients with radiological and clinical find- ings of degenerative cervical disc, who underwent surgical ACDF in one level after the failure of conservative management for neck pain. As regards the demographic data, results showed that male gender was more prevalent than female gender was male 16 cases (53.3%), the mean age was 44.53±7.61 years, ranging from 18yrs to 61yrs. These results were in agreement with Jang, 2017. A retrospective review of 49 patients who underwent surgical treatment for ACDF was performed on 34 males and15 females **(8)**.

As regards the distribution level :ACDF level was distributed among the study group as (C3-C4) level 6 patients (20.0%), C4-C5 level 6 patients (20.0%), C5-C6 level 9 patients (30.0%)

and C6-C7 were 9 patients (30.0%). These results were in agreement with Li et al. (2008) who revealed a prospective study of 126 patients treated by ACDF from July of 2002 to June of 2005, The levels of involvement were 21 cases at (C3–4), 30 cases at (C4–5), 40 cases at ( C5–6)and 35 cases at (C6–7).Habba et al. (2019) who represented a retrospective clinical study for 35 patient's most common level is (C5C6)

As regards the change in C1-C2 angle: our results showed that there was a significant increase in the mean degree of pre-operative C1-C2 lordotic angel to postoperative by 7 % change (which is responsible on 75% of cervical sagittal balance) from (-33.4± 1,8) to (-35.8±2.02).These results were in agreement with Siasios et al. (2018) who studied 47 patients found that there was a significant change in the mean C1-C2 angle from 6 months to 1 year pre and postoperatively (-34.6 ±5.6 and -36.3±5.4 respectively.

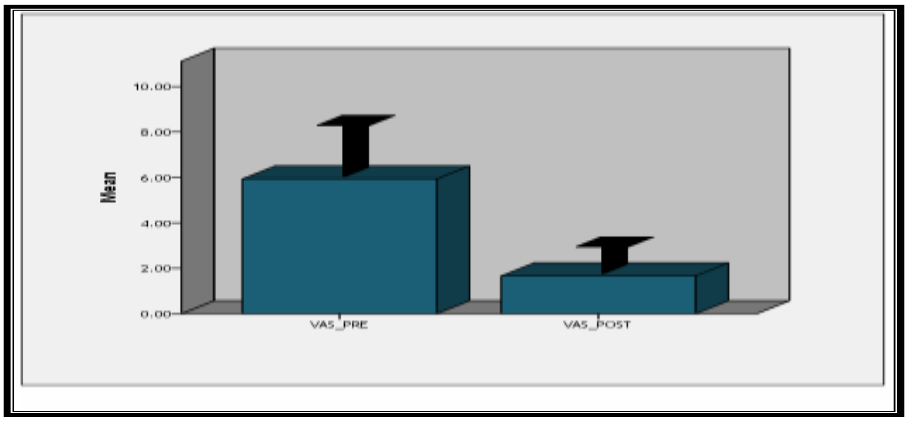


**Figure 1: Show distrubtion of VAS pre and post-operative.**

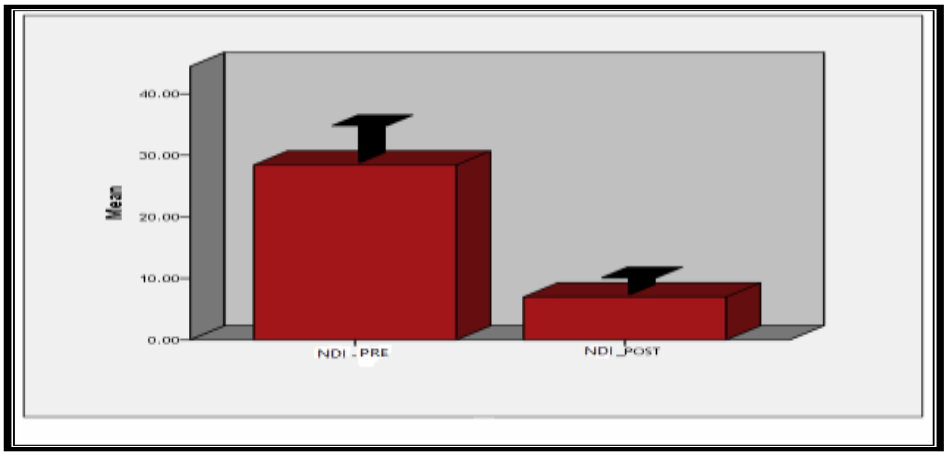


**Figure 2: Show distrubtion of NDI pre and post-operative.**

**Table 3: NC1-C2 and C2-C7 angle change assessment between pre and postoperative:-**

| | Mean | SD | Paired t | P |
|---|---|---|---|---|
| **C2-C7_angle_PRE** | -13.0367 | 0.81430 | -10.415 | 0.00** |
| **C2-C7_angle_POST** | -11.1733 | 0.54705 | | |
| **C1-C2_angle_PRE** | -33.4333 | 1.80801 | 2.828 | 0.011* |
| **C1-C2_angle_POST** | -35.8667 | 2.02833 | …… | ….. |

**Table 4: Correlations between VAS, NDI post-operative and all angle postoperative:**

| | | VAS_POST | NDI_POST |
|---|---|---|---|
| **NDI_POST** | Correlation | .704** | 1 |
| | P-value | .000 | ….. |
| **SVA POST** | Correlation | -.035- | .106 |
| | P-value | .854 | .577 |
| **C2-C7 angle_POST** | Correlation | -.211- | -.092- |
| | P-value | .262 | .630 |
| **C1-C angle_POST** | Correlation | .295 | .243 |
| | P-value | .114 | .196 |
| **C7-SLOPE_POST** | Correlation | -.446-* | -.212- |
| | P-value | .014 | .262 |

While, our results are in disagreement with Kato et al. (2006) who reported a study retrospectively analyzed 28 patients for relation between the preoperative andpostoperative C1/2 angle and they observed significantly reduced C1/2 angle. Changed from -6° to 28° angle reduction was 34° (range 0 to 34), all patient in this study were rheumatoid arthritis cases which wasn't included in our study**.**

As regards the change in C2-C7 angle: our results showed that C2-C7 angle significantly decreased by 15% from (-13.03) preoperative to (-11.17) postoperative.These results were in agreement with: Guo et al.(2011), who revealed that the relation between C1-C2 angle and C2-C7 angle in cervical sagittal balance is stronger from other parameters including OC-C2 and C2-C7 angle and it was an adverse correlation between C1-C2 and C2-C7 in both genders which performed both measurements in healthy asymptomatic volunteers and found that C1–C2 alignment correlated better with that of C2–C7 than that of OC–C2

As regards the change in VAS and NDI: our results showed that the change in VAS was 72% after 6 months (pre-operatively (5.9± 1.1) and post-operatively (1.6 ±0.6), and NDI was significantly improved to 75% pre-operative (28.4± 3.0) and post-operative (6.9± 1.4) relation to the cervical sagittal parameters return to normalvalue. The VAS correlated positively with NDI, while VAS and NDI showed a negative correlation with C2-C7 angle but VAS and NDI were significantly positive correlated with C1-C2angle. These results were in agreement with Duncana Mac-Rae et al. (2012) study which done on 113 patients and measured all cervical parameters C1-C2 and C2-C7 and SVA and C7 slope for long period of follow up for 4 years were NDI score range from 1 to 46 with mean (20.9 ±11.0) VAS score range from 0 to 10 with mean (4.32±2.9). Simillary, Lau Darryl et al. (2019) follow up for 186 patients for 4 months post ACDF by the same parameters and showed improvement in NDI and VAS post-operative after 4 months and remained the same after follow up for 6 months. A study of Mittal (2020) who conducted on 31 patients post ACDF Showing improved clinical outcome VAS and NDI between preoperative and post-operative.

## CONCLUSION

Maintain the cervical sagittal balance in normal angel post the ACDF procedure gives a significant improvement in the function of the patient post-operatively. The most important cervical sagittal balance is the thelordotic upper angle in restoring the patient active life is recommended. The cornerstone to achieve longterm and excellent results postoperative is to correct the sagittal balance.

## CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

## AUTHOR CONTRIBUTIONS

All authors read and approved the final version.

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