Scholars LITERATURE

Neurological Sciences and Neurosurgery

Research Article

DOI: https://doi.org/10.47275/2692-093X-137
Volume 5 Issue 1

The Analysis of Complications of Anterior Cervical Discectomy and Fusion

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Abstract

Background: Anterior cervical discectomy and fusion (ACDF) is the gold standard in the surgical interventions of radiculopathy in cervical inter-vertebral disc herniations or cervical spondylosis.

Aim: The study aimed to analyze the complications of ACDF procedures.

Methods: Retrospective work of collected database and assessing cases that underwent an ACDF in period one year. Totally, 104 cases with 133 operated levels were included. All cases had symptomatic degenerative cervical disc diseases or disc herniations between the levels of C-3/4 to C-6/C7. Epidemiological findings, the pathologies' locations, fixation levels, complications and follow-up variables were collected.

Results: A total of 104 patients with demographic data of 53 males and 51 females (mean age 56 years ranged from 25 - 75 years). C3 - C4 lesion in 20 cases, C4 - C5 in 25 cases, C5 - C6 in 32 cases and 27 cases with more than one level were seen. Neck pain in 104 cases, radiculopathy pain in 90, arms paresthesia in 40, weakness of limbs in 4 and sphincter paralysis in 40 cases. Postoperative dysphagia was found in 104 cases and C5 root lesion in 40 cases, cage dislodgment in one case and hematoma in one case.

Conclusion: Neck Pain is the most common presenting symptom. Dysphagia is the most common postoperative complication and usually transient in most cases. C5 root lesion is not uncommon as complication of ACDF surgery.

Keywords: Radiculopathy pain, Paresthesia, Weakness, Sphincter paralysis, Anterior cervical discectomy

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Citation: Faisel AK, Alabid SSA, Refat OM, Azeez AH, Abdulwahid T, Shakir ZM, et al. (2024) The Analysis of Complications of Anterior Cervical Discectomy and Fusion. . Neurol Sci Neurosurg, Volume 5.1 DOI: https://doi.org/10.47275//2692-093X-137

Received: April 12, 2024; **Accepted:** May 22, 2024; **Published:** May 24, 2024

Introduction

Despite the potential complications associated with ACDF, it remains the gold standard for treating radiculopathy and/or myelopathy caused by cervical intervertebral disc herniation and cervical spondylosis [1]. There are several indications for cervical discectomy, including persistent radiculopathy and myelopathy that do not respond to nonsurgical treatment [1, 2]. Indications are less commonly accepted, such as axial neck pain [3] and headaches [4]. It is possible to approach the pathologic cervical disc either ventrally or dorsally. Over a half century has passed since both approaches were developed [3-8] and are still useful today [2].

Most spine surgeons are familiar with the ventral approach. In most patients, levels C3-4 to C7 - T1 can be reached with the standard ventrolateral approach. Advantages of the ventral approach include central access and bilateral foraminal decompression. Nonunion is still an important clinical problem that may lead to the need for reoperation [4].

But there are many risks and risks associated with back surgery. Implant failure and graft migration often occur anteriorly and may result in neurological symptoms such as partial kyphosis, dysphagia, esophageal perforation, or carotid artery compression [7].

Additionally, increased patient morbidity and the incidence of nonunion have been documented after the use of grafts instead of autologous bone grafts [4-5]. Improper surgical technique during osteophyte removal can lead to dural injury and cerebrospinal fluid leak [6].

Age-related degeneration and trauma can lead to disc pathology that requires surgical removal. Commonly accepted indications for cervical surgery include myelopathy and persistent radiculopathy unresponsive to nonsurgical measures [1, 2]. Less common symptoms include axial neck pain and headaches caused by disc pathology. Pathological cervical discs can move ventrally and dorsally. Both methods have been used for half a century [4-11].

Although some authors have reported good results with external surgery without disc fusion, disc fusion after discectomy has become the standard of care in many centers. Choices include the use of allografts or synthetic intervertebral as well as ventral cervical laminae [12]. Nonunion remains a significant clinical problem that may lead to the need for reoperation [13]. Cervical disc replacement devices are now commercially available for postoperative reconstruction.

Although the indications are fewer, positive results have been reported in appropriately selected patients [14].

Examine radiographs in advance to identify anatomical features. It is particularly important to correctly identify existing equipment to ensure that all necessary equipment is available. Knowledge of ventral osteophytes can help the surgeon determine the appropriate level through palpation and visualization during surgery. Vertebrae were marked horizontally and the anteroposterior distance between the vertebral bodies was measured (minus focus) to estimate implant and screw size. Anatomically, the lower cervical spine of the "short" neck is at or below the level of the clavicle, which will alert the surgeon that access to these lower levels will be difficult for the procedure. It may be useful for patients with symptoms (especially left and right symptoms, radiculopathy, or myelopathy), surgery (graded discectomy), and significant comorbidities (smoking, diabetes, etc.). Axial MRI or CT scans of the vertebral artery area should be examined carefully, and any abnormalities carefully noted. The surgical site is marked in a fixed place. ACDF is a procedure designed for the treatment of cervical myelopathy and radiculopathy. This procedure is designed to create nerve decompression and provide segmental stability at the level of symptoms of the cervical spine. The technique has undergone many changes since it was first described approximately 50 years ago [2, 3]. Current techniques combine internal metal barriers with synthetic, allograft, or metal grafts [3-9]. Although the addition of the front plate increases the biomechanical stability of the building and makes fusion more common, it is also associated with prevertebral soft tissue damage and dysphagia [10-14]. The causes of dysphagia after ACDF anterior plate surgery include retraction, direct compression of the esophagus, and irritation of the surrounding tissues [15, 16].

Feeling mild pain or sore throat after abdominal and neck surgery; It is reported to be seen in approximately 50% of patients. Most patients recover without further complications within weeks or months. The most common cause is edema due to endotracheal intubation. However, laryngeal nerve damage can also occur and lead to laryngeal dysfunction [17].

Vertebral artery injury may be due to asymmetry and removal of distal bone and usually occurs with the left standard approach [17]. To prevent damage to the carotid artery, intracranial artery or vagus nerve, care must be taken not to penetrate the carotid sheath. Carotid artery tears may occur due to the sharp blade of the retractor knife or during dissection using sharp instruments.

In most cases, carotid artery ruptures can be treated first. The chain has the potential to cause further injury to the lower ventral portion of the cervical spine because it is closer to the medial border of the longus colli muscle at C6 than at C3 [17]. Differences in neurological deficits after ventral cervical spine surgery. Most spinal cord or nerve root injuries are associated with accidents (including most C5 defects) [17]. During posterior longitudinal ligament resection or drilling, dural tears and cerebrospinal fluid leakage may occur. Direct treatment is usually not possible [17]. Cervical soft tissue hematomas after cervical and abdominal surgery are rare and most can be treated without surgery. However, large hematomas can cause airway obstruction and be life-threatening. To avoid this problem, careful hemostasis must be achieved before closure. The Jackson-Pratt flow is placed in the prevertebral space before closure [17]. Infectious processes may occur after ventral cervical surgery and affect only the outer layer or deep structures. These complications have been reported in 0.4% to 2% of spinal cord injury patients [17].

The main complications associated with bone grafting are collapse, dislocation, displacement and nonunion of the graft. These may be due to size, vertebral end plate fractures, postoperative trauma, or inadequate fixation. Graft collapse often occurs in adults with osteoporotic bone. If there is doubt about the integrity of autogenous bone, allograft bone can be used. However, in young patients, autografts are more resistant to axial compression than allografts. Most patients with graft infection are asymptomatic and do not require reoperation [17].

Methods

Population

A retrospective analysis of the collected data by evaluating patients who received ACDF at a single center between October 2012 and October 2022 was conducted. A total of 104 cases of individuals with 133 surgical degrees were included. All patients had symptomatic degenerative cervical disc disease or disc herniation at the C3/4 to C6/C7 levels. Epidemiological data, pathological location, degree of recovery, surgery time, estimated blood loss, length of hospital stay, complications, and follow-up data were collected. This project was approved by the research council. The follow-up period of all patients was at least one year. Two groups of patients are selected based on the cervical segments involved; group A: one single (one segment), and group B: multiple (more than one segment).

Surgical technique

During this procedure, the patient is intubated through the endotracheal system. To achieve the high level, the Smith-Robinson method was used [3]. The patient is asleep on the operating table. A horizontal, curvilinear incision is made from the midline to the anterior aspect of the sternocleidomastoid muscle. The tissue is dissected, the carotid artery is mobilized laterally, and the trachea and esophagus are mobilized medially. After entering the prevertebral space, the longus colli muscle is cut from the vertebral body. Traction pins were placed under fluoroscopic guidance and osteophytes were removed with a high-powered drill under an operating microscope. Discectomy was performed using a straight curette and a pituitary rongeur. The posterior longitudinal ligament was repaired using a Kerrison rongeur.

Place the tetanus cage or PEEK cage, determine the final position of the fluoroscopy, and then use the internal cervix for various ACDF levels. Irrigation and closure and drainage of the wound. In addition to abdominal pain and deep vein thrombosis prophylaxis, patients receive standard postoperative care and appropriate pain medication. Wear a postoperative collar only if the patient smokes.

Clinical evaluation

Clinical data were collected before, after surgery and after the last visit. Intraoperative and postoperative complications of all patients were recorded and monitored.

Radiological evaluation

Antero-posterior and lateral cervical spine radiographs are used to evaluate material failure and/or instability immediately and laterally after surgery. Antero-posterior and lateral cervical spine radiographs were taken 6 months after surgery to evaluate the outcome of bone fusion. The formation of a trabecular bridge across the cage interface and the absence of a gap between the graft and the vertebral end plate are radiological criteria used to evaluate the fusion (Figure 1).

Statistical analysis

Data were compiled and analyzed using version 22.0 (MedCalc Software Ltd, USA). Descriptive statistics consist of numbers and percentages. Variance distribution was evaluated using the chi-square

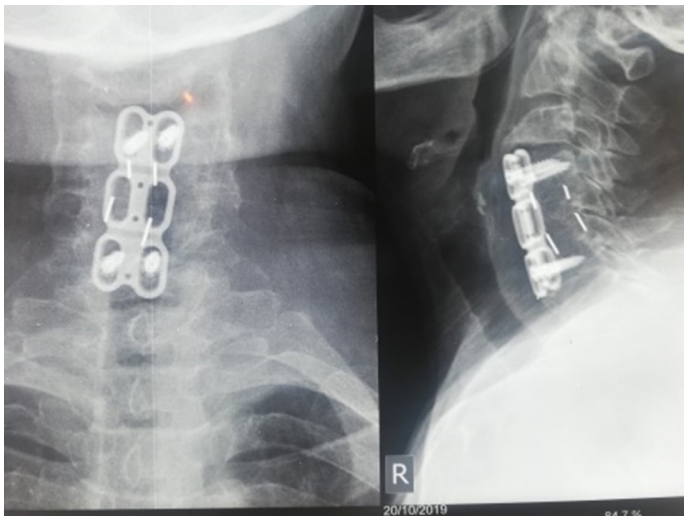

Figure 1: AP and lateral X-ray of cervical spine show bonny fusion at C4 - C5, C5 - C6 ACDF after 2 years of operation.

test. A p value below 0.05 was considered significant.

Results and Discussion

A total of 104 patients with demographic data of 53 males and 51 females, mean age 56 years ranged from 25 - 75 years (Figure 2). Group A had 83 patients while group B had 21 patients. When examining presented symptoms, a significantly great percent presented with myelopathy in the group A (71.4%) compared with those in the group B (21.2%). The proportion of patients in C4 - 5 and C5 - 6 levels were instrumented was 75% of patients in both groups. The comorbidities (hypertension, diabetes mellitus and ischemic heart diseases) recorded more in group B (19 patients) in which the mean age group was 62.5% while there was no incidence of comorbidity in group A with mean age of 53.2%. Totally, 67 patients had normal power of their upper and lower limbs, while the others had subnormal power grade on examination, nevertheless all patients improve their power grade except four patients (one in group A and three in group B) sustained their power grade and two patients (in group B) get deteriorate their power postoperatively. There were four cases with recurrent laryngeal nerve (RLN) palsy in 4 patients, one in group B while C5 root lesion was found in 3 of group B and one in group A.

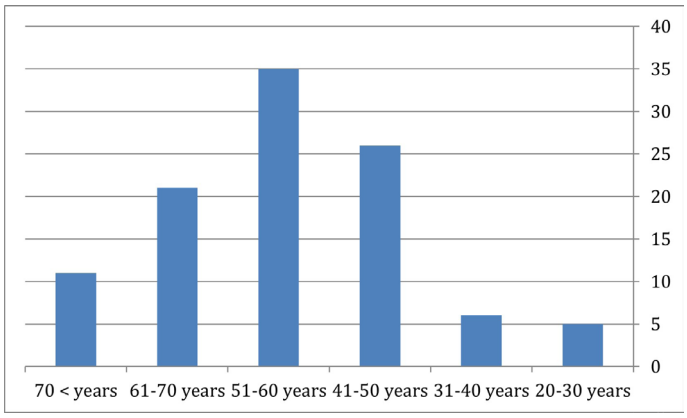

Figure 2: The distribution of age groups.

Dural tear happened in single case belonged to group A. There was no incidence of esophageal injury or vascular (carotid or vertebral artery) injury in this series. Nonunion was observed in 2 patients and both were in group B. Postoperative infection had not been found in the patients (Table 1, table 2, table 3 and table 4).

ACDF is a well-established treatment for cervical spondylitis myelopathy and radiculopathy [13-20]. Hysterectomy and fusion are a common spine surgery between 1990 and 1999, 500,000 ACDF surgeries were performed in the United States [21]. In general, the results of this surgery are good or very good [22-24]. Although this surgery is relatively safe, its complications can be problematic in some cases and rarely devastating [13-16]. Identification and early management of these potential problems is necessary to achieve recovery in these patients [16].

Many problems associated with ACDF have been previously reported. Common symptoms include: postoperative RLN palsy, Horner syndrome, pharyngeal or esophageal rupture, thoracic duct injury, pneumothorax, vertebral artery rupture, carotid artery or carotid artery injury, and postoperative epidermis aneurysm, respiratory failure, angioedema, wound infection, deep infection, epidural abscess, discitis, aseptic discitis, seroma, scleroderma Meningeal laceration, cerebrospinal fluid leak, meningitis, spinal cord contusion, transient or permanent myelopathy, radiculopathy, additional nerve symptoms. postoperative angular deformity, bone graft or measured extrusion, mechanical instability after cervical spine stabilization surgery [17-20] (Figure 3 and figure 4).

Table 2: The demographic data and clinical features.

Clinical feature	Number	Percentage
Gender (Male/Female)	53/51	50.9/49.1
Neck pain	104	100
Radiculopathy pain	90	86.5
Arms paresthesia	40	38.5
Weakness of limbs	37	35.6
Sphincter paralysis	40	38.5

Table 3: Motor power of all patients in preoperative and postoperative evaluation.

Grades	Group A		Group B	
	Power preoperative	Power postoperative	Power preoperative	Power postoperative
Grade II	6	0	4	2
Grade III	7	0	5	0
Grade IV	9	14	6	10
Grade V	61	69	6	9

Table 4: The complication incidence.

Complication	Transient	Permanent
Dysphagia	104	0
Recurrent laryngeal nerve	4	3
New neurological deficit	2	2
Cage dislodgment	1	1
Dural injury	1	0
Postoperative hematoma	1	0
C5 root lesion	5	0
Nonunion	2	2
P value	0.001	0.049

Table 1: The cervical levels distribution.

Cervical level	C3 - C4	C4 - C5	C5 - C6	C6 - C7	C3 - C4; C4 - C5	C4 - C5; C5 - C6	C5 - C6; C6 - C7	C3 - C4; C4 - C5; C5 - C6
No. of patient	18	25	30	10	6	7	3	5

Figure 3: 38 year old female with spastic quadriparesis and MRI show C5 - C6 chronic disc degeneration and cord compression treated by C5 - C6 ACDF preoperative MRI and postoperative X ray.

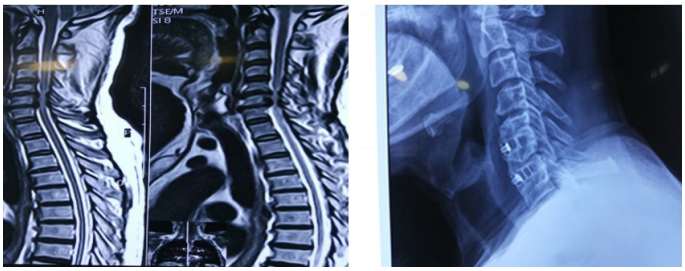

Figure 4: 65 year old male with C5 - C6, C6 - C7 chronic discs disease and cord compression treated by ACDF.

Dysphagia is the commonest post-operative complication, with an incidence of nearly 100% in this research at the immediate first week after operation and this had been suggested in other studies as an inevitable symptom, not a complication, closely linked to ACDF [8]. Fortunately, the cases with dysphagia staying for more than 3 months were non in this study. The most consistent risk factors for post-operative dysphagia in terms of prolonged duration were old age and higher numbers of operated levels where it was found in two patients of all dysphagia cases. The increased number of levels needs wider dissection and more soft tissue retraction and that may explain the more time needed for disappearance of dysphagia [25].

The non-sustained dysphagia in this study is found in other studies [26-30]. However other studies showed more incidence of permanent dysphagia as in Fountas et al. [31] and Fountas et al. [27] who had results of incidence of 3.6% and 9.5% respectively. RLN palsy represents the common reported ACDF-related complications [8-20]. The incidence during ACDF has been reported to range from 0.2 - 16.7% [8, 13, 17].

RLN palsy manifested by hoarseness was found to occur at 4 cases across all patients, while the those with permanent hoarseness of voice were only three patients. These three patients had permanent hoarseness of voice (2.8%) all had more than one level ACDF and all above 50 years and all are smokers. The excessive dissection and prolonged retraction of soft tissue, especially laryngeal retraction obviously increases hazard of RLN palsy. This incidence is comparable to other authors who had similar results as observed post-operative, clinically symptomatic RLN palsy in 3.1% (32 of 1015 patients) [31].

More incidence of RLN palsy had been observed in other studies like Azab et al. [19] who had incidence of hoarseness' of voice postoperatively in 5% (21 of 441 patients). The same had been observed by Fountas et al. [31] who reported postoperative RLN palsy in 7.1% of their cases. Dural injury had occurred in one patient with no incidence of either CSF leak or meningitis as it stopped spontaneously postoperatively. This is comparable to other studies with an overall incidence of 0.3 - 1.8 from Fountas et al. [31] and Wilkinson et al. [32] respectively.

Rates of infectious were low with an incidence of 0% across this study. This is better than other studies who showed a higher rate of infection who observed 5.5% rate of infection [25]. Postoperative C5 palsy observed in 5 cases (4.8%), and no relation was found with number of levels. Many studies have focused on the development of C5 palsy after neck surgery. Although various theories have been put forward to explain this problem, it remains a controversial issue. C5 palsy after cervical spinal cord injury is thought to be the result of nerve damage or segmental spinal cord disease [33-35]. There are various studies showing the incidence of C5 paralysis. A meta-analysis focused on estimating the prevalence of C5 palsy after cervical surgery, based on 13,621 patients in 79 articles [35].

Cage dislodgment observed in one patient only with no significant neurological deterioration as the cage had displaced to the ventral part of cervical spine column. There was 96% fusion rate in the patient documented by radiograph and CT scan in the postoperative period with only one patient who showed non symptomatic pseudoarthrosis who was 65 years smoker patient. Other studies showed similar incidence of fusion rate as in Fountas et al. [27] who observed 94.5% fusion rate.

Vertebral artery injury has been reported in several studies and may be rare, with the overall incidence in this study being 0 and the over reported occurrence of VAI being 0.2% to 0.5% of the test associated with anterior cervical surgery [36, 37]. New or negative neurological deficits after anterior cervical surgery were found 2 cases, one of them (0.7%) returned to normal neurological status after 2 months while the other 65 years female sustained the new quadriparesis status during the follow up period. The incidence of new neurological deficit or worsening of the neurological status in ACDF had been observed in other studies with incidence from 05% - 1.1% in Lonjon et al. [36].

The incidence of postoperative hematoma was found in single patient (0.9 %) and reoperation and evacuation of hematoma was done within 24 h. The incidence of postoperative hematoma was reported to be 0.78% in Iyer et al. [38]. On comparing group A with group B, it was found that rate of complication increased in group B in term of time of disappearance of dysphagia was prolonged in group B (30 days) compared to group A (14 days). The higher incidence of RLN palsy and C5 palsy in group B compared to group A may be explained by more tissue dissection and more time of retraction at site of surgery because of increased number of segments involved, as shown in (Table 5).

Conclusion

ACDF is a safe and easy surgical option in management of cervical degenerative diseases if done by well skilled hand. The rate of all complications is low. Dysphagia is the commonest postoperative complication and can be avoided by decreasing the time of retraction. The commonest root injured postoperatively is C5. Early diagnosis of complication and comprehensive management yield good results. It is recommended to utilize ACDF operation in therapy of degenerative cervical spine illnesses, good magnification in ACDF operation and close observation for all patients with ACDF operation for any neurological or systemic complication.

Table 5: Comparison between groups of the study.

Segments	Group A	Group B	P value
Mean time of dysphagia	14 days	30 days	0.044
RLN palsy	1 (1.2%)	3 (14.2%)	0.9
New neurological deficit	0 (0%)	2 (9.52%)	NS
Cage dislodgment	1 (102%)	0 (0%)	NS
C5 palsy	0 (0%)	5 (23.8%)	NS
Nonunion	0 (0%)	2 (9.52%)	NS
Postoperative surgical site hematoma	0 (0%)	1 (4.76%)	NS

Acknowledgements

None.

Conflict of Interest

None.

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