

Article

Outcome of Three Levels Prefilled Cervical Interbody Fusion without Plates after Anterior Cervical Discectomy

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Abstract: Prefilled Cervical interbody fusion by synthetic bone without plate Facilitates the retention of physiological lordosis and cervical spine stability in patients who have undergone cervical discectomy by anterior approach, a secure and efficacious treatment for disc herniation or spondylosis. Several spine specialists advocate the incorporation of a plate system to boost outcomes. According to literature findings, surgery involving three levels results in reduced fusion rates. Sixty-three person with cervical radicular pain and nine with myelopathy underwent anterior discectomy and fusion with prefilled or (Impregnated) cervical cages by anterior approach between July 2012 and June 2022 were included in the study without using plate systems. There was a total of 72 individuals, comprising of 48 males and 24 females, whose average age amounted to 54.33 years, falling within a range of 33 to 73 years, In variable hospitals of Erbil city. All cases took (an MRI), and 35 among them also took a C-Scan for preoperative assessment. All cases exhibited improvement in radiculopathy following surgery. However, myelopathy persisted in only three patients. After 12 months, 96% of patients demonstrated the fusion of surgically treated discs, as confirmed by an X-ray of the cervical spine region. Cervical lordosis was reinstated in nearly all patients who had lost it prior to the operation. No complications stemming from cage extrusion were reported and there were no instances of symptomatic pseudarthrosis. The inclusion of impregnated interbody fusions serves to impart a load-sharing capability and enhance spinal stability, thereby resulting in augmented segmental stiffness. This, in turn, leads to similar fusion rates as those elicited by bone grafts, even in cases of cervical degenerative disease spanning three levels.

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1. Introduction

Cervical discectomy and fusion by anterior approach (ACDF), which was primarily articulated by Robinson [1], is a remarkably triumphant approach in cases where there is nerve roots or cord compressed by disc material or other surrounding tissues like ligament and bone. The effectiveness of the procedure is further enhanced through the modified abrasion of the vertebral endplates. Bohlman et al. [2, 3, 8] exhibited greater rates of fusion and favorable results. Nevertheless, when executing several-level surgeries, the rate of fusion declines significantly, reaching a substantially lower level compared to single-level procedures [9]. Efforts to augment the fusion pace after three-level cervical discectomies by anterior approach encompass the adoption of complete or partial vertebral bone removal, ensuring that merely two bony interfaces (comprising a solitary graft) mend to achieve a stable conglomeration [7, 9].

The decreased rates of fusion have been ascribed to a larger number of grafts and interfaces that necessitate amalgamation in the context of several-level surgery and to the amplified stress on several graft areas as well as the resulting slight movement, as in previous studies [14]. Alternative approaches entail employing cervical plating spanning the complete fusion construct to furnish augmented fusion and mitigate slight movement at the bone-graft junction [4, 6, 7, 11].

The utilization of cervical plating by the anterior approach has exhibited a surge in recent times. Several biomechanical investigations have demonstrated the additional stability provided by these plates, which theoretically results in an increase in fusion rate [5, 6, 10, 12].

The employment of cervical plating for one-level cervical discectomy remains a subject of controversy. While certain studies manifest augmented one-level rates of fusion and reduced reoperation rates through the implementation of cervical plating, others indicate decreased rates of fusion for one-level fusions with the utilization of plating and screws. Due to their capacity to maintain the intervertebral space in distraction and impede graft integration; this could bear relevance in the amalgamation of the graft [4, 6, 13]. Intervertebral fusion cages are sophisticated implant devices that aim to reinstall the anatomical disc height while stimulating osteogenesis inside and outside them, thereby triggering osseous coalescence. Their progress focuses on foiling an impending collapse of disc space. The major intricacies linked with the embedding of fusion cages comprise of subsidence into adjacent vertebral bodies, dislocation of the cage, instability linked with nonunion, and vexing pseudarthrosis [15]. The aim of this study was to assess the safety and effectiveness of infused intervertebral fusion cages for the treatment of cervical spinal disease, as well as their use in surgical procedures involving three vertebral levels without the need for anterior cervical plating.

2. Materials and Methods

Sixty-three persons with cervical radicular pain and nine with myelopathy underwent anterior discectomy and fusion with prefilled or (Impregnated) cervical cages by anterior approach between July 2012 and June 2022 were included in the study without using plate systems. There was a total of 72 individuals, comprising of 48 males and 24 females, whose average age amounted to 54.33 years, falling within a range of 33 to 73 years. In variable hospitals of Erbil city (Erbil Teaching Hospital, PAKY Hospital, Sardam Hospital and PAR Hospital) during this period.

The perioperative parameters included the assessment of the patient's neurological deficit using the Japanese Orthopedic Association (JOA) score and the evaluation of neck motion using the neck dysfunction index (NDI) score, as illustrated in Figure 4. The improvement rate (IR) was determined by computing $IR = \frac{\text{Postoperative JOA score} - \text{Preoperative JOA score}}{17 - \text{Preoperative JOA score}} \times 100\%$. These parameters were assessed both before the operation and during the last follow-up. Collected complications

included cerebrospinal fluid (CSF) leakage, hoarseness, dysphagia, bleeding, adjacent segment disease (ASD), plate and cage dislodgement, breakage, and migrations. The need for surgical intervention in our sample of 72 cases was established on the basis of the following characters: clinical finding of cervical spinal disease affecting three levels, concomitance of signs and symptoms with radiographic findings, and lack of response to non-surgical therapeutic interventions.

Kyphotic deformation was observed in 27 (37.5%) cases, as demonstrated on preoperative radiographs. Prior to surgery, all patients underwent magnetic resonance imaging.

Sixty-six individuals underwent surgery at adjacent spinal levels, whilst merely six underwent surgery at more distant zones. The operation was carried out on the spinal vertebrae. Cervical 4-5, Cervical 5-6, and Cervical 6-7 on 54 patients (constituting 75%), at Cervical 3-4, Cervical 4-5, and Cervical 5-6 on 12 patients (constituting 17%), and at Cervical 3-4, Cervical 5-6 and Cervical 6-7 in the remaining six patients (totaling 8%). Prior to being medically discharged, all individuals underwent cervical imaging and were promptly provided with an inflexible cervical brace that had to be worn continuously for a period of six weeks. Post-surgery, all subjects were monitored for a minimum of six months (with a span of 6-47 months) using clinical and radiological methods. The seamless unification of the implicated segments was achieved with a deviation of under 2 degrees on extension-flexion radiographs, and less than half of the external surfaces of the implants displayed radiolucency.

The Cobb angle was employed to evaluate cervical lordosis prior to surgery and during the conclusive follow-up. The angle was formed by lines running along the inferior endplates of C2 to C7's inferior endplate while in the state of alignment. Intervertebral body Cage dislodgement was stipulated as an occurrence where the instrument exceeded the foremost point of the connecting upper and lower vertebrae by a margin of 2-4 mm, as depicted on lateral cervical X. Ray. Instrument subsidence is characterized as the reduction in height of the surgical components visible on lateral X-Ray of the cervical spine. Radiographic evidence indicating adjacent segment degeneration (ASD) comprises any of the following parameters: (1) Formation of new osteophyte bone anteriorly or their progressive enlargement, (2) Reduction of the intervertebral disc high by $\geq 30\%$, or (3) ossification of the anterior longitudinal ligament [30, 31].

The cervical cage design integrates the nuances of anatomy with a textured surface, thus resulting in optimal stability and fusion conditions. This concept is a groundbreaking approach to maintaining inter-vertebral spacing and showcasing remarkable attributes such as endurance and adaptability, coupled with the necessary level of biocompatibility essential for extended implantation within the body. The enclosures are furnished with titanium alloy spikes to enhance stability and are accompanied by markers to ensure precise positioning in the postoperative period.

The upper and lower contact surfaces are designed with retentive teeth and titanium spikes with an optimal design for long-term load bearing and maximal maintenance of inter-vertebral height and lordosis, flexibility, and durability, which best visualization on X-ray.

3. Results

During the presentation, it was found that 54 patients, comprising 75% of the participants, had experienced neck pain of moderate-to-severe intensity before undergoing the operation. 63 (87.5 %) patients complained from radiculopathy, and 9 (12.5) patients complained from myelopathy (Figure 1).

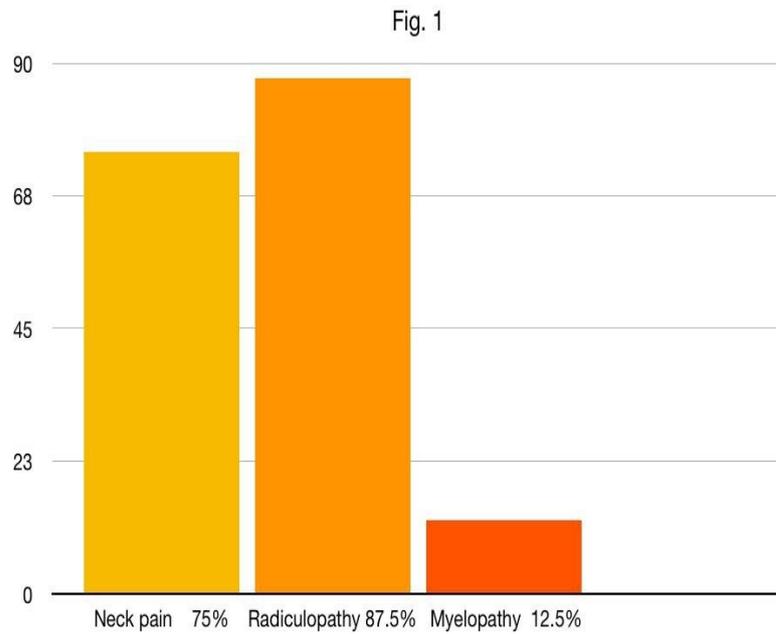


Figure 1. Clinical presentation of patients.

All patients had an MRI study before surgery to identify the pathological levels of disc prolapse, as shown in (Figure 2).

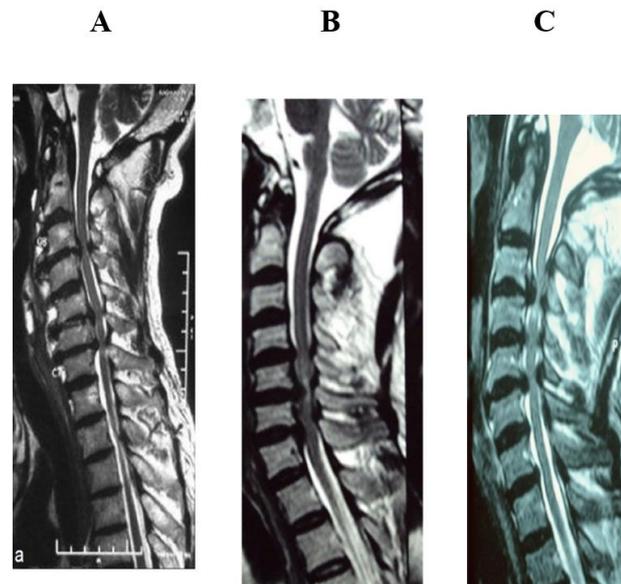


Figure 2. Preoperative sagittal MRI image. A (Cervical 3-4, Cervical 5-6, Cervical 6-7), B (Cervical 4-5, Cervical 5-6, Cervical 6-7), C (Cervical 3-4, Cervical 4-5, Cervical 5-6).

Sixty-six cases received surgical intervention at adjacent spinal segments. While six individuals underwent surgical procedures at remote anatomical levels, Surgery were performed at Cervical 4-5, Cervical 5-6, Cervical 6-7 in 54 cases (75%), at Cervical 3-4, Cervical 4-5, Cervical 5-6 in 12 cases (17%), and at Cervical 3-4, Cervical 5-6 and Cervical 6-7 in 6 (8%) as shown in (Figure 3).

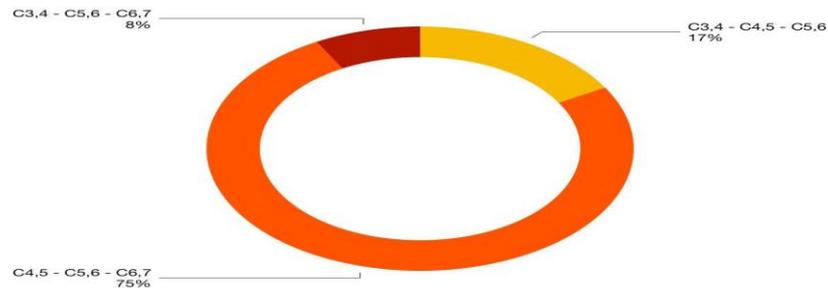


Figure 3. Surgical levels of surgery

All cases complaining from radicular pain (63 patients) are improved postoperatively. While in those suffering from myelopathy (9 patients), only three (1/3) patients did not improved.

After the surgical procedure, the mean JOA score exhibited a noteworthy enhancement to 13 during the last follow-up assessment in contrast to the preoperative score of 8, with an IR of $62.2 \pm 15.1\%$. Conversely, the NDI score notably diminished from the preoperative evaluation of 13 ± 1.95 to the postoperative evaluation of 3 ± 1.06 , as demonstrated in Figure 4.

Column Chart Showing comparisons between pre and post. JOA and NDI SCORE

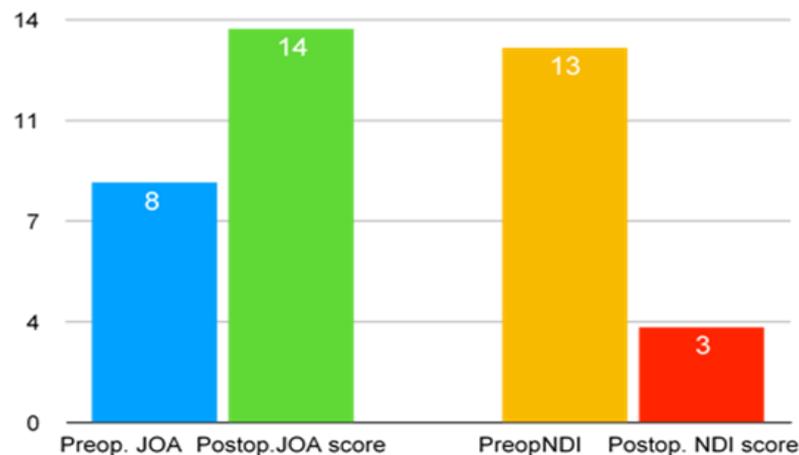


Figure 4. Preoperative & postoperative JOA & NDI scores.

The disparities showed statistical significance with a p-value of less than 0.01. Post-operative recurrent radiculopathy did not occur in any instances. A sole occurrence of dysphagia was observed but subsequently resolved after a span of two weeks following the surgical procedure.

Each functioning component was considered to be united when the movement of a component segment was less than 2° , which was noticeable on radiographs displaying lateral flexion extension. The fusion process would be deemed as accomplished if the adjacent vertebral bodies have wholly absorbed the endplates, consequently forming a solid block devoid of any radiolucency except for the cage itself. After the completion of one year, a significant percentage of 68 surgically treated patients (96%) exhibited complete radiographic fusion, as depicted in Figure 5. The four patients in whom the fusion was not fully accomplished expressed slight discomfort in the neck region but did not present with any indications of pseudarthrosis. The average cervical lordosis

measured $10 \pm 1.59^\circ$ prior to the procedure and notably elevated to $17 \pm 2.79^\circ$ subsequent to the operation.

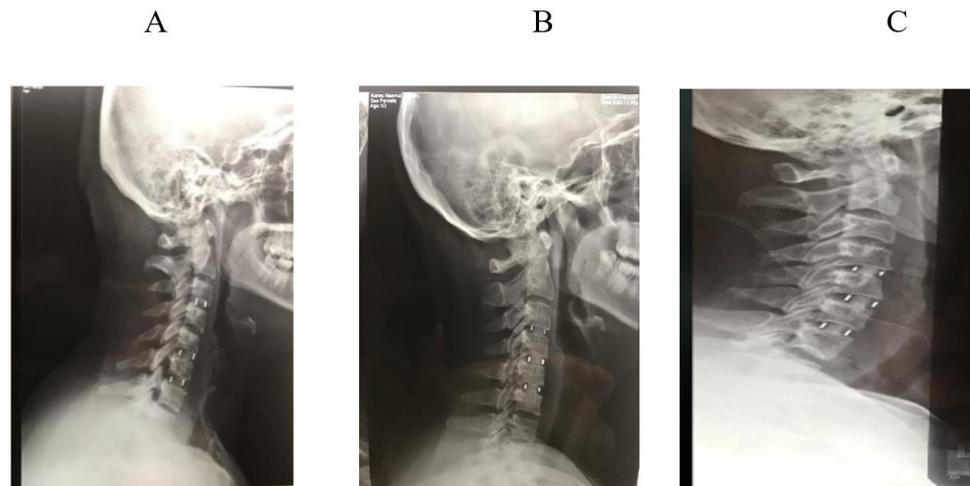


Figure 5. Postoperative lateral cervical x- ray showing fusion of all cervical cges : A (Cervical 3-4,5-6,6-7), B (Cervical 3-4, 4-5, 5-6), C (Cervical 4-5, 5-6, 6-7).

All instances of the kyphotic deformity were rectified with the exception of one patient who unfortunately lost the correction preoperatively (see Figure 6). It was noted that no sign of iatrogenic cervical deformity was observed in any case postoperatively.

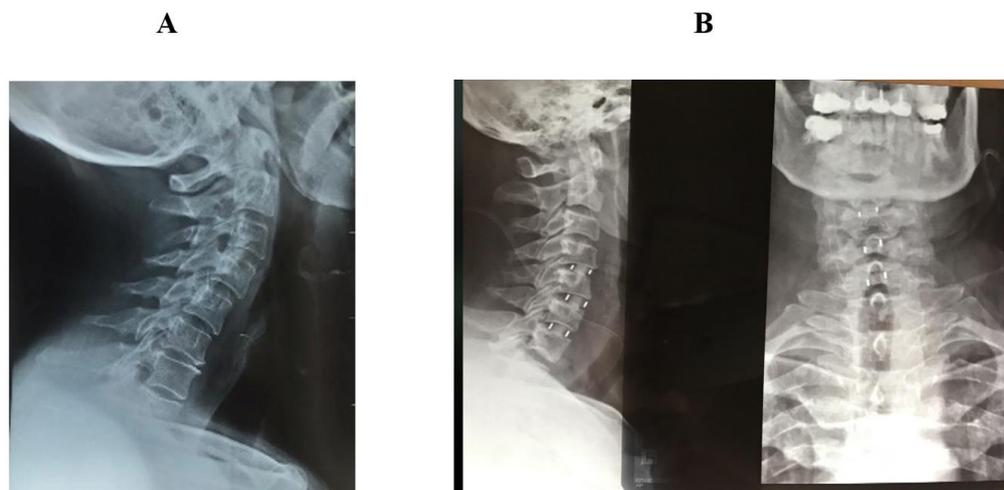


Figure 6 : A: Preoperative lateral cervical radiography with kyphotic deformity. B: Postoperative lateral and AP radiography with cages at Cervical 4-5, Cervical 5-6, Cervical 6-7, and correction of deformity of kyphosis.

4. Discussion

The cervical interbody fusion after anterior discectomy is a surgical approach that has been extensively utilized for treating spinal degeneration at the cervical region. Yet, the optimal technique for achieving superior clinical results remains a contentious issue. Cervical discectomy solely or in combination with interbody fusion or discectomy alongside intervertebral fusion and putting plates are the treatment options available for cervical disc disease. Recently, A potential randomized trial was carried out to compare the effectiveness of Cervical Discectomy anteriorly, Anterior Cervical Discectomy and cervical interbody fusion, and Anterior Cervical Fusion (ACF) with plates and screws. The study revealed there was no substantial variation in the clinical outcome during the follow-up period of 2 years [23]. Several authors have documented decreased occurrences of graft dislodgment and collapse, as well as increased rates of fusion following ACDF with

internal fixation as opposed to ACDF alone [5, 8, 9, 16, 17]. Certain orthopedic surgeons have communicated unsatisfactory results and fusion percentages resulting from an elevated incidence of cervical pseudoarthrosis and interbody dislodgement [12, 14]. They expressed their opinion on this phenomenon was a consequence of the inadequate fixation capability of the cervical interbody cage singularly. This may signify the absence of a robust fastening force in cervical interbody fusion using a cage only, thereby facilitating after operation micro-displacements to persistently transpire amidst the interface of the cage and the vertebra. Such constant micro-displacements impede the instigation of osseous amalgamation [2, 12, 14]. Some studies suggest that in individuals who suffer from cervical disc disease affecting two levels, the anterior cervical discectomy and cervical interbody fusion technique with internal fixation may improve fusion and produce more favorable results compared to interventions involving only one level [3, 5, 7].

However, our research has demonstrated that there was no significant discrepancy between cervical discectomy anteriorly and fusion utilizing only a cage as opposed to cervical discectomy anteriorly and fusion with plate fixation, with respect to fusion rates, dislodgment or subsidence rates, and changes in the angle of kyphosis.

Whilst a variety of technical alternatives for anterior cervical surgery do exist to achieve decompression of the cord and nerve roots in individuals suffering from radicular pain and myelopathy in the cervical region, research has yet to highlight a single technique that can be considered superior or of greater efficacy. The employment of artificial bone grafts, pelvic bone, bone materials, internal fixation, or any graft in the field of literature continues to be a subject of controversy [18, 19, 20, 21, 22]. Certain surgeons hold the belief that anterior fusion subsequent to discectomy is deemed unnecessary [22, 24, 25]. In a randomized trial investigating one-level cervical discectomy anteriorly [23]. It was ascertained that the outcomes exhibited parity amongst individuals who underwent mere discectomy as opposed to those who underwent discectomy concomitant with fusion. However, patients who did not receive instrumentation had a greater occurrence of kyphosis. Wilson and Campbell [23] reported satisfactory outcomes solely through anterior cervical discectomy in 85% of their cohort. Martins [26] reported a favorable outcome following either Cervical Discectomy Anteriorly or Anterior Cervical Discectomy and interbody Fusion during a follow-up period of 10 months; a staggering 92% of their patients displayed positive results.

Nevertheless, it was observed that 10% of individuals who underwent a basic discectomy exhibited a notable development of kyphosis. Watters and Levinthal [27] It has been ascertained those cases who underwent anterior discectomy and fusion displayed expedited alleviation of symptoms as opposed to those who underwent discectomy anteriorly. Additionally, the former cohort manifested a greater prevalence of sustained triumph over a prolonged period.

Sonntag et al. [24] have proposed the use of anterior cervical discectomy (ACD) as the primary treatment for the majority of patients, reserving cervical fusion solely for cases of instability or impending instability due to factors such as acute ruptured disc, Extensive removal of the vertebral body, or previous or planned surgery to remove the bony arch of bone called the lamina. Nevertheless, in their experience, the application of cervical discectomy in isolation frequently led to an extended period of postoperative discomfort, specifically in the neck and interscapular regions, in the immediate aftermath.

In our clinical setting, we consistently utilize interbody cage fusion to eliminate the potentiality of donor-site morbidity, which has been speculated to reach an incidence of up to 35%. The implications of foraminal stenosis and kyphotic deformity following surgery are still indeterminate.

These ailments frequently have an asymptomatic presentation. Nonetheless, there are surgeons who opine that the compromise of sagittal-plane equilibrium may expedite the progression of degenerative disc disease in the vicinity [22].

Hacker et al. [19] divided their patients who underwent fusion procedures into two groups. They reported that 19.8% of the patients who did not show any obvious abnormality before the surgery developed sagittal malalignment postoperatively. During our observation, At the one-year follow-up, we observed a mild kyphotic deformity after operation in one case, where the cage had dislodged into the adjacent vertebral body. Despite the occurrence, no clinical consequences were observed. The procedure of cervical interbody cage fusion appears to facilitate the maintenance of the natural cervical lordosis and its rectification in cases where it has been lost prior to surgery. Additionally, it endows stability to the spinal system, thereby advancing the process of fusion.

In the course of our study, all patients who presented with kyphotic deformity preoperatively underwent successful correction of this abnormality. According to the literature, fusion rates exhibit a marked decline when multiple levels are operated upon, with a greater incidence of pseudarthrosis evident in two-level surgeries as compared to single-level procedures [28, 29, 30, 31]. Martin and colleagues (2020) observed a fusion rate of 90% upon the implantation of freeze-dried allografts after single-level discectomy. However, this rate was reduced to 72% following two-level interbody fusions.

Our research has the rate of fusion was 96% exhibited in patients who underwent cervical discectomy and fusion with cage by anterior approach in three-levels during the 2-year follow-up duration. It was particularly noteworthy that none of the patients exhibited pseudarthrosis symptomatically. Certain writers advocate for the incorporation of a plate system in order to enhance outcomes. Specifically, they have noted that the use of an anterior cervical plate raises the rate of fusions. This facilitates a hastened resumption of work and reduces occurrences of both dislodgement and kyphosis [4, 6, 14]. Lee et al. [5] There have been reports of a greater incidence of kyphosis, suboptimal fusion, and descent among patients who undergo the cervical discectomy and are treated with bone graft taken at the iliac crest, as opposed to patients treated with its bone and stabilized. Their findings also indicate that individuals subjected to a cervical plating experience a quicker return to its job. Although anterior cervical plating is a viable treatment option, it is not exempt from complications and morbidity.

Furthermore, there is a great risk of failure of hardware. Injury to the esophagus is a prevalent occurrence when performing anterior cervical plating subsequent to cervical discectomy by anterior approach. In comparison to anterior plating, interbody cages are situated beneath the edges of the vertebral body, thereby rendering them recessed. Even the most discreet anterior cervical plating extends contact with the surrounding tissues above. Additionally, the cervical interbody cage demonstrates cost-effectiveness [6]. Savolainen and colleagues [23] Reportedly the rate of arthrodesis at the 6-month mark was marginally higher in cases who underwent fusion with anterior plating as opposed to those in whom anterior cervical plating were not used.

5. Conclusion

Our objective is to attain successful rates of fusion and restoration of neurological function while preventing surgery-related complications through the utilization of cervical fusion techniques. The fusion is brought about by prefilled bone material that is placed inside and around the cage itself; this technical approach Offers prompt internal fixation of segments and provides structural reinforcement, even at three levels. Our conclusion is that CFCs possess a capacity to attain elevated fusion rates, even in the context of surgical procedures involving three levels. Moreover, their observed clinical outcomes seem to be favorable or exemplary, with minimal occurrences of surgical or cage-related complications., even in the absence of anterior plates.

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