Integrated Screws with Cage Spacer System in the Treatment of Cervical Spine Degenerative Disease with a Minimum Follow-up of 2 Years

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Abstract

Background: Anterior cervical disectomy and fusion (ACDF) is a widely accepted surgical treatment for cervical degenerative disease. Integrated screws with cage spacer system is a relatively new device designed for patients undergoing ACDF with the dual properties of plating and standalone cage. We are reporting our findings in term of clinico-radiological outcomes following the use of such devices in the treatment of cervical spine degenerative diseases. Materials and Methods: Retrospectively, we studied 18 patients treated with integrated screws and cage spacer system for cervical degenerative diseases with a minimum follow up period of 2 years. We compared the preoperative Visual analogue scale (VAS) pain score both neck and for arm, neck disability index (NDI), overall cervical sagittal alignment (OSA) and segmental sagittal alignment (SSA) with the postoperative data. The final outcome was assessed with Odom’s criteria. Paired student t test was used for statistical analysis. Results: The mean age of the patient was 46 years (range: 29-63 years) with the mean follow up period of 28 months (range: 24-47 months). The total operated levels were 19. Out of which 11 were at C5-C6 level. The mean pain VAS score for neck and arm along with NDI improved significantly after surgery at last follow up. The mean OSA and SSA improved from 8.00 ± 5.00 to 10.61 ± 3.50 and 3.50 ± 3.20 to 8.11 ± 4.65 at last follow up. X ray showed 100% fusion rate and majority of the patients had a good outcome. Conclusion: Integrated screws and cage spacer device is a safe and effective alternative for the treatment of cervical degenerative diseases.

Keywords: Anterior cervical disectomy and fusion, cage system, cervical spondylosis, dysphagia, integrated screws

Introduction

Cervical spondylosis is one of the common degenerative problems in spine. They usually present with neck pain, radiculopathy, or myelopathy. Anterior cervical disectomy and fusion (ACDF) remains the most accepted surgical procedure for the treatment of cervical degenerative disease.[1-4] Most of these procedures are done using anterior cervical plate with the advantages of immediate stability, improved fusion rate, and avoiding graft-related complications. However, plating also has its complications of adjacent segment pathology, soft-tissue injury, implant failure, dysphagia, etc. Furthermore, studies have reported that with the use of standalone interbody cages, there was an increased chance of pseudoarthrosis, cage subsidence, migration, and need for patients to wear a rigid collar after surgery for longer period.[5-8] Song et al.[9] in their study, observed that there was a higher occurrence of pseudoarthrosis in the patient operated with ACDF with cage alone group along with the development of cage subsidence and local kyphosis.

With the aim of providing the biomechanical strength of a traditional stability and also to reduce the complications related with anterior cervical plating or with standalone cage only, a new integrated plate and spacer system has been developed. We have studied retrospectively our experience with such devices in term of clinicoradiological outcomes in the treatment of degenerative cervical spine diseases.

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MATERIALS AND METHODS

We conducted a retrospective study of 18 patients operated with integrated plate and spacer system for the treatment of cervical degenerative disease in our hospital between the duration of September 2010 and September 2013. The inclusion criterion of this study was patients with degenerative cervical spine presenting with radiculopathy or myelopathy not responding to conservative treatment. Patients with infections, tumors, traumatic fractures, and degenerative disease >2 levels involvement were excluded from our study. All the patients were operated by a standard left-sided Smith-Robinson approach to cervical spine under general anesthesia. After cervical discectomy and decompression at the desired level and after the preparation of endplate, trial sizers were used to measure the appropriate size of the cage. A correct size cage packed with autologous bone graft was placed in the prepared disc space. Using aiming device and C-arm guidance, appropriate locking screws of 14 mm or 16 mm length were inserted in the upper and lower cortices, and the final position reconfirmed under C-arm. Postoperatively, patients were advised with soft neck collar for 3 weeks.

The clinical outcomes were assessed using the Visual Analog Scale (VAS) and Neck Disability Index (NDI) score both preoperatively and postoperatively. Radiographic parameters of sagittal segmental alignment (SSA) and overall sagittal alignment (OSA) were assessed and compared preoperatively and at the last follow-up. OSA is an angle formed between inferior endplate of C2 and inferior endplate of C7. SSA is an angle formed between the superior endplate of the upper vertebra and the inferior endplate of the lower vertebra of the affected level [Figure 1]. Fusion was also noted by the presence of continuous trabecular bony bridges anterior or posterior or within the cage. Any absence of such bridges was considered nonunion. Moreover, the final outcome was evaluated at last follow-up using Odom’s criteria as excellent, good, fair, or poor. Complications, including cage migration, pseudoarthrosis, screw loosening, and cage subsidence (>3 mm of distance between midpoint of the upper endplate of the upper vertebrae to midpoint of the lower endplate of the lower vertebrae) were also noted. Statistical analysis was performed using the SPSS software version 16 (SPSS Inc. Chicago, IL 60606-6412) using the pair t-test for comparison, and P < 0.05 was considered statistically significant.

RESULTS

We studied 18 patients (male = 15 and female = 3) with a mean age of 46 years (range: 29–63 years) who underwent ACDF with integrated screws and cage spacer system. The mean follow-up period was 28 months (range: 24–47 months). The total number of operated levels was 19 (17 cases of single-level ACDFs and one case of two-level ACDF). The most common level of surgery was C5–C6 (11 cases), followed by C6–C7 (4 cases), C4–C5 (3 cases), and C3–C4 (one case). The mean operating time was 123 min (range: 100–170 min). Fifteen patients were operated using COALITION cage (Coaliation cage, Globus Medical Inc., Audubon, Pennsylvania, US) and three patients with PEEK prevail cage (Medtronic). The mean VAS pain scores for neck pain and arm pain decreased significantly as compared to preoperative scores. NDI score also showed improvement at the last follow-up. The mean OSA and SSA improved significantly after surgery [Table 1].

All the 19 operated levels had a good fusion on radiographs at the last follow-up [Figures 2 and 3]. The final outcome according to Odom’s criteria [Table 2] was excellent (5), good (11), fair (2), and poor (nil). There were three cases of cage subsidence. Other complications such as dysphagia, pseudoarthrosis, and screw loosening were not detected at the last follow-up.

Table 1: Mean scores preoperative and at last follow-up

| Parameters                  | Preoperative | At last follow-up | P     |
|-----------------------------|--------------|-------------------|-------|
| Mean VAS pain score (neck)  | 6.33±2.08    | 0.94±0.93         | 0.000 |
| Mean VAS pain score (arm)   | 6.50±2.20    | 0.66±0.97         | 0.000 |
| Mean NDI score              | 29.88±5.57   | 3.61±3.07         | 0.005 |
| Mean OSA (angle)            | 8.00±5.00    | 10.61±3.5         | 0.000 |
| Mean SSA (angle)            | 3.50±3.20    | 8.11±4.65         | 0.000 |

VAS: Visual Analog Scale, OSA: Overall sagittal alignment, SSA: Sagittal segmental alignment

Figure 1: Measurement of overall sagittal alignment and segmental sagittal alignment in the lateral view radiograph of cervical spine

Figure 2: Radiographs showing preoperative (a), immediate postoperative (b), and at final follow-up (c). After 2 years, at final follow-up, there is good union
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Table 2: Final outcome assessed by Odom’s outcome score

| Grade  | Outcome                                                                 | Number of patients |
|--------|-------------------------------------------------------------------------|--------------------|
| Excellent | All preoperative symptoms relieved; abnormal findings improved         | 5                  |
| Good   | Minimal persistence of preoperative symptoms; abnormal findings unchanged or improved | 11                 |
| Fair   | Definite relief of some preoperative symptoms; other symptoms unchanged or slightly improved | 2                  |
| Poor   | Symptoms and signs unchanged or exacerbated                              | Nil                |

Figure 3: Radiographs showing preoperative (a) and at last follow-up (anteroposterior view, b and lateral view, c) showing good union with coalition cage

Discussion

Cervical spine degenerative disease is a very commonly encountered problem. It can arise from traumatic injury or degenerative changes due to aging process. Treatment of patients of cervical spondylosis presenting with radiculopathy or myelopathy includes conservative methods such as oral medications, physical therapy, epidural steroids, and surgery. Patients not responding to conservative treatment are subjected to surgery. Various surgical options include cervical disc replacement, posterior laminectomy, laminoplasty, foraminotomy, and ACDF. Smith and Robinson were the first to introduced anterior approach to cervical spine for ACDF with tricortical iliac crest graft. With time several modifications have undergone. Iliac crest bone harvesting is associated with problems such as herniation of abdominal contents, vascular injuries, deep infections, deep hematoma formation, and iliac wing fractures. To avoid these complications, different cages are available for ACDF such as titanium cage, carbon-fiber cage, and PEEK cage. To overcome the problems related with plating or standalone cage, integrated screw and cage spacer system (such as coalition cage, prevail cage, etc.) have been developed. These are newer options of implants available for the treatment of cervical spine degenerative diseases. This implant is made of PEEK polymer and has a titanium alloy markers for guiding its placement and position on fluoroscopy during surgery. It has integrated oblique screws directed upward and downward for placement through the cortices of upper and lower vertebrae, respectively, to provide strong fixation. Several authors have conducted the studies of the biomechanical properties of these devices and found that the integrated screws and cage system give similar biomechanical stability as compared with cervical plating. In the present study, we report our experience with integrated screws and cage spacer system in the treatment of cervical radiculopathy/myelopathy requiring surgery. All the patients in our study had satisfactory outcomes with a significant improvement in their VAS pain score for neck and arm pain. Furthermore, there was an improvement in NDI score at last follow-up. These findings were consistent with other literature. Majority of the studies irrespective of standalone cage, plating or integrated screws, and cage spacer system showed improvement in VAS and NDI score after surgery. Song et al. in their study, found that with the use of cage and plate construct, there was an increase in sagittal cervical lordotic alignment as compared with cage only. Wu et al. also found improvement in mean C2–C7 sagittal Cobb angle at final follow-up with no significant difference between subsidence and nonsubsidence groups. We also found improvement in overall sagittal as well as segmental cervical lordotic angles at last follow-up which is comparable with other studies.

Dysphagia is one of the major problems with ACDF with anterior cervical plating. Integrated screws with cage system offered the advantage of being low profile and hence decrease the rate of dysphagia after surgery. Lane et al. in their study of 57 patients treated with low zero-profile integrated cage and screws implant found two patients with dysphagia lasting for more than 5 weeks with chronic dysphagia rate of 3.5%. Barbagallo et al. also reported moderate dysphagia in three patients (9.3%) and mild dysphagia in two patients (6.2%) which improved and were absent at the first follow-up. However, in our study, we did not encounter any case of dysphagia postoperatively and at last follow-up. This may be because there is no mechanical irritation to the prevertebral soft tissues and esophagus by the cage system as they are completely contained inside the decompressed disc space.

Cage subsidence is another important problem seen after ACDF done with standalone cage. However, it was mentioned that it is less common with plating. We encountered three cases of cage subsidence (<3 mm) in our study. All the cases had a good fusion, and no intervention was required. In a comparative study by Shin et al., the incidence of subsidence was the highest in standalone cage group as compared with plating and zero-profile device, but there was no statistical significance among them. Therefore, it is always not necessary that cage subsidence will worsen the symptoms or lead to poor results. We avoided harvesting iliac crest bone graft in all the patients, thus, avoiding graft site-related complications. Song et al. found fusion in 78.9% in patients operated with cage alone and 97.5% in patient with cage plate construct. Yang et al. reported nonunion in 35% (7/20 segments) after two levels fusion and none (0%) after one level fusion with standalone PEEK cage. Other studies with integrated screws with cage system have shown good fusion rate ≥95%. We found...
100% fusion rate in the present study as per X-ray evaluation [Figure 3]. Our drawback was we could not take computed tomography scan in all the patients which would give a better understanding for bony fusion. There were certain limitations of our study. First, it is a retrospectively collected data; second, there were less number of patients in the study; and finally, the radiographic measurement was done by a single observer only, and hence, observer bias may confound the results.

**Conclusion**

Our findings suggest that integrated screws and cage spacer system are a promising device and a good option for the treatment of cervical degenerative disease. It has an advantage of lesser tissue dissection, low rate of dysphagia, and low subsidence rate with good maintenance of cervical lordosis without compromising its bony fusion. However, to understand the efficacy of such device, a prospective, randomized control study in a larger number of patients and with a longer follow-up may be required.

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**Conflicts of interest**

There are no conflicts of interest.

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