A Comparative Study of ACD with Peek Stand Alone Cervical Cages Versus Cage and Plate Fixation, Study of 100 Patients

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ABSTRACT

AIM: To compare interbody fusion with standalone PEEK cages and augmenting this fusion with cervical plating for degenerative cervical spine disorders.

Material and Methods: A prospective randomized controlled study on 100 cervical disc disease patients between 2007 and 2010.

RESULTS: The patients were classified into group I (ACDF with stand-alone cage) and group II (cervical plate was added). There were no complications related to the surgical approach. No failure or migration of the implants. Initial improvement of the neurological symptoms was achieved in all patients. In the follow up we had solid fusion in all cases. By 18 months postoperatively there was a statistical significant difference in neck pain between the groups in favor of group II. Cage subsidence rate in group I was 52% at 18 months follow up, as compared to only 12% in group 2. We found a statistically significant correlation between cage subsidence and higher grade of neck pain VAS in the postoperative period.

CONCLUSIONS: Adding cervical plate to ACDF with stand-alone cage is associated with less incidence of subsidence, more lordotic alignment and lower incidence of neck pain.

KEY WORDS: Bone graft substitute, Cervical plating, Neck pain, Radiculopathy, Stand alone PEEK cage

INTRODUCTION

Cage-assisted anterior cervical discectomy and fusion (ACDF) has proven to be a safe and effective procedure in current studies. Restoration of physiological disc height leads to restoration of normal alignment, decompression of foraminal stenosis, and prevention of collapse into kyphosis (16). Cervical intervertebral disc replacement by means of a stand-alone cage provides immediate load bearing support to the anterior column and may facilitate arthrodesis (10). On the other hand, there is evidence documenting relatively frequent complications in stand-alone cage assisted ACDF. The most commonly discussed complication seems to be cage subsidence. Bartels et al recently reported an incidence of 29.2% in 69 patients (2). The subject of subsidence tendency has been also analyzed in cadaver laboratory testing (19). Clinical observations indicate that subsidence is a common phenomenon after spine instrumentations. Postoperative subsidence may decrease an initially good correction of foraminal area and intervertebral disc height (9). It can also be a cause of implant-related complications. The majority of these complications appear in the early postoperative period related to the adjustment of the cage-bone interface (9). The interbody cage provides
stability only through tensioning of the remaining ligaments. Thus, it offers little stabilization during extension because the anterior ligamentous structures are absent after ACDF. Some surgeons therefore prefer to add an anterior plate to enhance stabilizing properties (15). The recently introduced so-called dynamic plates carry loads more effectively and allow compressive forces to transfer through an interbody graft, which is essential for interbody fusion (3, 4).

In Egypt during the past decade, many centers have been implicating stand-alone cage for single and even multiple level disc diseases (Figure 1). Many advantages of this technique as the ease of surgery and short operative time, but especially the low cost have gained interest. However on follow up many cases showed subsidence of the cage with subsequent axial neck pain, and the recurrence of radicular symptoms created some concerns about the technique. We decided to run a comparative study between the two techniques.

**Figure 1:** A 42-year-old patient who was referred after 2 procedures of ACDF with stand-alone cage fusion where stand-alone cages with cage subsidence at C6-7 mainly led to axial neck pain. The patient refused reoperation.

**PATIENTS and METHODS**

A prospective randomized controlled study on 100 patients of cervical disc disease diagnosed and treated in 2 hospitals (Arab Contractors Medical Center and Red Crescent Hospital, Cairo, Egypt) between 2007 and 2010.

Inclusion criteria were patients who presented with radicular or myelopathic symptoms due to herniated cervical discs or cervical spondylosis and failed to respond to medical treatment. A trial of at least six months of conservative treatment was given to patients with radicular symptoms. Shorter periods of conservative treatment were offered to those with myelopathy or motor weakness.

We excluded from this study cases with dynamic or static instability as we tend to do fusion and fixation for these cases.

All cases had preoperative complete general and neurological examination. Patients had evaluation of pain using Visual Analogue Score for neck pain and brachialgia. The preoperative protocol included plain radiographs of the cervical spine antero-posterior (AP), lateral and oblique views. All patients had preoperative MRI.

Patients had been randomly divided into two equal groups. Group I had anterior cervical microdiscectomy and fusion (ACDF) with stand-alone cage, group II had additional cervical plating fixation to augment fusion. Informed consent for surgery and participation in the study was taken from all patients.

**Operative procedures:** Standard anterior approach to the cervical spine was used. Complete discectomy with slight distraction using Casper retractor and osteophyte removal and removal of the cartilaginous end plates with preservation of the subchondral bone to avoid cage subsidence was done. Bilateral decompression of the neural foramen has been achieved in all cases.

A cervical cage (Fidji Cervical cage, Zimmer Spine ME, France) was placed in all cases. The size of the cage was determined from preoperative films and seen on intraoperative AP and lateral views on the image intensifier. The cage was filled with bone graft substitute (TCP, Ksios, France) mixed with 1cc blood. Fifty cases had additional fixation with the anterior cervical plate system MAXIMA (U&I, Uijeongbu, South Korea).

Follow up: Pain was assessed at postoperative visits using VAS for both neck pain and brachialgia. Patients had immediate postoperative X-ray (AP and Lateral views) to assess proper instrumentation placement. Patients of group I had external orthosis with hard neck collar with chin support for three weeks postoperatively, while none was needed in group II patients. VAS for neck pain and brachialgia was done in all postoperative visits. Another set of plain radiographs were taken at six months to assess fusion, and at 18 months which was considered the end point of follow up at this study. Disc height was measured on digital X-ray to estimate the degree of subsidence (Figure 2). In our study we considered subsidence as a decrease in the disc height with at least 3mm between immediate and 18 months postoperative lateral X-rays. Postoperative MRI was done to cases of recurrent brachialgia or intolerable neck pain with second surgery being inevitable.

The postoperative clinical and radiological results were compared using the independent T test. All statistical analyses were done using SPSS software (SPSS 18, Chicago, USA).

RESULTS

The patient population was classified into 2 groups where group I had ACDF with implantation of stand-alone cage and group II where cervical plate was inserted to augment fusion.

The sex distribution of the groups are shown in Table 1.

Table 1: Sex distribution of the groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>42</td>
<td>8</td>
</tr>
<tr>
<td>II</td>
<td>40</td>
<td>10</td>
</tr>
</tbody>
</table>

The main presentation at the time of surgery is shown on Table 2.

Table 2: The main presentation at the time of surgery

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Neck pain</td>
<td>84%</td>
</tr>
<tr>
<td>Brachialgia</td>
<td>80%</td>
</tr>
<tr>
<td>Myelopathy</td>
<td>24%</td>
</tr>
<tr>
<td>Radicular Motor Weakness</td>
<td>10%</td>
</tr>
</tbody>
</table>

In group I, 30 patients were operated for single level, 15 patients had 2 levels and 5 patients were operated for 3 levels. In group II 15 patients had single level, 25 patients had 2 levels and 10 patients had 3 level surgery.

The average age at surgery for group I was 46.36, whereas the average age of surgery for group II was 47.36.

There were no complications related to the surgical approach. There was no failure or migration of the implants. Initial improvement of the neurological symptoms was achieved in all patients. None of the patients had deterioration of neurological status. Numbness was present initially in 46% of the patients and resolved in all cases by the end of the first week. We had statistically significant improvement of brachialgia in the immediate postoperative period on both groups.

Neck and radicular pain were measured using Visual Analogue score scale (VAS).

The immediate postoperative neck pain scores in both groups are shown in Figure 3. There was no statistically significant difference between the groups.
In the follow up we had solid fusion in all cases. Patients in group I started to show progressive neck pain starting from the 3rd month postoperatively where by 18 months postoperatively there was a statistically significant difference in neck pain between the groups in favor of group II. The 18-month postoperative pain scores are shown in Figure 4.

Cage subsidence rate in group 1 was 52% at 18 months follow up, as compared to only 12% in group 2. We correlated the cases with cage subsidence with those with neck pain in the postoperative period. We found a statistically significant correlation between cage subsidence and the higher grade of neck pain VAS.

Six cases in group 1 needed reoperation in the follow up period (3 for intolerable neck pain, 1 for recurrent brachialgia and 2 for adjacent segment disease). Only one case of group 2 needed reoperation for adjacent segment degeneration following 3 levels ACDF.

**DISCUSSION**

Anterior cervical discectomy and interbody fusion (ACDF) is a well-accepted management option for the treatment of persistent cervical radiculopathy or myelopathy due to cervical disc prolapse. Typically a fusion is performed to stabilize the segment, maintain foraminal height and the normal sagittal profile (14).

With the use of un-instrumented autograft fusions, there is an incidence of graft displacement, subsidence and non-union (8). More recently synthetic cages, initially titanium and more recently polyetheretherketone (PEEK) have been employed.
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. However, recent studies have shown that cage subsidence is a major complication of ACDF using stand-alone cages regardless of the composite materials (20).

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 (18). However, various degrees of subsidence have been reported after ACDF using stand-alone PEEK cages (20).

Cage subsidence is a concern in that the decrease of the foraminal volume, cervical spine instability and loss of segmental lordosis can lead to adjacent segment degeneration (12).

Many spine surgeons induce bone fusion by filling the cage with autogenous iliac cancellous bone, achieving good or excellent clinical outcomes and fusion rates. However, others have reported poor clinical outcomes and fusion rates secondary to a high rate of cage subsidence, local kyphosis, and pseudarthrosis (17).

The rate of cage subsidence is variable at different studies. With stand-alone cages there are incidences from 13-62% in different studies (1, 2, 7).

Studies comparing the 2 techniques are few. Song et al in their published series in spine 200917 compared two patient groups of stand-alone cage with cage and plate fixation. The use of cage and plate construct in 1- or 2-level ACDF results in a more lordotic alignment, an increased disc height, a higher fusion rate, a lower subsidence rate, and a lower complication rate than that of cage alone. However, they did not find a clinical outcome difference between the groups. They had a rate of subsidence of 32.3% in the stand-alone cage group as compared to 9.7% in cage and plate group.

Our study was a prospective study that was conducted on 100 patients with cervical disc prolapse who were surgically treated by ACDF. Patients were classified into 2 groups; group 1 (N=50) in whom interbody fusion was done using stand-alone cage, and group 2 (N=50) in whom interbody fusion was done by cage augmented by anterior cervical plating.

Some studies document a male to female ratio in cervical disc diseases of 2:1 to 3:1 (6, 13). We had 4.5:1 male to female ratio. The reason of that is that most of the cases were operated at the Arab Contractors Hospital in Cairo, which a hospital is belonging to a major construction company in Egypt with predominant male workers.

In this study we had 100% bone fusion after 6 months using PEEK cages and bone graft substitute. This was similar to many studies with more or less similar techniques (11). This technique also eliminate the need of iliac crest graft harvesting with graft site complication reported as high as 10-18% in many series (5).

In our study lordotic alignment was preserved in 94 % of cases in group 2 as compared to 64 % in group 2.

We considered subsidence as a decrease in the disc height with at least 3 mm between immediate and 18 months postoperative lateral X-rays. The rate of subsidence in the stand-alone cage group (group 1) was 52%, whereas the rate of subsidence in cage and plate fixation was 8 %, which is towards the high end incidence in cage subsidence studies. We have no clear explanation for the high subsidence rate and we plan to carry on a future study for factors affecting cage subsidence in stand-alone cages.

In our study there was no statistically significant difference between the two groups with regards to the improvement of brachialgia, and immediate post-operative neck pain. However, an important finding in our study with regards to the clinical outcome, is that we found that patients of stand-alone cage group (group 1) started to develop neck pain starting from the third month post-operative and by the 18 month post-operative there was statistically significant difference in neck pain between the two groups as assessed by VAS score (64% neck pain grade 3 or more in group 1 as compared to 6% in group 2).

The neck pain may be secondary to increased tension in the posterior cervical area, an imbalance of the cervical lordotic curve caused by cage subsidence and local kyphosis.

**CONCLUSION**

The use of cervical plate and cage fixation in ACDF is associated with less incidence of subsidence, more lordotic alignment and lower incidence of neck pain than the use of stand-alone cage. Our results prove that adding anterior cervical plating improve the outcome in patients.
operated for cervical spondylosis and disc herniation rather than inserting stand-alone cervical cage over at least 18 months follow up. Studies needed however to documents the factors leading to increase incidence of cage subsidence in stand-alone cervical cages.

REFERENCES