

Fusion rate following fixation with anterior titanium plate and screws in association with anterior cervical micro-discectomy and interbody insertion of bone-filled PEEK cage in cases of single level cervical discogenic radicular pain.

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Abstract: Background: A lot of previous studies concerning cervical fusion have discussed the issues of using PEEK cages versus autologous bone graft, filling the cage with natural or artificial bone versus inserting it empty and the use of titanium plate for multi-level cervical disc disease; but less number of previous studies have discussed anterior cervical microdiscectomy plus interbody insertion of bone-filled cage plus fixation using anterior titanium plate and screws in single level cervical disc disease especially those with radiculopathy without myelopathy. **Material and methods:** A retrospective study (over the last 2 years) of 36 patients surgically treated with single level anterior cervical microdiscectomy and interbody insertion of artificial bone-filled cage in addition to fixation using anterior titanium plate and screws aiming at evaluation of clinical and radiological outcome of this technique and how far it can produce fast, good and solid fusion and minimize early and late complications. **Results:** Immediately after the procedure, all cases revealed disappearance of the radicular pain due to the enough nerve root decompression. After clinical and radiological follow up for an average period of 18 months, no one of these patients showed disc space collapse, kyphotic deformity, non-union, cage extrusion or erosion into the vertebral body or plate and screws displacement or pull out. On the other hand the rate of degeneration in the neighboring levels was slightly increased. **Conclusions:** The addition of plate fixation following anterior cervical microdiscectomy and artificial bone -filled PEEK-cage implantation is a safe and highly effective procedure in obtaining good solid fusion.

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Introduction

Anterior cervical discectomy and fusion (ACDF) is a highly effective procedure in the management of neural compression by cervical disc material and/or osteophytes. After sufficient discectomy, good drilling of the vertebral endplates prevents pseudo arthrosis and leads to higher rate of fusion and consequently successful outcome. However, with multilevel procedures, the fusion rates decrease and are much lower than that with single-level surgeries. The lower fusion rates have been attributed to the increased number of grafts and interfaces that mostly consolidate with multilevel surgery and to the increased stresses on the multiple graft sites and the resultant micro-motion (Robinson et al., 1962).

In cases of multiple levels cervical disc disease, attempts were made to increase the fusion rates through total or subtotal corpectomies, so that only two osseous surfaces for single bone graft need to heal to obtain a solid fusion. Other methods involve filling the cages with bone or bone substitutes, and the use of anterior cervical plates across the entire

fusion construct to provide increased stability and minimize micro-motion at the bone graft interfaces (Coric et al., 1997).

The use of anterior cervical plating in spinal surgery has increased recently. Several biomechanical studies have demonstrated the added stability provided by these plates which theoretically may result in increased fusion rates (Connolly et al., 1996).

The use of anterior cervical plating for single level ACDF is controversial. Some studies demonstrated increased single-level fusion rates and decreased reoperation rates with the use of cervical plate fixation (Coric et al., 1997).

Others showed decreased fusion rates for single level fusions with the use of plates because they may hold the disc space in distraction and prevent graft settling which may be important in graft consolidation (Capen et al., 1997).

The aim of this study is to review the results, fusion rates, complications and outcome of anterior cervical discectomy, with bone patty-filled PEEK

cage implantation, and anterior cervical plate fixation in single level cervical radiculopathy.

Material and Methods

This is a retrospective study that was carried out in Al-Azhar University Neurosurgical Spine Centre where review of achieved files containing full data (history, clinical examination, laboratory and radiological investigations, conservative and surgical management and follow up data) for 36 patients whom were suffering from unilateral cervical radicular pain resulting from ipsilateral single level cervical disc prolapse. All patients were proved refractory to conservative outpatient treatment for at least 3 months which included anti-inflammatory medications, physical therapy, periods of rest and neck collar limitation of neck mobility. After that all patients were admitted consequatively for management surgically through single level anterior cervical microdiscectomy and interbody insertion of bone-filled cage and fixation using anterior titanium plate and screws.

The procedure: After fluoroscopic leveling and under microscopic visual magnification using knife, disc rongure, currets and high speed drill, all disc material was removed along with endplate and osteophytes back to the posterior longitudinal ligament and bilaterally to the unco-vertebral joints. Casper retractor with pins screwed in the upper and lower vertebral bodies for temporary distraction.

After satisfying nerve root decompression, poly ether ether ketone (PEEK) cages were used after being filled with artificial bone and inserted in the resulted disc space. Height of the used cages varied from 4 mm up to 8 mm with small, medium or large widths as suitability to disc space. Enough spacing during discectomy using vertebral spreader or Casper retractor was done to allow insertion of cage with height more than the relaxed disc space resulting in compression and impaction of the cage after removal of the retractor. Thereafter, anterior titanium plates of convenient lengths were affixed with two screws in each of the upper and lower vertebral bodies followed by tightly screwing the small locking screws to prevent pull out. Postoperative, hard cervical collars were used for 6 months. Plain X-Rays were taken in the second post-operative day for all cases to insure that hardware (cages, plates and screws) are in place (Figure 1) and then at 1, 6, 12 and 18 months after surgery (Figure 2). Satisfactory fusion was confirmed especially on the basis of the lateral radiographs by presence of continuous trabecular bone bridges in the disc space, absence of motion between spinous processes in flexion-extension lateral films and absence of the radiolucent gap between the endplates. Pseudoarthrosis was confirmed if any by the absence of these trabecular bone bridges, motion on the dynamic radiographs, and a radiolucent line between the endplates.



Figure (1) one day post operative lateral plain x ray showing C5-6 ACDF with bone patty-filled cage and plate in place.



Figure (2) Follow up lateral plain x ray 18 months later showing complete solidified fusion in a single level ACDF

Clinical outcome assessment after 18 months of follow up was done according to Odom's scale

criteria (table1) utilizing residual neurological symptoms and clinical findings.

Table (1): Odom's scale criteria for clinical outcome

<i>The scale</i>	<i>Preoperative symptoms</i>	<i>Abnormal findings (signs)</i>
Excellent	All relieved.	Improved.
Good	Minimal persistence	Unchanged or improved.
Fair	Definite relief of some	Unchanged or slightly improved
Poor	Unchanged or exacerbated	Unchanged or exacerbated

Early and late possible postoperative complications were searched for from clinical and radiological points of view especially hardware failure complications and development of adjacent level new disc prolapse which is anticipated if was markedly degenerated in the pre-operative MRI.

In absence of radiological signs of complications, evaluation of completeness of fusion is looked for.

Simple statistical parameters were applied using personal computer with the aid of statistical package (SPSS) version 9. Numerical data were expressed as minimum, maximum and mean \pm standard deviation.

Results

This retrospective study involved 36 patients whom were complaining of cervical discogenic radicular pain due to single level cervical disc prolapse.

Ages of the included patients ranged from 22 – 58 years with the mean \pm SD = 41.5 \pm 9.4 years. There were 26 males (72%) and 10 females(28%).

After conservative treatment for at least 3 months (3-6 months with different pain tolerabilities), all patients underwent surgical intervention through the procedure of fixation using anterior titanium plate and screws in association with anterior cervical micro-discectomy and insertion of bone-filled PEEK cage in the interbody space.

The total number of levels operated upon was 36 single levels where 36 cervical cages and 36 anterior cervical plates and 144 screws were consumed. Height of the used cages ranged from 4 mm up to 9 mm.

After surgery, all patients showed a significant reduction in the radicular pain. Radicular numbness across the related dermatome continued for 2 weeks with gradual fading in 12 patients (33%).

Plain X-rays taken in the 2nd day after surgery for all cases insured that hardware (cages, plates and screws) were in place.

Six months after surgery, 31 patients (86.1%) rendered radicular pain-free, while 5 patients (13.9%) still complaining from intermittent effort-related axial neck pain that was usually relieved by simple analgesia alone or with physiotherapeutic remedies.

One year after surgery, 34 patients (94.4%) rendered pain-free while still 2 patients(5.6%) complaining of mild tolerable radicular pain that sometimes needed simple oral analgesics.

One and half years (18 months) later, 34patients (94.4%) became pain free, 1 patient (2.8%) still complaining of mild tolerable radicular pain while 1 patient (2.8%) suffered from recurrence of progressive radicular pain explained after MRI imaging by an ipsilateral disc protrusion of the adjacent level below the operated one.

Solid fusion on radiological bases (continuous trabecular bone bridges in the disc space, absence of motion between spinous processes in flexion-extension lateral films and absence of radiolucent gap between the endplates) was obtained in 22 cases (61%) by 6 months and in 12 cases (33%) by 12 months while the remaining 2 patients showed complete fusion after 18 months.

No one of the 36 cases showed infection, early or late hardware failure, pseudoarthrosis, misalignment or cage settling into vertebral bodies.

According to Odom's criteria, the outcome was excellent in 94.4%, good in 2.8% and poor in 2.8 (table 2). So, anterior cervical discectomy with implantation of bone-filled PEEK cages and anterior titanium plating for single level cervical discogenic radicular pain is an effective and safe technique in obtaining persistent pain-free state.

Table (2): Results of ACDF sorted according to Odom's criteria.

Odom's outcome scale	No of cases	%	Symptoms	Signs
Excellent	35	(94.4%)	All relieved	Improved.
Good	1	(2.8%)	Minimal persistence	Improved
Fair	0	0 %	Relief of some	Unchanged
Poor	1	(2.8%)	Unchanged or exacerbated	Unchanged or exacerbated

Discussion

In this study, we concluded the effectiveness of management of cervical radicular pain in selected patients with single level degenerative cervical disc prolapse aiming at long term pain free state through utilizing all the best available proved techniques including insertion a PEEK cage instead of leaving empty disc space after anterior microdiscectomy and filling the cage's space by artificial bone instead of leaving it unfilled or use autologous iliac crest graft (Lied et al., 2010) giving chance for donor site morbidity and routine addition of fixation with anterior cervical plate and screws to provide best chance for obtaining fast solid fusion as evaluated along 18 months of follow up where all patients showed radiological fusion with most of cases have already obtained their fusion by 6 months, and there was no detected misalignment. The only radiological complications that later developed was the appearance of new disc prolapse in adjacent levels to the fused segment in 1 cases at 18 months after the procedure.

Some studies already discussed the utilization of the PEEK cages without filling it with bone graft or patties and they proved a decreased incidence of post-operative fusion compared with the filled cages as the study of Pechlivanis et al. (2011) discussing implantation of empty PEEK cages after anterior cervical discectomy showed an unexpectedly low rate of fusion according to radiologic criteria, although no statistically significant difference could be observed clinically.

The importance of additional fixation with cervical plate for single or multi-level ACDF was debatable and has been covered in several studies as that of Jeffrey *et al.* They proved increased efficacy of the technique resulting in a better fusion in multilevel ACDF obtained from limiting the micro-motion that destroy fusion attempts and subsequently decreasing the pseudoarthrosis rates. But was debatable concerning the single level fusion surgery, where some studies as that of Capen *et al.* (1997) proved decreased fusion rate assuming that plating for single level leads to more distraction of the fused surfaces. Really, in the procedure used in our study, no distraction is allowed due to the enough spacing during discectomy using vertebral spreader or Casper retractor allowed insertion of cage with height more than the relaxed disc space resulting in compression and impaction of the cage after removal of the retractor without dead space or mobile interfaces.

Although there were always potential hardware complications associated with the use of spinal instrumentations (Connolly et al., 1996), in this study there were no complications associated specifically with the use of the cervical cages or plates and

screws. This could be explained by the limited number of cases in our study, choice of best commercial types of hardware and extra-care during its application.

Conclusion

Anterior cervical microdiscectomy with implantation of bone-filled PEEK cages and anterior titanium plating for single level cervical discogenic radicular pain is an effective and safe technique in obtaining persistent pain-free state with very high rate of solid bony fusion within 18 months and without an increase in early or late possible complications. Only mild increase in probability of developing new disc prolapse in the adjacent levels (2.8%).

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