

# Results Following Posterior Cervical Microforaminotomy and Discectomy using McCulloch Retractors for Cervical Radiculopathy

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## Abstract

Cervical radiculopathy frequently occurs secondary to degeneration of cervical disc and cervical spondylosis. The herniated disc material and the osteophytes compress the spinal cord and the nerve roots, resulting in clinical symptoms. Severe pain and neurological deficits often requires surgical intervention. Surgical management for radiculopathy of the cervical spine includes Anterior Cervical Discectomy with Fusion (ACDF), cervical foraminotomy via an anterior (ACF) or posterior approach, and Anterior Cervical Decompression and Arthroplasty (ACDA). Surgeons tend to choose the surgical method that is appropriate to the patient's needs, the pathological characteristic of the case, and the surgeon's skill.

**Keywords:** Radiculopathy • Arthroplasty • Surgery education

## Introduction

ACDF is the most frequently used method and considered standard for cervical degenerative disease. Advantages of ACDF include the wide exposure of the lesion, direct decompression of neural structures and reproducible results [1,2]. However, complications such as graft-site complications, implant related complications and pseudoarthroses may be encountered. Moreover, loss of motion and long-term consequences of cervical fusion on treated segments have been associated with increased pressure in the adjacent disc space which leads to adjacent segment degeneration [3,4]. Artificial Cervical Disc Replacement (ACDA) and posterior cervical microforaminotomy is advantageous for preserving segment mobility. Results of ACDA are controversial and mobility following ACDA after 2 years is doubtful. The anterior approach is especially useful and indicated for patients with the midline or para median localized cervical disc herniation and osteophytes, but for patients with posterolateral disc herniation and osteophytic structures which is a more common entity, a posterior approach may be less morbid than an anterior approach while providing adequate decompression and relief of symptoms. Posterior Cervical Microforaminotomy was first described by Scoville in 1946 as a treatment option for cervical disc herniation [5-8]. It is safer, less time consuming and does not have implant related complications. This reduces the hospital stay and is economically favorable to the patient. This approach provides easy access to multiple segments with bilateral foraminotomies and also allows laminectomy and laminoplasty when necessary. This procedure can be done by tubular retractor or Mccullochs retractors. Tubular retractor requires expertise, use of microscope and training. Insertion of guide wire for localization of tube adds risk of intraoperative injury to neural structures. Whereas use of Mcculloch retractors is easy, safer and can be done via posterior approach at any small set up. It provides more exposure so it can be performed without use of microscope. This prospective study was designed for the functional outcome of posterior cervical microforaminotomy.

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## Materials and Methods

Total 31 cases were included in this prospective study having cervical radiculopathy.

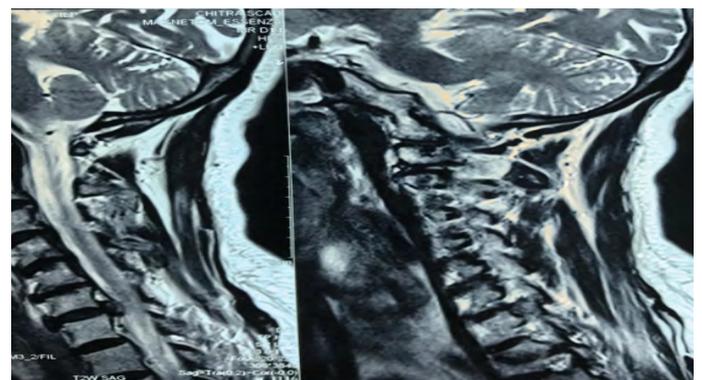
### Inclusion criteria

- Patient having unilateral radicular symptoms and/or neck pain consistent with radiologic findings as per Magnetic Resonance Imaging (MRI) having unilateral cervical foraminal stenosis or unilateral posterolateral soft disc herniation (Figure 1).
- Not responding to conservative treatment for at least 6 weeks.
- Normal cervical lordosis and stable cervical spine as per radiograph (Figure 2).

### Exclusion criteria

- Bilateral radicular symptoms.
- Symptoms <6 weeks with absence of myelopathy or cord edema or significant muscle weakness.
- The midline or para median localized cervical disc herniation in MRI.

Visual Analogue Scale (VAS) score was used for radicular pain to evaluate clinical outcomes. Plain cervical radiographs were performed before surgery, after surgery and at the time of final follow-up to assess spinal instability and



**Figure 1.** Resonance Imaging (MRI) having unilateral cervical foraminal stenosis or unilateral postero-lateral soft disc herniation.



**Figure 2.** Normal cervical lordosis and stable cervical spine as per radiograph.

cervical lordotic angle. Spinal instability was defined as recent translation of >3.5 mm or angulation of >11 degrees in the index level. The Cobb angle of C2 to C7 was measured on neutral plain radiograph for evaluation of the cervical lordotic angle. Surgical procedure- After thorough preoperative evaluation, proper informed consent were taken for surgery. After induction of General anesthesia patient placed in the prone position (Figure 3), a midline skin incision placed over affected level, paravertebral muscles of desired side retracted subperiosteally up to facets to expose the desired space. Mccullochs retractors applied (Figure 4) and the level was confirmed using image. All procedures were performed under the microscopic view. Laminotomy was done using high-speed burr and Kerrison rongeur in the lateral third of the lamina and then the facetectomy done at medial half but more than half of the facet joint was preserved (Figure 5). Hemostasis achieved of bleeding from the epidural vein and radicular plexus using bipolar cautery. Sequestered disc were removed after teasing out by a nerve hook. In the case of contained disc herniation the discs were extracted by incising posterior longitudinal ligament by a knife or sharp Penfield dissector. The osteophytic structures or ossified PLL were excised using a 5 mm osteotome when required. The foramen were decompressed and confirmed with help of probe. After we confirmed under the microscopic view that the root was properly decompressed, the wound was closed layer by layer without using drain.

### Post-operative management

IV antibiotics were given for one day then shifted to oral drugs. Mobilization and physiotherapy started on same day and patient was discharged on next day. Soft cervical collar was applied for 2 weeks. Patient was allowed to return to normal activity after 7-10 days.

### Observations

Out of 31 patients 17 were male and 14 were female in this prospective study. Mean age was 41.58 years (Range 23 to 64 years), for females 42.29 (range 25 to 63 years) and for male 41 years (range 23 to 64 years). Mean follow up was 22.5 months. Most common affected level was C5-C6 in 16 patients. 11 patients were affected at C6-C7, 2 patients each at C 4-5 and C7-T1 level. Left side radiculopathy was present in 17 patients and 14 were having right side radiculopathy. Mean preoperative duration of radiculopathy was 8.4 weeks (range 4 to 14 weeks). Extruded disc, contained disc and hard disc were present in 22, 6 and 3 patients respectively. There was variable muscular weakness in 7 patients. For radiculopathy postoperative VAS score

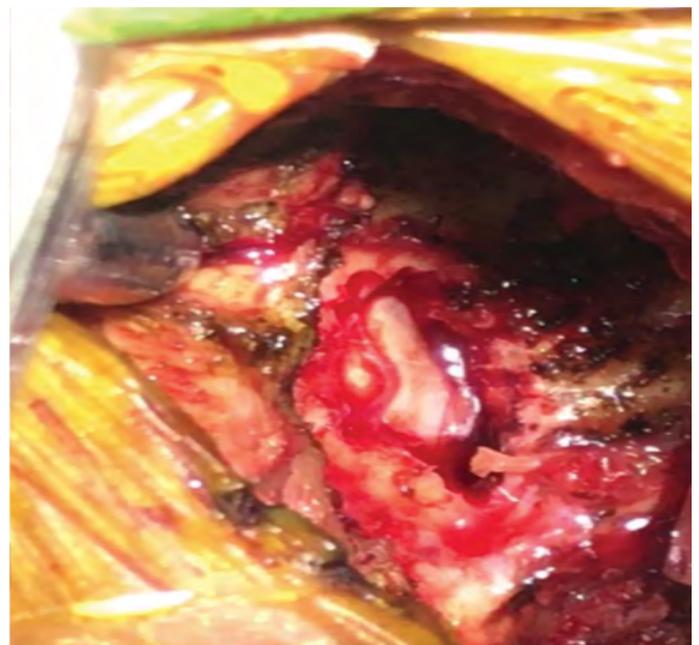
(0.2) was improved in all patients in comparison with preoperative VAS score (7.7). C2-C7 angle before surgery was reduced post operatively but it was not significant (p value 0.267 i.e. >0.05) (Graph 1). In one patient extruded disc removal was incomplete according to preoperative MRI, but he got significant pain relief from radiculopathy. The mild paresthesia was present in 4 cases postoperatively; all got relieved within 2 weeks with conservative treatment. There was superficial infection in one patient who was known case of diabetic, infection was subsided after serial dressings and oral antibiotics according to sensitivity.



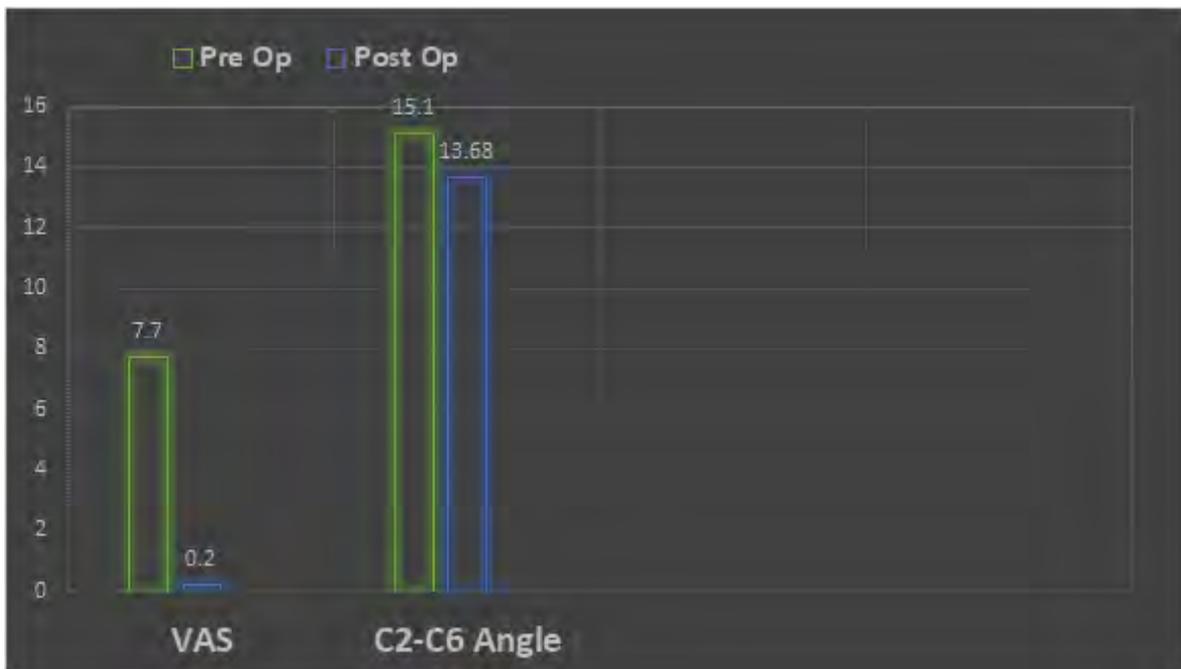
**Figure 3.** Induction of General anesthesia patient placed in the prone position.



**Figure 4.** Mccullochs retractors applied and the level was confirmed using image.



**Figure 5.** Facetectomy done at medial half but more than half of the facet joint was preserved.



Graph 1. All patients in comparison with pre-operative VAS score (7.7). C2-C7 angle before surgery was reduced post operatively but it was not significant.

## Discussion

Cervical radiculopathy is frequently observed and it may cause pain, altered sensations, sensory symptoms, weakness or altered reflexes. Incidence of cervical radiculopathy is 107.3 per 100,000 for men and 63.5 per 100,000 for women with a peak at 50 to 54 years of age [9]. Diagnosis can be made with clinical picture and by radiograph and MRI scan. While most cases are self-limiting, some are refractory to conservative care [10]. Cases not responding to conservative care requires surgery. The main aim of any type of surgery in these patients is to decrease pain and improve neurological deficits. This can be accomplished by decompression of the compressed nerve root. Radiculopathy can be caused by osteophytes and hard disc causing stenosis or soft disc herniation. Different techniques are required to treat them. Anterior approaches are used most frequently. They allow for restoration of cervical lordosis and spinal stabilization through fusion, and allows easy access to anterior compressive lesions, such as central or paracentral disc herniations or uncovertebral osteophytes, without the need for neural retraction. ACF, ACDF, ACCF (anterior cervical corpectomy and fusion) and ACDA can be done via this approach. But complications associated with anterior approaches are major including injury to nearby neurovascular structures and esophagus leading to esophagus perforations, cerebral ischemia, lesion of the sympathetic plexus, vocal cord paralysis [11-16]. Injury to the vertebral artery ranges from 0.3% to 0.5% [17,18]. There is 2% risk of permanent injury to superior and recurrent laryngeal nerves and 0.25% risk of esophagus perforation [19-21]. Implant related complications like increased cost, dislocation of implant, infections, degeneration of adjacent segment and graft related complications like graft rejection, dislocation, nonunion, donor site morbidity are associated with anterior surgeries. The risk of complications related to graft-site is up to 18% [22]. However, ACDF is most commonly used procedure but it is not motion preserving so adjacent segment degeneration occurs. Rate of adjacent segment degeneration in 10 years of surgery is 25.6% [23].

ACDA is motion preserving procedure but results are controversial as biomechanical studies shows increased range of motion at the implanted segment in comparison to normal physiological segment which causes increased adjacent segment degeneration [24]. Approach related complications are mostly similar to ACDF but dysphagia and recurrent laryngeal nerve injury are notably high [25,26]. Some specific complications are also related to arthroplasty including prosthesis mal-positioning and displacement,

subsidence and heterotopic ossification [27]. In Anterior cervical foraminotomy motion segment is kept intact so adjacent segment degeneration doesn't occur. ACF is devoid of implant related complications but excessive resection of an uncovertebral joint may cause instability and leading to a second surgery for fusion [28]. Additionally, it is technically challenging and has high learning curve. Decompression at C7-T1 and multilevel decompression are not feasible with this procedure. Posterior microforaminotomy is motion preserving. Posterior microforaminotomy can be extended to multiple segments and implant related complications are also absent. Not using implants makes it cost effective and increases satisfaction level of patient. In the study of Haley E, W Jeffrey et al. at one level of ACDF costs 89% higher than posterior microforaminotomy. Most importantly posterior approach minimize manipulation of neural structures and exposes the involved nerve root directly to offer better visualization of the exiting nerve root. The hospital stay is less in posterior cervical foraminotomy in comparison with anterior cervical surgeries. Early mobilization leads to early return to the work so less morbidity is associated with posterior surgery.

Posterior approach is utilized by the tubular retractor and Mcculloch retractors. There are technical difficulties in the tubular retractor as it requires skilled surgeon and instrumentation like microscopes. Insertion of guide wire for localization of the tube may injure neural elements [29-31]. Another disadvantage is increased X-ray exposure. Whereas conventional midline posterior approach is used in case of Mcculloch retractor system which provides good exposure of surgical field which also allows excision of contained disc and hard disc as well as soft herniated disc. Therefore, posterior microforaminotomy and discectomy using Mcculloch retractors can be done in small set up without instrumentation. In our series of patients who underwent operative treatment of cervical radiculopathy, C5-C6 was the most commonly affected levels. This is consistent with the findings of several previous studies showing that the C5-C6 and C6-C7 disc levels are the most susceptible to degenerative disease and resulting nerve root impingement [10-33]. This can be explained by high load subjected at C5-C6 and C6-C7 level because maximum flexion and extension occur over here. Cadaveric dissections in the lower cervical spine revealed that at the C5-C6 and C6-C7 levels the intervertebral disc has an "axillary" relationship to the nerve root, which may have an increased propensity for symptomatic compression compared to the C7-T1 disc, which usually had no direct contact with the C8 nerve root [34].

Various studies shows pain relief after surgery is comparable among anterior and posterior surgeries. According to Kyoung -Tae Kim, Dae Chul

Chol et al. post op VAS score is 1.3 in anterior and 1.6 in posterior surgery. C Balsubramanian, R Price et al. study show 1 post op VAS score for anterior surgeries and 1.14 for posterior surgeries according to Subramanian N, Srikanth U et al. In our study post op VAS score was 0.2 which was significantly reduced ( $p$  value $<0.01$ ). We did not face any case of postoperative kyphosis in our study. Reduction in C2-C7 angle was not significant in our study ( $p$  value $>0.05$ ). This is supported by Hyo-Cheol Jeon, et al. The extent of facet resection required during posterior foraminotomy kept less than 50% and facetectomy was unilateral in all of our cases. If segmental instability is suggested in the evaluation of preoperative flexion and extension views, posterior foraminotomy should be clearly excluded from the surgical options. Minimal and unilateral paraspinous dissection and facetectomy for one- or two-level radiculopathy do not influence the development of postoperative cervical kyphosis because contralateral paraspinous muscles and midline ligamentous structures are preserved although we exclusively included cases with single affected level. In posterior surgeries indirect decompression is achieved so exposure is less and neural retraction is minimal so this method is difficult in more medial disc herniation, long standing cases, compression due to osteophytes. Direct decompression through anterior approach is preferable in these cases. Our study also has some limitations like sample size is small, and we did not compare study with other methods.

## Conclusion

Posterior microforaminotomy and discectomy using Mcculloch retractors in cervical radiculopathy is a safe method for decompression of nerve roots without using implants with preservation of motion. It does not require technical expertise in use of tubular retractor. Contained disc and hard disc removal, although difficult, is feasible with this technique. Multiple segments can be approached by this approach. This technique is adequate, economical and safe in selected cases of unilateral cervical radiculopathy.

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