

## Assessment of Disk Preserving Functional Cervical Disc Surgery

Santosh J Mangshetty<sup>1</sup>, Abhinandan Gangannavar<sup>2</sup>, Satish Rudrappa<sup>3</sup>, Swaroop Gopal<sup>4</sup>

**Author's Affiliation:** <sup>1</sup>Consultant, Department of Neurosurgeon, Mangshetty Neuro Clinic, Arya Elite Complex, behind Anand Hotel, NV Layout, Kalaburagi, Karnataka 585102, India. <sup>2</sup>Consultant, Department of Neurosurgeon, Sparsh Hospital, Yeshwantpur, Bengaluru, Karnataka 560022, India. <sup>3</sup>Consultant, Department of Neurosurgeon, Sakara World Hospital Bengaluru, Karnataka 560103, India.

**Corresponding Author:** Santosh J Mangshetty, Consultant, Department of Neurosurgeon, Mangshetty Neuro Clinic, Arya Elite Complex, behind Anand Hotel, NV Layout, Kalaburagi, Karnataka 585102, India.

**E-mail:** [intellec19@yahoo.com](mailto:intellec19@yahoo.com)

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### Abstract

**Introduction:** Majority of the cases of cervical radiculopathy are due to the anterior relations of the cervical nerve root, with disc herniation and uncovertebral osteophytes. The standard techniques of surgery were posterior laminoforaminotomy and anterior discectomy with or without fusion. The main limitation of these techniques being excessive bleeding and fusion related adjacent segment disease. The disk preserving functional cervical disc surgery is minimally invasive anterior cervical disc preserving technique of upper vertebral transcorporeal anterior microforaminotomy. **Objectives:** To assess the Disk Preserving Functional Cervical Disc Surgery for cervical radiculopathy cases. **Methodology:** This is a non randomized prospective study carried among 11 consecutive patients who were operated for cervical radiculopathy with the new technique at the Department of Neurosurgery, Manipal Hospital, Bangalore. The patients were considered for surgery on the basis of Inclusion criteria: Unilateral cervical radiculopathy not responding to conservative treatment of more than 6 weeks (or earlier if patients exhibited profound weakness). Imaging studies were corresponding to the clinical features. **Results:** The majority of patients mean preoperative disc height was in the 5.5 to 6.0 group. One patient disc height was in the 6.0 to 6.5 group. The mean disc height was 5.59 mm preoperatively and 5.49 mm postoperatively. There was no significant reduction in the disc height postoperatively. The spinal motion was preserved at the operated level in all patients. **Conclusion:** The modified transcorporeal anterior cervical microforaminotomy technique is a minimally invasive procedure for the treatment of cervical radiculopathy as it preserves most of the disc tissue.

**Keywords:** Cervical disc surgery; Cervical radiculopathy; Disk preserving technique.

### Introduction

Cervical radiculopathy is mainly a disease of the anterior relations of the cervical nerve root, with disc herniation and uncovertebral osteophytes accounting for the majority of cases. Until now, posterior laminoforaminotomy and anterior discectomy with or without fusion have been the standard surgical treatments for this group.

However, all these techniques have been associated with limitations of indirect decompression or technical difficulties due to excessive bleeding and fusion related adjacent segment disease etc.<sup>1-4</sup> We describe a minimally invasive anterior cervical disc preserving technique of upper vertebral transcorporeal anterior microforaminotomy to treat cervical radiculopathy and discuss the results.

In general, the vertebral bodies help with support, whereas the pedicles and laminae protect

the spinal cord. The superior and inferior articular processes help determine spinal movement by the facing of their facets. The transverse and spinous processes aid movement by acting as lever arms on which the muscles of the spine act.

The posterior arches also function to support and transfer weight, and the articular processes of the cervical region form two distinct pillars that bear weight. The pedicles also act to transfer weight from the posterior arch to the vertebral body, and vice versa, in the cervical region.<sup>5</sup>

There are various surgical procedures for the treatment of cervical disc disease causing radiculopathy. In 1944, Spurling and Scoville<sup>6</sup> reported removal of cervical discs by laminectomy. Since that time, the posterior approach for the treatment of cervical radiculopathy has evolved into keyhole foraminotomy being popularized by Frykholm.<sup>7</sup> In a study of 182 patients, Tomaras et al.<sup>8</sup> noted that 93% had good or excellent outcomes at a mean follow up of 19 months. Henderson et al.<sup>9</sup> also reported the resolution of radicular symptoms in 96% of 846 patients, with 91.5% reporting good or excellent outcomes in patients treated with posterior microforaminotomy procedure. Jay Jagannathan et al.<sup>10</sup> have also reported excellent outcome with posterior microforaminotomy technique in their series of 162 cases. Although posterior cervical keyhole foraminotomy maintains the motion in the affected segment, it only enables an indirect decompression of the nerve root that does not allow the removal of an offending lesion medioventral to the nerve root, with the exception of soft disc fragments.

### **Objective**

Assessment of clinical outcome in the management of cervical disc prolapse with disc preserving functional cervical disc surgery.

### **Materials and Methods**

The study period was between July 2007 and June 2010, 11 consecutive patients were operated for cervical radiculopathy with the new technique at the Department of Neurosurgery, Manipal Hospital, Bangalore. It is a non randomized prospective study. The follow up period was from 8 months to 30 months, with a mean follow up of 17 months. The patients were considered for surgery on the basis of Inclusion criteria: Unilateral cervical radiculopathy not responding to conservative treatment of more than 6 weeks (or earlier if patients exhibited profound weakness).

Imaging studies were corresponding to the clinical features. Exclusion criteria were presence of cervical spondylotic myelopathy symptom, previous cervical spine surgeries and multilevel disc prolapse. The study was performed after obtaining informed consent from the patients and after clearance from the hospital ethical board.

*Diagnostic evaluation:* Anterior-posterior and lateral standard radiographs of the cervical spine and magnetic resonance imaging (MRI) evaluation of the cervical spine were performed in all patients.

*Surgical technique:* The surgical approach was made in an almost similar fashion to conventional anterior cervical discectomy. The operation was performed under endotracheal general anesthesia. The patient was positioned supine with head rested on silicon head ring and bolster placed below shoulder, for gentle extension of the cervical spine. Cervical spine traction with 3 kilograms of weight was applied with Gardner Wells traction tong. The approach was made at the side of the radiculopathy. The vertebral level and site of the skin incision was confirmed preoperatively by fluoroscopy. The anterior neck was then prepared and draped in an aseptic technique.

A transverse skin incision of 3 to 4 cm was made at the intended site, two-thirds medial and one-third lateral to the medial border of the sternocleidomastoid muscle. The platysma was incised along the line of the skin incision. Access to the cervical column was prepared by sharp and blunt dissection opening the superficial fascia at the medial border of the sternocleidomastoid muscle, keeping the visceral structures medial and the neurovascular bundle lateral. The prevertebral fascia was opened and the anterior aspect of the vertebral bodies, the intervertebral disc and the medial portion of the longus colli muscle at the target level were exposed. The correct level was reconfirmed by lateral fluoroscopy.

Once the prevertebral fascia was opened, the midline on the anterior surface of upper vertebral body of affected segment was marked in relation to the two longus colli muscles (LCM). (Fig. 1a) The LCM attachment from its medial margin was erased subperiosteally with monopolar cautery, and self retaining retractors were applied under LCM. In this technique, the affected disc level is exposed but there is no need to expose the lower vertebra of the affected segment. The position of the drill was 4 to 6 mm above the lower border of the exposed vertebra, at the level of the medial border of LCM. The trajectory of the tunnel was decided depending upon the location of the target identified on preoperative assessment of the offending pathology from imaging

studies. A 5 x 6 mm drill hole is made from a medial to lateral direction so as to open into the foramen (Fig. 1b). Care is taken to avoid damage to the medial wall of the transverse foramen as well as to preserve the integrity of the underlying end plate especially in the anterior two-thirds of the disc.

Due to the obliquity of the cervical disc, this trajectory leads directly to the pathological site in the foramen. Initially a 4 mm matchstick type diamond burr was used with a high-speed drill to start the drill hole from the desired point. Extra care needs to be taken at this point to avoid any untoward injury. The posterior longitudinal ligament still acts as a protective barrier between the instruments and the neural structures. When the thin, ivory white cortical shell of the posterior vertebral wall was encountered, the drilling was stopped, and gentle, careful lifting of the cortical shell was done with thin bone punches and curette. After opening the posterior wall of the foraminotomy hole (Fig. 1c), we can visualize the herniated disc fragment and the hypertrophied uncovertebral region, which can be gently removed with a combination of microcurettes, micro punch and blunt hook (Fig. 1d). Finally, the adequacy of the foraminal decompression was checked by blunt hook palpation of the superior and inferior pedicles along the course of the nerve root sleeve with CSF and CSF pulsation in the nerve root.

Surgical results were graded as follows: Excellent – patient exhibited complete resolution of all symptoms. Good – patient experienced relief of radiculopathy but still experienced occasional mild residual nonradicular discomfort. Fair – patient exhibited mild residual symptoms of radiculopathy, with or without mild/moderate residual nonradicular discomfort. Poor – patient continued to exhibit significant radicular symptoms, with or without nonradicular discomfort. Unchanged or worse.



Fig. 1(a): C6-7 Level, left antero- inferior part of C6 exposed



Fig. 1(b): C6 vertebra being drilled



Fig. 1(c): Hole in the C6 vertebra with posterior longitudinal ligament superiorly and the disc inferiorly at the depth.



Fig. 1(d): Disc fragment being removed with hook.

Figs. 1(a,b,c,d): Intraoperative Photographs

## Results

An evaluation of prospective surgical study. The

**Table 1:** Sociodemographic profile of patients

Characteristics	Variables	Percentage (%)
Age in years	<30	9
	31-40	46
	41-50	27
	51-60	18
Sex	Male	64
	Female	36
Clinical symptoms	Neck pain	100
	Radicular pain	100
	Radicular muscle weakness	0
	Elbow extensor	64
	Elbow flexion	27
	Shoulder abduction	9
	Radicular numbness	0
	Nil	46
	C5	9
	C6	36
C7	9	

age distribution ranged from 28 years to 59 years. The majority of the patients (five) were in the 31-40 age groups and only one patient was in <30 year group. Male patients constituted 63.6% of patients and 36.4% of patients were female. All patients in this study had neck pain, radicular pain and weakness. Among radicular muscle weakness seven patients had elbow extensor weakness and one patient had shoulder abduction weakness. Radicular numbness was seen in six patients. Three patients had symptoms less than a month and four patients each had symptoms between 1 and 3 months and more than 3 months (Table 1).

The C6-7 level was affected in seven patients and C4-5 level was least affected with only one patient symptomatic at this level. The surgical results were excellent in nine patients and were good and fair in one patient each. The mean preoperative visual analogue scale score was 8.55 and postoperative score was 1.18. The VAS score reduced significantly postoperatively and it was statistically significant. The majority of patients mean preoperative disc height was in the 5.5 to 6.0 group. One patient disc height was in the 6.0 to 6.5 group. The mean disc height was 5.59 mm preoperatively and 5.49 mm postoperatively. There was no significant reduction in the disc height postoperatively. The spinal motion was preserved at the operated level in all patients.

## Discussion

The posterior cervical keyhole foraminotomy

for the treatment of cervical radiculopathy poses a limited overall spectrum of approach-related complications and allows the motion in the affected segment to be maintained. However it only permits indirect decompression of the nerve root and does not allow the removal of a compressive lesion medioventral to the nerve root, with the exception of soft disc fragments. It is associated with the technical limitations of limited surgical view, difficulty in resecting osteophytes, limited visualization of the distal foramen and increased epidural bleeding. In addition, higher incidence of postoperative muscle spasm, neck pain and long recovery time have been reported with technique, probably due to the muscle dissection needed to obtain adequate surgical exposure.

This prompted several surgeons to perform discectomy with or without fusion, first by Smith and Robinson<sup>11</sup>, and later by Cloward.<sup>12</sup> The treatment was well conceived in principle, with the idea of direct anterior decompression of the offending structures, but it had the inherent disadvantage of disc height reduction (for discectomy without fusion cases) and fusion of a mobile motion segment. One of the main complications associated with the loss of a motion segment was the adjacent segment disease, the incidence for which has been quoted from 25 to 81% in various long-term studies. In addition, the anterior fusion technique has also been fraught with a significant incidence of pseudoarthrosis and bone graft-related problems.

To avoid this significant accompanying morbidity to anterior cervical discectomy the functioning motion segment should be preserved

during surgery whenever possible. In order to accomplish decompression of more limited anterior foraminal compressive lesions, anterolateral and transuncodiscal approaches have been introduced by Verbiest<sup>17</sup>, Hakuba<sup>13</sup> and Lesoin<sup>14</sup>. The first surgical technique with direct access to a limited anterior foraminal compressive lesion was introduced in 1989 by Snyder and Bernhardt<sup>15</sup>, who reported an anterior fractional interspace decompression, but their technique still required removal of the lateral one-third of the disc. George et al.<sup>16</sup> revisited the original technique of Verbiest<sup>18</sup> for oblique transcorporeal approach for anteriorly located lesions in the cervical spinal canal, but it needs to expose the vertebral artery with its inherent risks and is more suitable for lesions extending over a wide area.

In 2002, Jho<sup>4</sup> reported an upper vertebral transcorporeal foraminotomy technique in his paper on results of various anterior microforaminotomy techniques, overcoming some of the disadvantages of the lower vertebral transcorporeal approach. The hole in this technique was drilled at the most lateral, inferior 4–5 mm portion of the upper level vertebral body and the medial 1 or 2 mm portion of the transverse foramen was also drilled. The cartilage end plate was exposed and entered in its posterior third. The posterolateral portion of the lateral uncinat process, which often represented the pathology, was excised. By using this technique, Jho claimed that the surgical target could also be preserved.

In our study the age group ranged from 28 to 59 years with a mean age of 40 year. In Jho HD et al.<sup>4</sup> study age range was 26 to 74 year with median of 46 year. In Gun Choi et al.<sup>1</sup> study age range was 37 to 74 year with average age of 48.7 year. The Jagannathan Jay et al.<sup>10</sup> study had mean patient age of 48.4 year with a range of 19 to 78 year. The majority of patients in our study was male and also in Gun Choi et al.<sup>1</sup> and Jagannathan Jay et al.<sup>10</sup> studies. In Jho et al.<sup>4</sup> study there was female preponderance.

The presenting symptom in our study was neck pain in all patients. The incidence of this symptom was 94% in Saringer et al.<sup>18</sup> study and 80% in Gun Choi et al.<sup>1</sup> study. All our patients had radicular pain and also in Gun Choi et al. and Jho et al. studies. Motor weakness was seen in 61.5% of patients in Jho et al. study, 80% of patients in Gun Choi et al. study and 70.5% of patients in Saringer et al. study. In our study all patients had motor weakness at the affected level. Sensory loss was seen in 54.5% of patients

in our study while it was 60.6% in Jho et al. study, 97% in Saringer et al.<sup>18</sup> study and 25% of patients were affected in GunChoi et al.<sup>1</sup> study. Duration of symptoms ranged from 10 days to 48 months with a mean duration of 10.4 months. In other studies the age range was 0.7 to 24 months (mean 2.4 months) in Saringer et al study, 4 weeks to 156 months (mean 17.6 months) in Jho HD et al.<sup>4</sup> study.

In our study the most common affected level was C6-7. In saringer et al.<sup>18</sup> study 55.8% of patients had disease at C6-7 level disease. The study involving posterior microforaminotomy by Jagannathan Jay et al.<sup>10</sup>, also had C6-7 level as the most common level affected (43%). In the present study 81.8% had excellent results, 9% had good outcome and 9.2% had fair outcome. In Jho et al.<sup>4</sup> study 79.8% patients had excellent, 19.2% had good results and 1% had fair outcome.

None of the patients in the present study had any complications. In Jagannathan Jay et al.<sup>10</sup> study CSF leak was present in 2.5% of patients, nerve root injury in 1.2% patients and infection in 1.2% of patients. Saringer et al. have reported ipsilateral incomplete transient palsy of the recurrent laryngeal nerve in 5.8% of patients. In Jho et al.<sup>4</sup> study two patients developed transient Horner's syndrome, one patient developed transient hemiparesis and one patient had discitis resulting in spontaneous fusion. Gun Choi et al.<sup>1</sup> reported no complications in their study.

## Conclusion

The modified transcorporeal anterior cervical microforaminotomy technique is a minimally invasive procedure for the treatment of cervical radiculopathy as it preserves most of the disc tissue. Complications like Horner's syndrome and risk to vertebral artery associated with earlier reports can be avoided with this technique. The duration of hospital stay is shortened, cost of treatment is reduced and the patient returns to work early. Also there is no need for bone grafts or implants, functional motion segment is preserved, adjacent segment disease with fusion technique is prevented and the pain relief is immediate. However the limitations of the study are small sample size, short follow up, centrally prolapsed disc cannot be treated by this procedure. Hence further research needs to be carried out in this field to support the literature with larger sample size.

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