Posterior Cervical Foraminotomy: An Alternative to Anterior Cervical Discectomy and Fusion

AHMED M. ALLAM, M.D. and AHMED HEGAZY, M.D.
The Department of Neurosurgery, Faculty of Medicine, Cairo University

Abstract

Objective: Is to perform a detailed retrospective assessment of the Safety, efficacy and complications of posterior microscopic cervical foraminotomy for treatment of cervical degenerative radiculopathy compared to published results of ACDF approach.

Methods: A retrospective analysis was conducted on 31 patients with unilateral cervical radiculopathy. Only patients with radiculopathy caused by single or double level cervical degenerative disc disease were included in the study. Degenerative disc disease was confirmed by concordant clinical and radiological data. Only cases refractory to non-surgical measures for 3 months at least were admitted and operated at Kasr El-Ainy university hospitals between March 2009 and August 2010. Outcomes were assessed by using the Odom's criteria. Patients were followed-up on an outpatient basis for periods ranging from 6 months to 2 years.

Results: Average age of presentation was 44.1 years, male to female ratio was 1.8:1 and average duration of symptoms was 51.4 weeks. 21 cases had left sided radiculopathy, 10 cases had right sided affection. The most common presenting symptom after brachialgia (100%) was neck pain (87%); most common sign was hyporeflexia (67%). Most common operated level was C5-6 (50%). Excellent and good outcomes were obtained in 87% of the patients. The mean follow-up period was 14.5 months with no complications, recurrence, instability or progressive kyphosis.

Conclusion: Microscopic posterior cervical foraminotomy is a safe and effective approach for treatment of cervical radiculopathy resulting from foraminal hard and soft disc pathologies with comparable results to the ACDF approach.

Key Words: Cervical spine — Posterior cervical foraminotomy — Degenerative cervical disc disease.

Introduction

DEGENERATIVE cervical radiculopathy encompasses the clinical syndrome of pain radiating from the neck due to compression of cervical nerve roots by a disc herniation, calcified disc bulge and/or uncovertebral osteophytes together with facet joint hypertrophy [1].

It is one of the most common clinical entities in daily neurosurgical practice. The average annual incidence rate is 83 cases per 100,000 individuals. Nearly 10-15% of patients with cervical radiculopathy fail to respond to conservative measures and eventually require surgery [2].

Spurling and Scoville in 1944 reported successful treatment of patients with cervical radiculopathy using a posterolateral approach, with excellent or good outcomes in more than 90% of their cases [3].

But since the description of anterior cervical discectomy by Smith and Robinson in 1955 and Cloward in 1958 [4,5], the popularity of the anterior approach has grown as the technique has gradually been made safer and easier to perform, especially with technological improvement over the following 30 years.

However, in the last 15 years, the posterior foraminotomy approach has made a strong come back, with the trend of microscopic minimally invasive and motion preserving spinal surgeries, and as the disadvantages of the anterior approach have come clearer in many reports and case series [6-8].

In keeping with the previous reports and theory, we attempted to study the effect of posterior foraminotomy in treating cervical radiculopathy, offering our patients a minimally invasive, fusion less and a less costly surgery.

Patients and Methods

This retrospective study was conducted on 31 patients with cervical radiculopathy due to degener-
erative cervical foraminal stenosis and/or postero-
lateral soft or hard disc, confirmed by concordant
clinical and radiological data, refractory to non-
surgical measures for a minimum of 3 months. Pa-
patients were operated upon by a posterior micro-
scopic minimally invasive foraminotomy approach
at Kasr El-Ainy University Hospitals between
March 2009 and August 2010. Patients with Central
/Para central disc pathology, Central canal stenosis,
cervical myelopathy, bilateral foraminal Pathology,
Cervical spinal instability, More than 2 levels disc
disease, Traumatic, and neoplastic or infective
pathologies were not included in the study.

All patients were assessed by a detailed clinical
history, Neurological examination, followed by
meticulous radiological assessment including plain
static and dynamic X-rays, CT and MRI of the
cervical spine. Electrophysiological testing was
carried out in one case, in which clinical and
radiological data were not confirmatory as the
patient had a previously operated median nerve
entrapment at the wrist.

**Surgical technique:** The patient is placed in the
sitting position with the cervical spine in a neutral
position with the aid of three-point cranial fixation.
This position keeps the cervical fascia loose, re-
duces epidural venous bleeding and facilitates a
clear view of the nerve roots with a good line of
vision.

A linear skin incision, just off the midline
approximately 4 to 5cm in length is used; the
incision is deepened until part of the spinous pro-
cess is exposed. A needle is introduced and a lateral
X-ray is obtained for level confirmation.

The posterior cervical musculature of the af-
ected side is detached from the lateral aspect of
the spinous processes, lamina, and facet joints
above and below the targeted disc space, we found
it useful at this stage to apply a regular Cloward
vertebral spreader between the two spinous pro-
cesses opening the interspace and separating the
facet joint articular pillars.

After introduction of the operating microscope
the foraminotomy is performed with a variable
speed, electric drill; edges of the hemilamina above
and below as well as the medial halves of the
inferior and superior facets are removed. Ligamen-
tum flavum is removed by sharp dissection; the
fibro vascular soft tissue surrounding the nerve
root is coagulated and cut. The dura of the nerve
root and its sensory and motor components can
now be visualized.

Extruded disc fragments are removed by a blunt
nerve hook by a sweeping motion after retracting
the nerve root superiority. In cases of a contained
herniation the thin layer of the posterior longitudinal
ligament is incised with a no. 11 scalpel. In cases
of osteophytes or hardened disc protrusions, a wide
opening of the lateral aspect of the spinal canal
(hemilaminotomy) and the posterior medial fora-
men is usually sufficient.

Hemostatic gelatin foam is placed within the
decompression. The posterior cervical fascia; the
subcutaneous tissue and skin are closed in layers.
For the patient's comfort, a soft cervical collar is
prescribed for 1 to 2 weeks. All patients were to
be discharged at 24 hours post-operative and were
allowed to resume normal daily activity at 3 weeks
after surgery.

**Clinical and radiological follow-up:** Patients
were routinely seen in the immediate post-operative
period and at regular follow-up intervals of 2 weeks
and then 3,6 and 12 months and subsequently every
6 months. Final outcome was determined for re-
cording at least one year post operatively. Outcome
was categorized according to Odom's criteria where
outcome was designated as:

- **Excellent:** When all preoperative symptoms are
relieved, abnormal signs unchanged or improved.
- **Good:** Minimum persistence of preoperative signs,
abnormal signs unchanged or improved.
- **Fair:** Definite relief of some preoperative symp-
toms, others unchanged or slightly improved.
- **Poor:** Signs and symptoms unchanged.

Plain X-rays and thin slice CT with sagittal and
coronal reconstruction in bone window were done
for all patients; follow-up MRI was acquired in
some patients on random basis.

X-rays with dynamic views were to be ordered
during follow-up if instability or progressive ky-
phosis were suspected, stability was defined as
lack of pathological motion (>3 5mm) in postop-
erative dynamic images. Focal alignment was
defined by the angle that was formed by lines
drawn at the superior margin of the superior ver-
tebral body defining the disc space at the operated
level and the inferior margin of the inferior Body
on a lateral radiograph obtained with the patient
standing, more than 11 degrees is considered un-
stable [9]. The segmental angulation was defined
as the Cobb angle of the entire segment from C-
2 through C-7 and was determined using a similar
technique to the focal angulation [10].
Case presentations:

Case 1:

This was a 50 year old male who presented with a left sided brachialgia associated with numbness for one year prior to surgery. On examination he had a left biceps hyporeflexia and hypoesthesia involving the left C6 dermatome. Radiologically he had a left sided foraminal stenosis with a soft disc and a straight cervical curve. The patient was operated upon by a postero-lateral cervical foraminotomy and removal of the extruded fragment. The total operative time was 70 minutes. Post operatively the brachialgia was completely relieved and the patient was discharged on the same day of surgery. Outcome was excellent.
Case 2:

This is a 53 year old male patient who presented with a 2 year history of right sided brachialgia, elbow weakness and neck pain. On examination the patient had weakness involving the right biceps grade IV, biceps hyporeflexia and hypoesthesia involving the C6 dermatome. Radiologically the patient had a C5-C6 right sided foraminal stenosis caused by a hard disc and a straight cervical curve. The patient was operated upon by a right sided cervical foraminotomy. The total operative time was 60 minutes and the patient was discharged on the same day. Outcome was excellent.
Results

In our study the male to female ratio was 1.8:1. The average age was 44.1 years. The average duration of symptoms was 51.4 weeks. 21 cases had Left sided radiculopathy while 10 cases had right sided affection. The most common presenting symptom after brachialgia was neck pain, presenting in 87% of cases, most common sign was hyporeflexia presenting in 67% of cases. The most commonly operated level was C5-6 in 50% of patients.

Of our patients, 48% had a hard disc compressive pathology, 35% had soft disc prolapse and 17% had a mixed compressive pathology. 4 of our patients had previous ACDF operations.

Twenty patients (64.5%) had an excellent outcome, 7 (22.5%) had a good outcome, 4 (13%) had a fair outcome and none of our patients had a poor outcome using Odom’s criteria. All patients with excellent and good outcomes returned to their previous level of activity or jobs at 3 weeks postoperatively.

Among the 4 cases with fair outcome, 3 cases (75%) had previous ACDF surgeries with recurrent or residual compression, one of them had a carpal tunnel surgery as well. 2 cases out of the 4 (50%) had long history of diabetes.

There was a statistically significant association between patient age and outcome ($p=0.0015$). There was also a statistically significant association between double level surgery and a worse outcome ($p=0.0437$).

There was no statistically significant association between lost or preserved cervical lordosis and outcome ($p>0.05$).

There was a single patient with a postoperative complication of anesthesia who recovered completely and was discharged 48 hours postoperatively; all other patients were discharged at 24 hours postoperatively. No other postoperative complications occurred.

The average follow-up period in our study was 14.5 months, in which we have noticed no recurrences, instability, kyphosis progression or adjacent level disease.

<table>
<thead>
<tr>
<th>Cases with motor deficit (n=11)</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolved</td>
<td>6</td>
</tr>
<tr>
<td>Improved</td>
<td>3</td>
</tr>
<tr>
<td>No change</td>
<td>2</td>
</tr>
</tbody>
</table>

Table (1): Frequency of motor deficit improvement at 12 month follow-up.

Table (2): Association between compressive pathology and outcome. There was no statistically significant association.

<table>
<thead>
<tr>
<th>Element</th>
<th>Excellent/ good outcome</th>
<th>Fair outcome</th>
<th>Total</th>
<th>Chi-square with Yates’ correction value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard</td>
<td>9</td>
<td>2</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>Soft</td>
<td>18</td>
<td>2</td>
<td>20</td>
<td>0.008</td>
</tr>
</tbody>
</table>

Discussion

The advantages of posterior approach include direct visualization of the involved nerve root and decompression without the need for fusion, thus, it has less cost due to unnessesity of implants or cervical plates used with the ACDF approach, and this is of much importance in developing countries.

Posterior foraminotomy approach has the ability to prevent structural and biomechanical damage to the remaining vertebral disc by preserving it, without loss of motion segment and reduced occurrence of complications associated with pseudoarthrosis, as well as degenerative changes of the adjacent joint 111-131.
As a fusion less surgery, earlier return to work without the need of cervical immobilization post operatively as well as an early return to field is anticipated with professional athletes.

A posterior approach to the neck allows for avoidance of damaging vital structures located in the anterior area of the cervical spine (trachea, esophagus, internal carotid artery, vertebral artery and recurrent laryngeal nerve which is particularly important with professional speakers and singers.

Results of laminoforaminotomy approach for soft and hard disc pathologies is comparable to those of anterior cervical disectomy and fusion approach in most published series: Tomaras, et al. [14] in a study of 182 patients operated upon by laminoforaminotomy, noted that 93% had good or excellent outcomes at a mean follow-up of 19 months. Also, Jgannathan et al. [12] conducted a retrospective study on 162 patients with minimum follow-up of 5 years, noted 95% improvement in radiculopathy. Many other large series reported similar good results with the posterior foraminotomy approach [11,13,15-17], which are comparable to the results of large series of ACDF like the study by Clements and O'leary [18], which was conducted on 94 patients reporting excellent and good outcomes in 88% of their cases and the series by Water and levinthal [19], who noted excellent and good outcomes in 92% of their 64 patients, as well as other large series of ACDF with coinciding outcomes [20,21].

In keeping with these previous reports, we note that foraminotomy is highly effective in treating cervical radiculopathy, and improving patient quality-of-life outcomes as 87% of our patients had excellent and good outcomes and returned to full level activities by the third week post operative. A statistically significant association was noted between fair outcomes and patients with previous ACDF, patients above 50 years of age and double level surgeries.

In earlier series like those by Henderson et al. and Herkowitz et al. [12,23], posterior foraminotomy approach was used only to treat soft sequestrated disc herniation, while in newer series the indications were extended to include hard disc and foraminalstenosis as in the work of Kim and Kim and the series by Winder and Thomas [16,17].

In our study, there was no statistically significant difference between soft and hard disc pathologies (p>0.05) in relation to the patients outcome. This was also noticed by Coric and Adamson in their study [13], this finding is rationalized by the complete decompression of the neural foramen and freeing of the nerve root via the posterior approach.

We utilized a microscopic technique similar to that described by Russell and Benjamin [24], with a few modifications; small 4-5cm incisions just off the midline and a small Scoville or a tubular Trans-sphenoid retractor, we never split the nuchal ligament or disrupt the facet capsule laterally. We found that applying a vertebral spreader between the spinous processes at the desired level, slightly distracting the articular pillars and the laminae allowing access to the facet joint with minimal or no bone removal from the laminae and less bone removal from the facet joints.

In our study, there were no major preoperative complications, but for a single case with history of COPD who needed over night ICU admission for delayed respiratory recovery post op., this patient was discharged from hospital 48 hours later with no effect on the final outcome of his surgery. The attendant risks of mortality and morbidity remain quite low for both the anterior and the posterior approaches In many large published series [11,12,20,21].

Conclusion:

Posterior microscopic cervical foraminotomy is a safe, effective, less costly motion preserving approach for treatment of cervical radiculopathy when indicated. It has comparable outcomes to ACDF approach with avoidance of possible complications associated with anterior approaches. This approach is as effective for both soft and hard disc pathologies. Preoperative loss or reversal of normal cervical curve appears not to affect the outcome of this approach nor to be associated with symptomatic progressive kyphosis; however, this observation needs larger studies and longer follow-up periods to be confirmed. Patients with previous ACDF operations seem to benefit less from the posterior microscopic foraminotomy approach; this particular issue also needs larger studies to be confirmed.

References

