Zagazig University Medical Journal
www.zumj.journals.ekb.eg
https://doi.org/10.21608/zumj.2021.53196.2043 Volume 30, Issue 1.1, -January 2024, Supplement Issue

Manuscript ID ZUMJ-2012-2043 (R2)
DOI **10.21608/ZUMJ.2021.53196.2043**

Original Article

Minimally Invasive Posterior Cervical foraminotomy Versus Anterior cervical discectomy and fusion in Cases of Cervical Radiculopathy.

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Submit Date 2021-01-03
Revise Date 2021-03-29
Accept Date 2021-05-09

ABSTRACT

Background::comparing posterior cervical foraminotomy versus anterior cervical discectomy and fusion to determine the best approach in cases of cervical radiculopathy.

Methods: This study carried out in Zagazig University Hospital, Neurosurgery Department during the year from 2017 to 2019. It is an interventional prospective study. The sample size was 24(12for each group) all patients suffering from cervical radiculopathy fulfilling the inclusion criteria and all of them will be included in the study as a comprehensive sample.

Results: 24 patients with posterolateral or foraminal cervical disc will be divided into two groups (12) for each and treated surgically.

Conclusion: Posterior microscopic cervical foraminotomy is a safe and effective technique for management of cervical radiculopathy in well selected cases. It has comparable outcomes to the ACDF approach without affection on mobility and with avoidance of possible complications associated with anterior approaches.

Key words: Anterior cervical discectomy and fusion; cervical radiculopathy; posterior cervical approaches; Cervical spondylotic radiculopathy; Cervical foraminotomy

INTRODUCTION

Cervical radiculopathy is a neurologic condition characterized by dysfunction of a cervical spinal nerve, the roots of the nerve, or both. It usually presents with cervical pain shooting to one arm, with a combination of loss of motor power, sensory impairment or reflex changes in the influenced nerve root[1].

In Latin America, population-based data from Rochester, Minne sota, cervical radiculopathy has an annual incidence rate of 107.3 cases per 100,000 males and 63.5 cases per 100,000 females, mainly between 50 to 54 years old [2].

The most widely recognized reason for cervical radiculopathy (in 70 to 75 percent of cases) is foraminal stenosis of the spinal nerve because of a blend of elements, including diminished disc hight and degenerative changes of the uncovertebral joints anteriorly and zygapophyseal joints posteriorly [3].

posterolateral cervical disc herniation presents 20 to 25 percent of patients with cervical radiculopathy, different causes, including tumors of the spine and spinal contaminations, are rare [4].

The clinical picture incorporates neck tenderness with radiation to the arm with or without fingers in dermatomal distribution, paraesthesias in arm and hand, heaviness of muscle tendon reflexes, tactile abnormaity and additionally motor disturbance [5].

Radiolgical diagnosis by Plain X-ray, CT and MRI which is the the investigation of choice to distinguish disc herniations [6].

Management of cervical radiculopathy, at first medical treatment will be tried to alleviate the radicular pain which incorporates exercise, osteopathic therapy, traction, neck braces, nonsteroidal medications and steroid injections.[7]

Surgical treatment is indicated in patients with profound motor power deficit or non improvement on medical treatment.

The fundamental point of all methods is to decompress the influenced neural structure which divided into anterior or posterior approach [8].

Anterior cervical approaches includes, anterior cervical discectomy with fusion (with cage or cage and plate) [9], anterior microdiscectomy, microsurgical anterior cervical foraminotomy without central discectomy and without interbody bone graft, a trans-unco-discal approach with a combined anterior and lateral approach[10], anterior cervical discectomy without fusion[11], and acervical fractional interspace decompression[12].

Posterior cervical approaches includes, cervical laminectomy (without graft) [13], laminoplasty, Posterior cervical foraminotomy, laminectomy or foraminotomy with lateral mass or pedicle screw fixation[14], and minimally invasive posterior cervical foraminotomy[15].

The cervical foraminotomy and discectomy is a good technique without bony fusion or instrumentation might be an option for patients with foraminal soft disc prolapse,[16] which had been embraced to defeat the complications related to anterior cervical discectomy with or without instrumentation, as heterotopic ossification, mechanical failure and adjoining level disc disease [17]

Posterior root decompression allows better access to laterally located disc fragments without retraction on the esophagus and laryngeal nerve, which can result in postoperative dysphagia and hoarseness following anterior approach, also graft subsidence and pseudoarthrosis can be eleminated by using the posterior foraminotomy approach.[18,19]

Minimally invasive posterior cervical foraminotomy have been developed to achieve comparable results to the traditional open approaches with a better outcome.[20]

The advantages of minimally invasive spine surgery includes, Small incision, decreasing muscle stripping and dissection, the use of the operating microscope or magnification loupes, specialized muscle retractors and instruments, and increased dependance on fluoroscopic images.[21]

The goals of minimally invasive spine surgery are decreased iatrogenic muscle trauma, less postoperative discomfort, fast recovery and return to work, no neck brace is required and little effect on the stability of the cervical spine. [22]

The ideal operative method for cervical radiculopathy caused by herniated disc stays a matter of discussion. [23]

METHODS

Technical design

This study carried out in Zagazig University Hospital, Neurosurgery Department during the year from 2017 to 2019.

Type of the study:

It is an interventional prospective study.

Consent and ethics:

Written informed consent was obtained from all participants, the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The study was done according to The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Sample size and patient selection:

The sample size was 24 (12 for each group).

Cases with posterolateral or foraminal disc complainning of unilateral brachialgia, not improving by consevative measures and fulfilling the inclusion criteria were randomizally divided into anterior or posterior.

Inclusion criteria

The patients included are all patients presented by posterolateral and foraminal cervical disc one level or more, adult patient 18 years old or more, no sex or cause will be an exclusion, clinically indicated in the form of neck pain and cervical radiculopathy.

Exclusion criteria:

Patient with central cervical disc or manifestations of cervical cord compression, spine infections (discitis or abcess), pine tumors or destructive lesions, patient with kyphotic cervical curvature, post traumatic cervical fracture and patient age less than 18 years old

Image:

X ray cervical spine: anteroposterior, lateral, flexion, extention and oblique views, MRI cervical spine and CT of cervical spine.

TO SHOW

Spinal stability pre operative and post operative, canal measurement, cause of compression, fragment site and size in case of disc prolapse and also in cases of degenerative radiculopathy determine the cause of compression anterior or posterior to the root.

B- Operational Design:

24 patients with posterolateral or foraminal cervical disc will be divided into two groups (12) for each and treated surgically.

Preoperaive evalution :

All patients were subjected to careful history taking, complete neurological examination. The diagnosis was established by the clinical picture, neuroradiological imaging including X ray and MRI of cervical spine to all patients. Routine laboratory investigations were done to all patients before surgery.

Surgical Instruments:

Tubular retractor system (METRx), High-speed drill, Intraoperative fluoroscopy, Microcurettes and 1 to 2 mm rongeurs, operating microscope or magnification loupes and Mayfield three-point-fixation system.

Surgical techniques

Minimal invasive Posterior cervical foraminotomy with or without discectomy:

In prone position, about 2.5 cm vertical incision was made and dilation can proceed over the desired level , tubular muscle dilators are placed sequentially in line with the diameter of the desired retractor, with each retractor docking onto bone

before the next dilator is placed. Visualization into the tube is performed with a microscope or magnification loupe and the bed can be turned to help gain a more comfortable working angle, after the lamino-facet junction was identified, a small lamino foraminotomy was done using kerrison rongeurs or a high speed drill, allowing visualization of the lateral border of the dura and exit nerve root.

The foramen was palpated by a nerve hook to identify any disc fragment or osteophytes. A No. 11 blade and forceps were used to remove the fragment, while down angled curettes were used to remove osteophytes, haemostasis and closure in layers.

Anterior cervical discectomy and fusion (ACDF) :Under general anesthesia ,supine position, anterior cervical discectomy was done as routine through a transverse incision, under microscopic guidance the remaining disc or osteophytes were removed with a curved angled curette or high speed drill. After discectomy and transection of the posterior longitudinal ligament, the dura was visualized. An artificial peek cage under c-arm visualization was inserted to confirm the correct position and level.

Outcome measurement:

All patients were followed up for at least 3 months. The patients were monitored in the postoperative period for the following:

Clinical follow up:

Pain in neck and upper limb by visual analogue scale(VAS).

Functional outcome by neck Oswestry disability index (ODI).

Image follow up:

X ray cervical spine, CT cervical spine and MRI cervical spine.

Statistical analysis

Data were entered checked and analyzed using Epi-Info version 6 and SPP for Windows version 8

RESULTS

There was an insignificant difference between the studied groups regarding age group distribution where patients with age more than 40 years represented 54.2% and less than 40 years old represented 45.8%, as regard occupation heavy workers represented 62.5% versus 37.5 light workers. (table1)

There was an insignificant difference between the studied groups regarding pre-operative level of cervical radiculopathy where patients with C5-6 level represented 50% of posterior group versus 53.3% of anterior group (p-value=0.693). (figure1)

There was an insignificant difference between the studied groups regarding site of encroachment where patients with latero-forminal encroachment represented 57.1% of posterior group versus 53.3% of anterior group (p-value=0.522). (Table 3)

There was an insignificant difference between the studied groups regarding type of compression where patients with hard type represented 57.1% of posterior group versus 40% of anterior group (p-value=0.356). There was an insignificant difference between the studied groups regarding transverse diameter of spinal cord where mean was 22.80 mm in posterior group versus 23.04 mm in anterior group (p-value=0.257). There was an insignificant difference between the studied groups regarding anterior-posterior diameter of spinal cord where mean was 13.17 mm in posterior group versus 12.30 in anterior group (p-value=0.114). There was an insignificant difference between the studied groups regarding size of spinal canal where patients with stenotic canal represented 41.7% of posterior group versus 58.3% in anterior group (p-value=0.414). There was an insignificant difference between the studied groups regarding anterior-posterior diameter of lateral recess where mean was 6.13 mm in posterior group versus 6.30 mm in anterior group (p-value=0.663). There was an insignificant difference between the studied groups regarding anterior-posterior diameter of foramen where mean was 4.35 mm in posterior group versus 4.76 mm in anterior group (p-value=0.373). There was an insignificant difference between the studied groups regarding base of fragment where mean was 10.04 mm in posterior group versus 10.68 mm in anterior group (p-value=0.487). There was an insignificant difference between the studied groups regarding anterior-posterior diameter of fragment to anterior-posterior diameter of lateral recess ratio where mean was 65.58% in posterior group versus 61.23% in anterior group (p-value=0.307). There was an insignificant difference between the studied groups regarding anterior-posterior diameter of fragment to anterior-posterior diameter of foramen ratio where mean was 63.17% in posterior group versus 59.87% in anterior group (p-value=0.541). There was an insignificant difference between the studied groups regarding obstruction degree where patients marked obstruction represented 92.9% of posterior group versus 86.7% of anterior group (p-value=1.000).(table 3)

There was an insignificant difference between the studied groups regarding change in motor power where patients with improved motor power represented 66.6% of posterior group versus 71.4% of anterior group.(table 4)

There was an insignificant difference between the studied groups regarding absolute change in VAS of pain where mean was -5.83 in posterior group versus -6 in anterior group (p-value=0.780). There

was an insignificant difference between the studied groups regarding relative change in VAS of pain where mean was -73.09% in posterior group versus -79.33% in anterior group (p-value=0.977). There was an insignificant difference between the studied groups regarding change in VAS of pain where patients with improved VAS of pain represented 100% of both groups (p-value=1.000). (figure 2)

There was an insignificant difference between the studied groups regarding absolute change in ODI where mean was -38.16% in posterior group versus -36.50% in anterior group (p-value=0.734). There was an insignificant difference between the studied groups regarding relative change in ODI where mean was -64.05% in posterior group versus -66.36% in anterior group (p-value=0.977). There was an insignificant difference between the studied groups regarding change in ODI where patients with improved ODI represented 100% of both groups (p-value=1.000). (figure 3)

There was a significant difference between the studied groups regarding disc removal where disc was removed in 35.7% of posterior group versus 100% of anterior group (p-value<0.001). (figure 4)

There was a significant difference between the studied groups regarding blood loss where mean was 155 ml in posterior group versus 93.33ml in anterior group (p-value<0.001). There was an insignificant difference between the studied groups regarding operative time where mean was 103.33 minutes in posterior group versus 98.33 minutes in anterior group (p-value=0.392). (figure 5)

There was an insignificant difference between the studied groups regarding complications where patients with complications represented 8.3% of both groups (p-value=1.000). (figure 6)

Table (1): Basic characters

Basic character	The studied patients (N=24)	
	No.	%
Sex		
Male	12	50%
Female	12	50%
Age (years)		
Mean ± SD	41.33 ± 5.98	
Median (Range)	41.50 (31 – 51)	
≤40 years	11	45.8%
>40 years	13	54.2%
Occupation		
Light worker (not job related)	9	37.5%
Heavy worker (job related)	15	62.5%
Level[a]	(N=29)	
C3-4	1	3.4%
C4-5	4	13.8%
C5-6	15	51.7%
C6-7	5	17.2%
C7-T1	4	13.8%

a: there is on case three levels C3-4, C4-5, C5-6; two cases double levels C4-5,C5-6 and one case double level C5-6 C6-7

Table (2): Comparison between posterior group and anterior group regarding pre operative clinical evaluation

Clinical Evaluation	Posterior group (N=12)				Anterior group (N=12)			
	Preoperative		Postoperative		Preoperative		Postoperative	
	No.	%	No.	%	No.	%	No.	%
Motor power								
Grade 1	0	0%	0	0%	0	0%	0	0%
Grade 2	0	0%	0	0%	0	0%	0	0%
Grade 3	1	8.3%	1	8.3%	0	0%	0	0%
Grade 4	8	66.7%	3	25%	7	58.3%	2	16.7%
Grade 5	3	25%	8	66.7%	5	41.7%	10	83.3%
VAS of pain								
Mean ± SD	7.91 ± 1.08		2.08 ± 1.16		7.50 ± 0.79		1.50 ± 0.52	

Clinical Evaluation	Posterior group (N=12)				Anterior group (N=12)			
	Preoperative		Postoperative		Preoperative		Postoperative	
	No.	%	No.	%	No.	%	No.	%
Median (Range)	8 (6 – 9)		2 (1 – 5)		7.50 (6 – 9)		1.50 (1 – 2)	
No pain	0	0%	0	0%	0	0%	0	0%
Mild pain	0	0%	11	91.7%	0	0%	12	100%
Moderate pain	2	16.7%	1	8.3%	1	8.3%	0	0%
Severe pain	10	83.3%	0	0%	11	91.7%	0	0%
ODI								
Mean ± SD	58.50 ± 9.81		20.33 ± 7.46		54.16 ± 8.87		17.66 ± 4.88	
Median (Range)	61 (40 – 71)		19 (12 – 40)		55.50 (38 – 65)		17 (10 – 25)	
Minimal disability	0	0%	8	66.7%	0	0%	9	75%
Moderate disability	1	8.3%	3	25%	1	8.3%	3	25%
Severe disability	4	33.3%	1	8.3%	6	50%	0	0%
Cripple	7	58.3%	0	0%	5	41.7%	0	0%

Table (3): Comparison between posterior group and anterior group regarding pre-operative radiological evaluation.

Pre-operative radiological evaluation	Posterior group (N=12)		Anterior group (N=12)		Test	p-value (Sig.)
	No.	%	No.	%		
Site of the fragment	(N=14)		(N=15)			
Lateral recess	5	35.7%	7	46.7%	1.300‡	0.522 (NS)
Forminal	1	7.1%	0	0%		
Lateral-Forminal	8	57.1%	8	53.3%		
Type of the fragment	(N=12)		(N=12)			
Soft (D)	6	50%	7	58.3%	0.168‡	1.000 (NS)
Hard (D/O)	6	50%	5	41.7%		
Spinal canal in CT						
TD (mm)	(N=12)		(N=12)			
Mean ± SD	22.80 ± 1.27		23.04 ± 2.17		-0.320*	0.752 (NS)
Median (Range)	22.75 (20.70 – 24.70)		22.90 (19.60 – 27.20)			
A-P (mm)	(N=12)		(N=12)			
Mean ± SD	13.17 ± 1.47		12.30 ± 1.10		1.646*	0.114 (NS)
Median (Range)	13.10 (10.60 – 15.80)		12.35 (10.10 – 13.70)			
Normal canal	7	58.3%	5	41.7%	0.667‡	0.414 (NS)
Stenotic canal	5	41.7%	7	58.3%		
Foramen & Recess in CT						
L. recess A-P (mm)	(N=14)		(N=15)			
Mean ± SD	6.13 ± 1.17		6.30 ± 0.91		-0.440*	0.663 (NS)
Median (Range)	6 (4.40 – 8)		6.50 (4.70 – 8.10)			
Foramen A-P (mm)	(N=14)		(N=15)			
Mean ± SD	4.35 ± 1.48		4.76 ± 0.95		-0.906*	0.373 (NS)
Median (Range)	4.05 (2.20 – 7)		4.40 (3.30 – 6.70)			
Fragment measurement in MRI						
Base (mm)	(N=14)		(N=15)			
Mean ± SD	10.04 ± 2.35		10.68 ± 2.55		-0.705*	0.487 (NS)
Median (Range)	9.80 (6.10 – 14.10)		9.90 (7.40 – 16.40)			
A-P at L. (mm)	(N=13)		(N=15)			
Mean ± SD	4.03 ± 1.32		3.80 ± 0.37		0.670*	0.509 (NS)
Median (Range)	4.40 (2.20 – 6)		3.80 (3.20 – 4.50)			
A-P at F. (mm)	(N=9)		(N=8)			
Mean ± SD	2.94 ± 0.73		2.80 ± 0.36		0.504*	0.622 (NS)
Median (Range)	2.70 (2 – 4.20)		2.70 (2.40 – 3.30)			

TD: transverse diameter, A-P: anterior-posterior diameter, L.: lateral; ‡ Chi-square test; * Independent samples Student's t-test; $p < 0.05$ is significant; Sig.: Significance.

Table (3): Continue.

Pre-operative radiological evaluation	Posterior group (N=12)		Anterior group (N=12)		Test	p-value (Sig.)
	No.	%	No.	%		
Ratios						
Fragment A-P to L. recess A-P (%)	(N=13)		(N=15)			
Mean ± SD	65.58 ± 12.80		61.23 ± 9.23		1.041*	0.307 (NS)
Median (Range)	66.66 (44 – 85.71)		61.19 (47.06 – 76.60)			
Fragment A-P to F. A-P ratio (%)	(N=9)		(N=8)			
Mean ± SD	63.17 ± 11.69		59.87 ± 9.78		0.626*	0.541 (NS)
Median (Range)	62.16 (44.07 – 83.33)		58.23 (44.78 – 75)			
Obstruction degree	(N=14)		(N=15)			
Mild-moderate	1	7.1%	2	13.3%	0.299‡	1.000 (NS)
Marked	13	92.9%	13	86.7%		

A-P: anterior-posterior diameter, L.: lateral recess, F.: foramen; ‡ Chi-square test; * Independent samples Student's t-test; p< 0.05 is significant, Sig.: Significance.

Table (4): Comparison between posterior group and anterior group regarding post operative changes in clinical evaluation.

Change in clinical evaluation	Posterior group (N=12)		Anterior group (N=12)	
	No.	%	No.	%
Motor power				
The same	5	41.7%	7	58.3%
Deteriorated	1	8.3%	0	0%
Improved	6	66.6%	5	71.4%
VAS of pain				
Absolute change				
Mean ± SD	-5.83 ± 1.64		-6 ± 1.20	
Median (Range)	-6 (-2 – -8)		-6 (-4 – -8)	
Relative change (%)				
Mean ± SD	-73.09 ± 16.50		-79.33 ± 8.67	
Median (Range)	-76.39 (-28.57 – -88.89)		-80.35 (-66.67 – -88.89)	
The same	0	0%	0	0%
Improved	12	100%	12	100%
ODI				
Absolute change				
Mean ± SD	-38.16 ± 13.22		-36.50 ± 10.29	
Median (Range)	-42 (- 13 – -56)		-37.50 (-13 – -49)	
Relative change (%)				
Mean ± SD	-64.05 ± 15.48		-66.36 ± 12.82	
Median (Range)	-68.94 (-24.53 – -78.87)		-70.79 (-34.21 – -77.78)	
The same	0	0%	0	0%
Improved	12	100%	12	100%

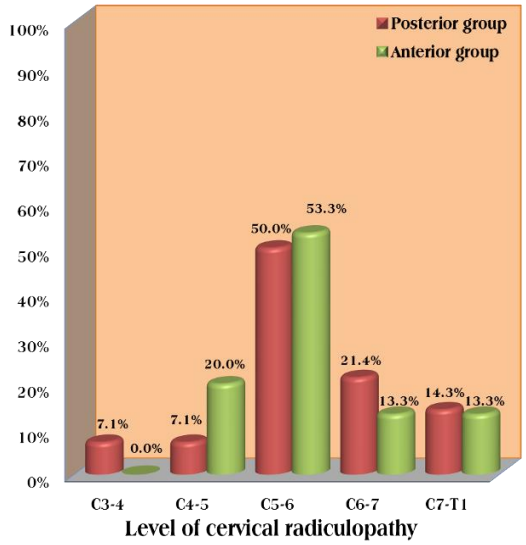


Figure (1): Bar chart shows comparison between posterior and anterior group regarding level of cervical radiculopathy

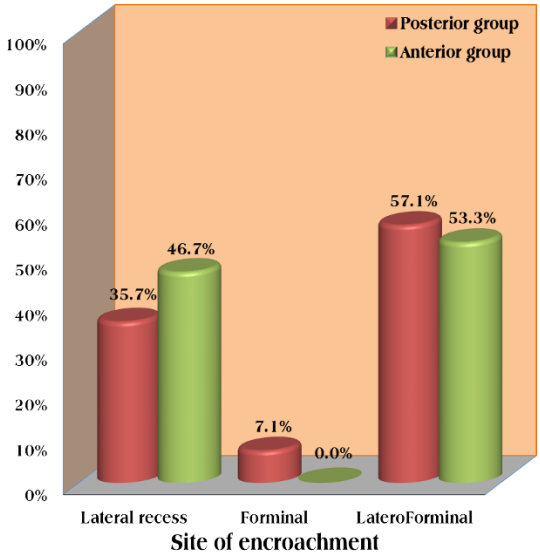


Figure (2): Bar chart shows comparison between posterior and anterior group regarding site of encroachment.

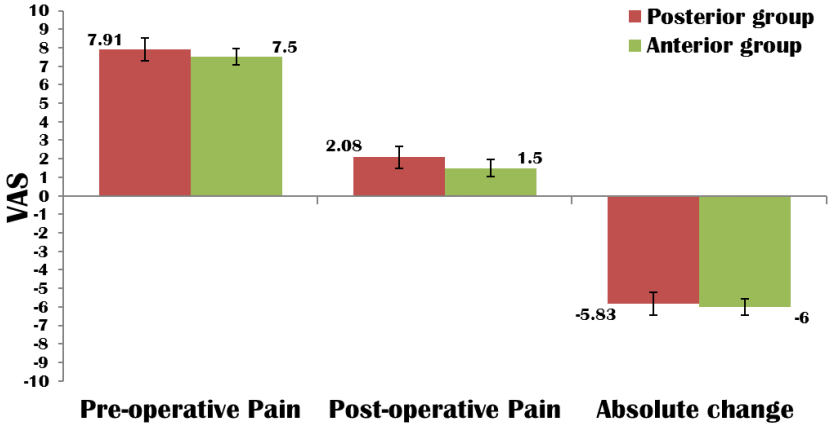


Figure (3): Error Bar chart shows comparison between posterior and anterior group regarding pre-operative, post-operative and absolute change in VAS of pain; Bar represents mean, Y-error bar represents 95%CI (Confidence interval) around mean.

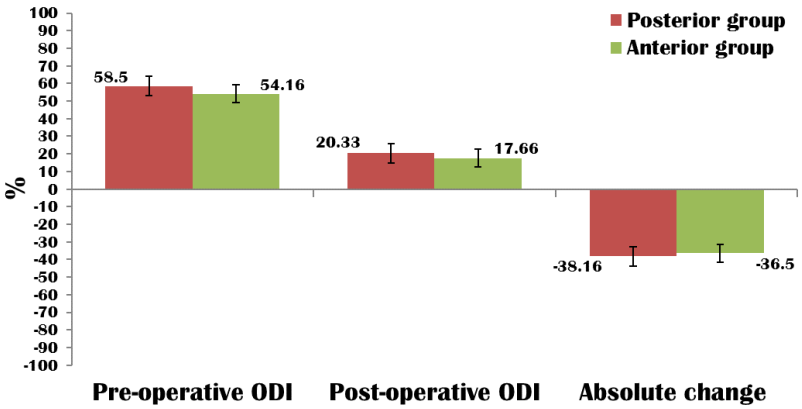


Figure (4): Error Bar chart shows comparison between posterior and anterior group regarding pre-operative, post-operative and absolute change in ODI; Bar represents mean, Y-error bar represents 95%CI (Confidence interval) around mean.

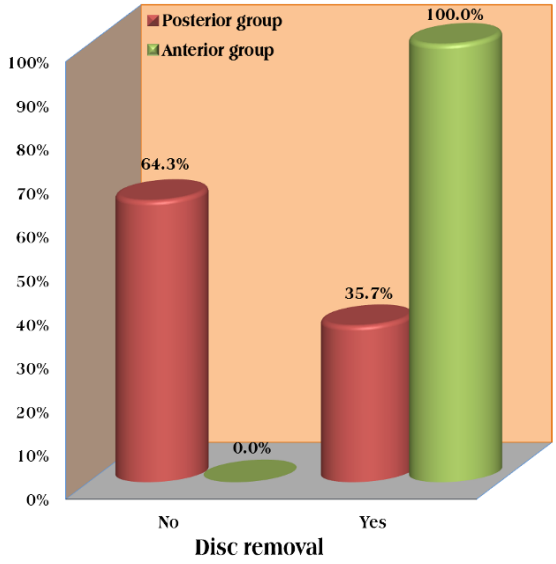
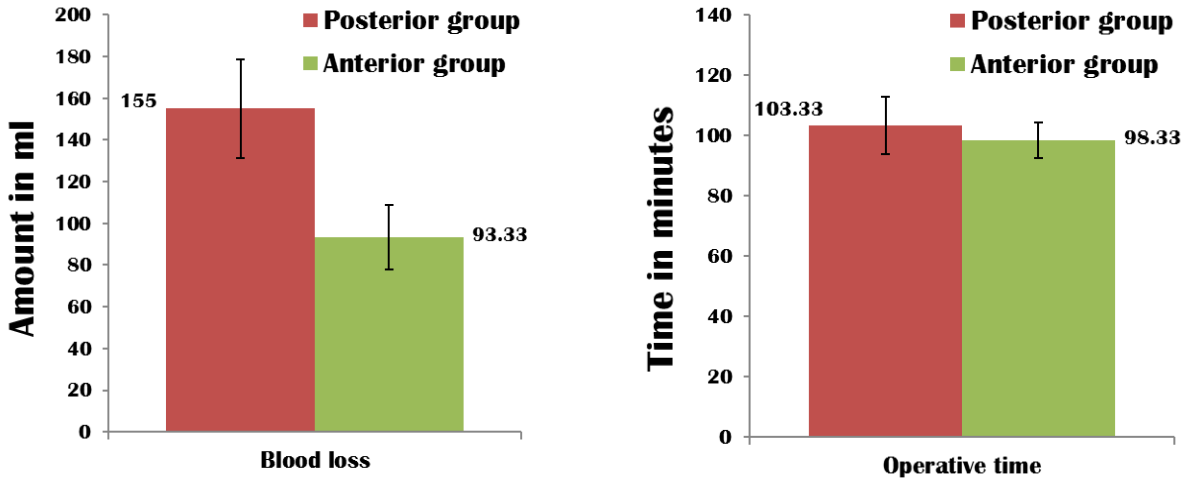


Figure (5): Bar chart shows comparison between posterior and anterior group regarding disc removal.



A) B)

Figure (6): Error Bar chart shows comparison between posterior and anterior group regarding A) Blood loss and B) Operative time; Bar represents mean, Y-error bar represents 95%CI (Confidence interval) around mean.

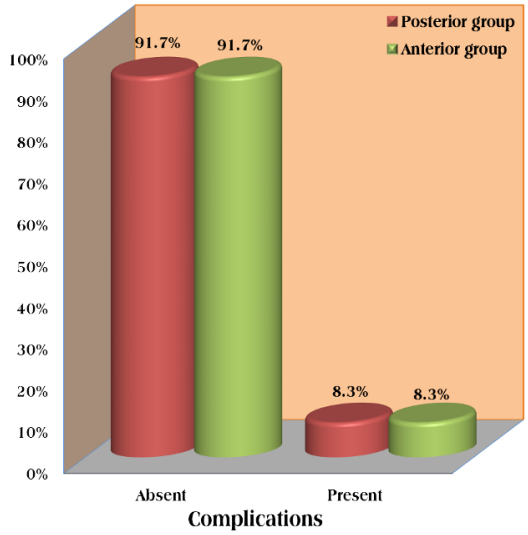
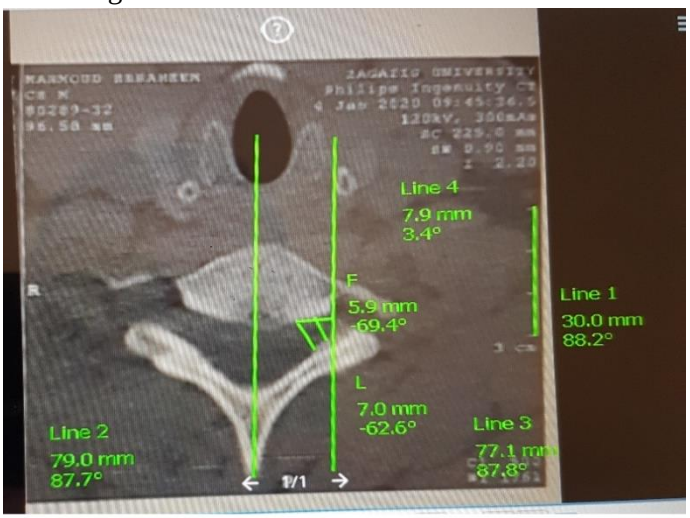


Figure (7): Bar chart shows comparison between posterior and anterior group regarding complication

Supplementary figures

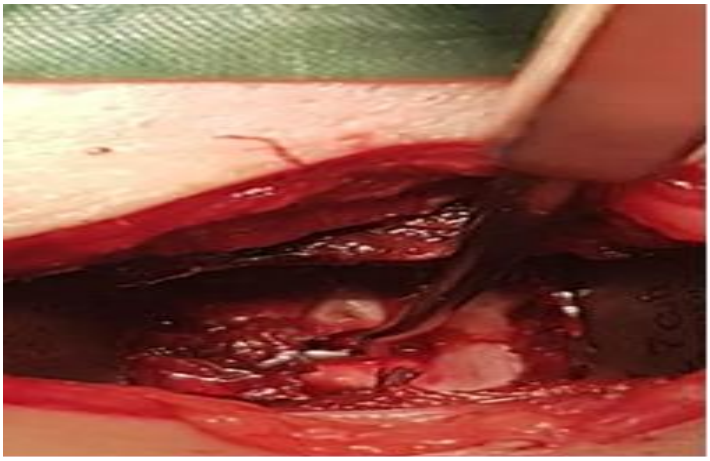
Fig(S1):MRI sagittal view showing C5-6 lateral cervical disc



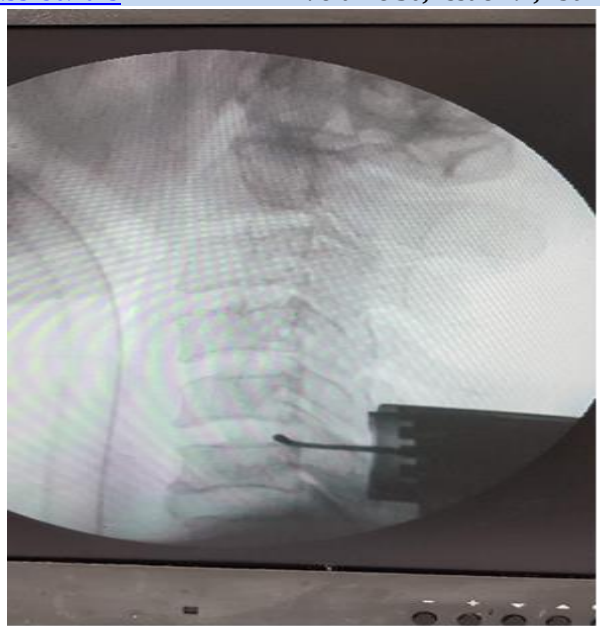
Fig(S2): Measurement of the foramen and lateral recess in CT

Fig(S3): Measurement of the fragment base and height in MRI axial view

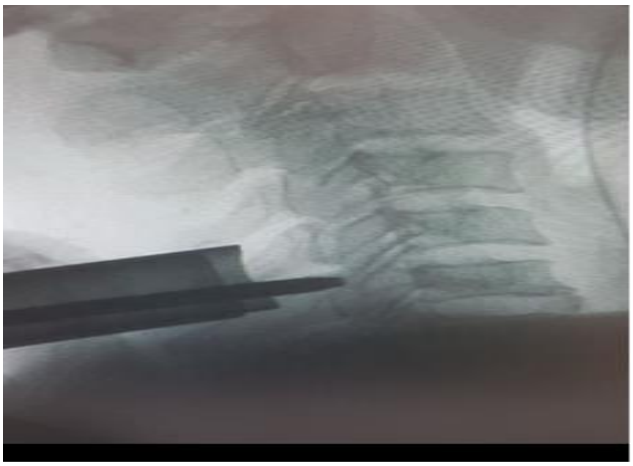
Fig(S4): A-p and transvers diameter of cervical spine in CT axial view



Fig(S5): nerve hook in the axilla of the nerve after completion of foraminotomy



Fig(S6): Retractor application at c5-c6 lamino facet junction



Fig(S7): Nerve hook in foramen after completion of foraminotomy

DISCUSSION

Spurling and Scoville in 1944 reported successful treatment of patients with cervical radiculopathy using a posterolateral approach, with excellent or good outcome in over 90% of the patients 10 years before Smith and Robinson described the ACDF procedure. The posterior approach became popular by Spurling and Scoville in the following years, the results obtained in many of these series were good, even by the present standards [24].

But since the description of anterior cervical discectomy by Cloward in 1958, the popularity of the anterior approach has grown as the procedure has been made more safe and more easy to perform, especially with improvement in operative magnification tools, lighting and instrumentation over the following thirty years[9].

However, in the last fivteen years, the posterior cervical foraminotomy approach has made a strong come back and, with the trend of microscopic and endoscopic minimally invasive and motion preserving spinal procedures, and as its advantages and the disadvantages of the anterior cervical approach have come more clear[20].

The advantages of a posterior approach include direct visualization of the involved nerve root and decompression without the need for bony fusion, less cost, ability to avoid damaging of vital structures located in anterior to the cervical spine (trachea, esophagus, internal carotid artery, vertebral artery and recurrent laryngeal nerve), an ability to prevent the structural and biomechanical distruction to the remaining intervertebral disc by preserving it, without loss of movement and reduced occurrence of complications associated with bone graft and pseudarthrosis as well as degenerative changes of the nearby joint [25,26].

The results of the foraminotomy approach for hard and soft disc is similar to those of the anterior cervical discectomy and fusion approach in most studies, Tomaras et al. studied 182 cases operated upon by laminoforaminotomy, noticed that 93% had good to excellent outcomes at a mean follow-up of 19 months. On the other hand, Jagannathan

et al. puplished a retrospective study on 162 cases with minimum follow up of 5 years, noted 95% improvement in radicular pain[25,27].

The choice to perform posterior approach versus anterior is made on a case-by-case basis, and usually is dependent on experience of the surgeon. Based on our decision-making paradigm, patients who have unilateral radiculopathy with images showing an isolated paracentral disc or a lateral hard disc posterior foraminotomy is the best choice[28].

Our prospective study was done in neurosurgery department, Zagazig University hospital on 24 patients to evaluate the effectiveness of minimally invasive posterior cervical foraminotomy with or without discectomy and to compare between it and the anterior cervical discectomy and fusion. Half of the studied patients underwent anterior cervical discectomy and fusion (ACDF) while the other half underwent minimally invasive posterior cervical foraminotomy (MI-PCF).

In keeping with these previous studies, we attempted to study the effect of minimal invasive posterior foraminotomy in treating cervical radiculopathy, and improving patient quality of life and compare it with anterior cervical discectomy and fusion to dedicate the absolute indication of posterior cervical foraminotomy.

In our study there was an insignificant difference as regarding sex distribution where male represented 50% and female 50% in agreement with Selvanathan et al. [29] where 49% was men versus 51% women while in Tomaras et al.,[27] there was 62% men versus 37% women.

The mean age in our study was 41.3 years in agreement with Tomaras al., [27] where the mean age was 46 years.

As regard pre-operative level of cervical radiculopathy in our study, patients with C5-6 level represented 51.6%, this also coincides with the series of Chang et al. [30] were 28 cases had C5-6 (51%) affection.

There was an insignificant difference between the studied groups regarding pre-operative VAS of pain where mean was 7.91 in posterior group versus 7.50 in anterior group. There was an insignificant difference between the studied groups regarding pre-operative ODI where mean was 58.50% in posterior group versus 54.16% in anterior group.

This coincides with the study of Selvanathan et al. where there was no differences in the pre-operative NDI, VAS scores between both groups [29].

On comparison between posterior group and anterior group regarding changes VAS score and ODI There was an insignificant difference between the studied groups with excellent clinical outcome and highly significant improvement in both groups, this also coincides with many studies, where both ACDF and PCF resulted in statistically significant improvement in NDI, VAS score. both procedures have similar improvement and have comparable outcome [31,32,33].

There was a significant difference between the studied groups regarding blood loss where mean was 155 ml in posterior group versus 93.33ml in anterior group. This coincides with other studies where more blood loss were reported associated with PCF[34,35].

There was an insignificant difference between the studied groups regarding operative time where mean was 103.33 minutes in posterior group versus 98.33 minutes in anterior group, which coincides with (Selvanathan et al.,)[29].

In our study groups regarding type of compression where patients with hard type represented 57.1% of posterior group versus 40% of anterior group, there was no significant difference between the two groups as regard change VAS and NDI scores where the two groups shows excellent improvement in the clinical outcome, and this coincides with, (Selvanathan et al., [29]), (Herkowitz et al,. [36]), (Onimus et al,. [37]), and (Wirth et al,. [32])

In Selvanathan et al., where in the ACDF group (74%) compression was due to postero-lateral disc herniaion, with the remaining secondary to foraminal stenosis due to cervical spondylosis. In the PCF group (35.5%) compression was due to foraminal stenosis, with the remaining scondary to postero-lateral disc herniation. There was no statistically significant difference in the NDI and VAS scores in both operative groups between those with nerve compression due to degenerative disc disease and those with foraminal stenosis. However, there is a trend suggesting that PCF may be more effective in foraminal pathology and ACDF may be more effective in compression related to disc at 2-year follow-up[29].

As regard complications there was an insignificant difference between the studied groups regarding complications where patients with complications represented 8.3% of both groups, one case in the posterior group had dural puncture minimal csf leak during surgery, putting muscle graft and gel foam on the site of the leak, tight closure without drain, wound healed normally and patient improved.

On the other hand one case in the anterior group had immediate postoperative mild dysphagia and dysphonia due to recurrent laryngeal nerve affection during traction, patient improved from these signs 3 months after surgery after follow up with ENT physician. This also coincides with

many studies, where the mean complication rate was 7% in ACDF group and 4% in PCF group. There was no significant difference in complication rate between ACDF group and PCF group[29,34,38].

The complications of anterior approach includes dysphagia, horsiness of voice, hematoma, esophageal injury and implant-related complications as pseudoarthrosis, adjacent segment degeneration, and wound infections and so on in ACDF patients, on the other hand root injury, CSF leak, infections and so on in PCF patients. There was no statistically significant difference in the complication rate between the two groups[39].

In our study the average cost of MI PCF was lower than ACDF, three RCoS cost reported or cost-effectiveness of both groups in the managment of single level cervical radiculopathy. These reports concluded that the average cost of posterior cervical foraminotomy was significantly lower than ACDF group[38,40].

CONCLUSION

Posterior microscopic cervical foraminotomy is an effective and safe motion preserving technique for management of cervical radiculopathy in well selected cases. It has comparable outcomes to the ACDF approach with avoidance of possible complications associated with anterior approaches. This approach is as effective for both hard and soft disc pathologies. The microscopic cervical foraminotomy approaches have comparable results regarding hospital stay, the return to daily activity or job and the final outcomes after recovery period, MI-PCF had less cost than ACDF. No need to wear neck collar postoperative without affection of stability. MI-PCF is effective for treatment of cervical radiculopathy with discectomy or not, just root decompression had good outcome.

The chance for disc removal from posterior approach is high where the fragment is laterally situated, free and large.

MI-PCF especially indicated for obese patients with short neck where the anterior approach is difficult to access especially for C3-4 or C6-7 and C7-T1 levels.

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Christopher D Witiw, MD, MS, Fabrice Smieliauskas, PhD, John E O'Toole, MD, MS, Michael G Fehlings, MD, PhD, Richard G Fessler, MD, PhD, Comparison of Anterior Cervical Discectomy and Fusion to Posterior Cervical Foraminotomy for Cervical Radiculopathy: Utilization, Costs, and Adverse Events 2003 to 2014, Neurosurgery, Volume 84, Issue 2, February 2019, Pages 413–420

How to cite

Abd Elmonem, M., Elhosiny, A., Elhady, W., Haggag, A. Minimally invasive posterior cervical foraminotomy versus anterior cervical discectomy and fusion in cases of cervical radiculopathy. Zagazig University Medical Journal, 2024; (54-68): -. doi: 10.21608/zumj.2021.53196.2043