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Functional outcome of anterior cervical discectomy and fusion with anterior cervical plate in cervical disc herniation

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Abstract

Introduction: Cervical radiculopathy is one of the most common symptoms of disc herniation although; it can also be associated with osteoarthritis of uncovertebral and facet joints. Patients with cervical radicular syndrome due to disc herniation who are refractory to Lifestyle modification and conservative management are offered ACD which is the standard procedure, often in combination with inter body fusion. ACD is widely accepted as standard procedure for cervical disc radiculopathy but fusion is still controversial. This study is intended to observe the role of ACDF with anterior cervical plate in cases of cervical disc Herniation and, its effects on cervical mobility, complications and the neurological improvement.

Objective: To study the Functional outcome ACDF with anterior cervical plate in cases of cervical disc herniation with respect to Post-operative neurological improvement, effect on quality of life and complications associated with procedure.

Material and methods: A prospective follow – up study of functional outcome following ACDF with Anterior locking plate in patients with Cervical Disc herniation. A sample size of minimum 50 patients was selected using purposive sampling technique. Clinical improvement was studied during follow up at 6 weeks, 12 weeks, 6 months and 9months and a Functional score was obtained using SF-36 questionnaire, Neck disability index score, and Visual analog scale at these visits. Statistical Analysis of the data was done by Friedman test, ANOVA and Wilcoxon signed rank test. X

Result Statistical significant improvement seen in SF-36 scores, Neck disability index score, and Visual analog scale was seen in study ($P < 0.01$). No worsening of neurological deficit or donor site morbidity found in the study of 50 patients. SF-36scores, NDI score as well as VAS scores featured gradual and constant improvement during the follow-up with best scores presenting 9 months after surgery.

Conclusion: Cervical plating increases the rate of fusion and decreases the change of graft related complication. Thus this study shows that the improved clinical outcome and fusion and low complication rate associated with anterior cervical plating may justify its use for cervical disc fusion.

Keywords: Anterior cervical discectomy and fusion, anterior cervical plating, cervical disc degeneration

Introduction

Anterior Cervical Discectomy and Fusion (ACDF) was first described by Cloward, Smith and Robinson in 1958 and later in 1960 by Hirsch who described Anterior Cervical Decompression (ACD) and debated the necessity of inter-body fusion ^[1].

The indications for ACDF include radiculopathy, myelopathy, myeloradiculopathy and traumatic instability of cervical spine involving single or multiple levels ^[4].

Patients with cervical radicular syndrome due to disc herniation who are refractory to Lifestyle modification and conservative management are offered ACD which is the standard procedure, often in combination with inter body fusion but in any case, quickened disc degeneration is a known element on the long haul. Although disc arthroplasty is gaining popularity, the anterior cervical decompression and fusion procedure remains the gold standard ^[4]

In ACDF, anterior spinal cord can be decompressed and it also preserves the stability of spinal column. It is also associated with a low prevalence of graft extrusion or migration ^[2]. ACDF with use of Anterior cervical plate has complications associated with it such as Bleeding, Dysphagia, hoarseness of Voice, damage to dura, locking screw pull out etc increases.

Whereas when an anterior cervical plate is not used for fusion the chances for nonunion, kyphosis deformity, posterior foramotomy and risk of graft extrusion increases [5].

This study is intended to observe the role of ACDF with anterior cervical plate in cases of cervical disc Herniation and, its effects on cervical mobility, complications and the neurological improvement.

Materials and Methods

A prospective study was conducted in tertiary care orthopedic and trauma institute located in Bangalore. All patients admitted with cervical disc herniation with radiculopathy and neurological deficits who underwent Anterior Cervical Discectomy and Fusion with Anterior locking plate in the Department of Spine in the duration November 2018 to March 2020. These 50 patients, who were admitted, operated and assessed at Department of Orthopedic Surgery, Sanjay Gandhi institute of trauma and orthopedics, Bangalore. Clinical improvement was studied during follow up at 6 weeks, 12 weeks, 6 months and 9 months.

The inclusion criteria included: (1) Age – 30-65 years not responding to conservative management for 6 weeks. (2) Patients with Cervical disc herniation with severe cervical radiculopathy or acute onset of neurological deficits. (3) Selected cases with myelopathy secondary to cervical spinal canal stenosis that can be adequately decompressed with ACDF.

The exclusion criteria were : (1) Previous cervical surgery (2) Multiple level cervical disc herniation (3) Infection, bone disease, neoplasm, pathological fractures and immune compromised.(4) Spinal anomalies (5) Stroke or Brain parenchymal deficit (6) Mental or psychiatric disorder (7) OPLL [Ossification of the posterior longitudinal ligament] (8) Serious co-morbid conditions precluding surgical intervention in these types of cases.

After approaching and priming participants regarding the study, each provided their written informed consent. Participants were assured privacy and confidentiality. Patients were counseled that participation was voluntary and they

could discontinue at any time without prejudice. No honorarium was paid and data was kept confidential with restricted access. After obtaining the institutional ethics committee clearance and written informed consent, the in-patients in the Department of Orthopedics fulfilling the inclusion criteria will be enrolled in the study.

Each patient was given a unique identity number. Demographic data, medical history, concomitant medications, physical examination, clinical examination including recording of vital signs, details of surgery and details of the implant was recorded in the study proforma and relevant radiological investigations as mentioned in the assessment tools was done at baseline visit. Follow-up visits will be at 6 weeks (visit 1), 12 weeks (visit2), 6months (visit 3) and 9months (visit 4) from the date of surgery. At follow-up visits, presenting complaints, general physical examination, local examination and standard radiographs was recorded. A Functional score was obtained using SF-36 questionnaire, Neck disability index score, and Visual analog scale at these visits.

Data collected by clinical Range of Movements studies and Disability Scoring System was analyzed by repeated measures of ANOVA followed by Bonferroni's post hoc analysis which was used to compare the mean SF-36 questionnaire scores between different time intervals among study patients. Friedman's test followed by Wilcoxon Signed Rank post hoc test was used to compare the mean NDI and VAS scores between different time intervals among study patients. The level of significance was set at $P < 0.05$.

Result

A total of 50 patients with cervical disc herniation with radiculopathy or neurologic deficit who were to undergo Anterior Cervical Discectomy and Fusion and who fulfilled the inclusion criteria, were selected for the study. No patients were lost to follow up. 50 patients were included in the study and followed up for 9 months at regular intervals.

Age and Sex Distribution

Distribution of age among study patients			
Variable	Category	n	%
Age	21-30 years	3	6%
	31-40 years	12	24%
	41-50 years	19	38%
	51-60 years	11	22%
	>60 years	5	10%

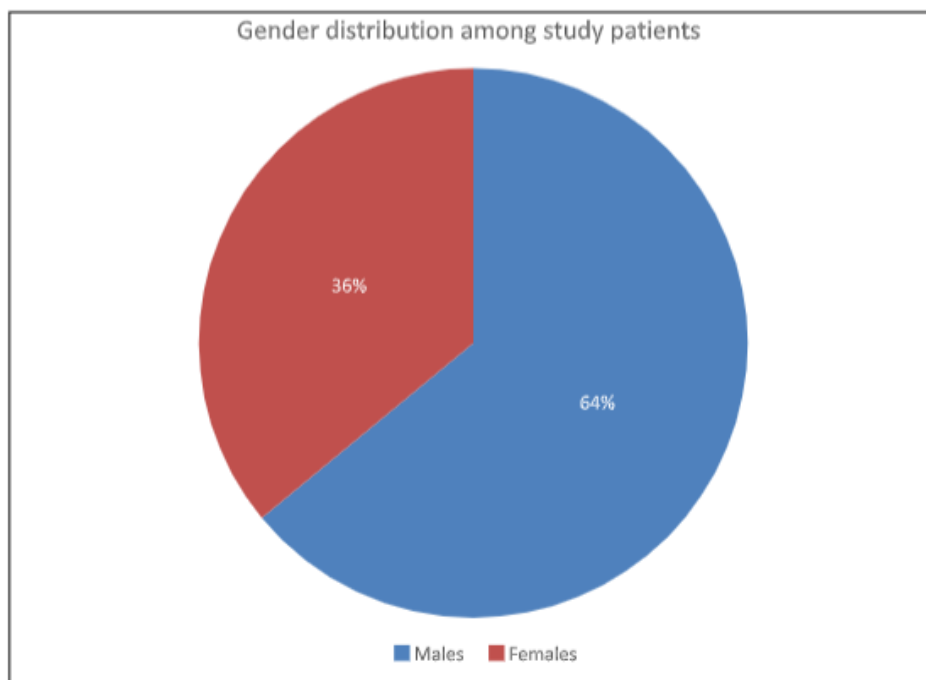
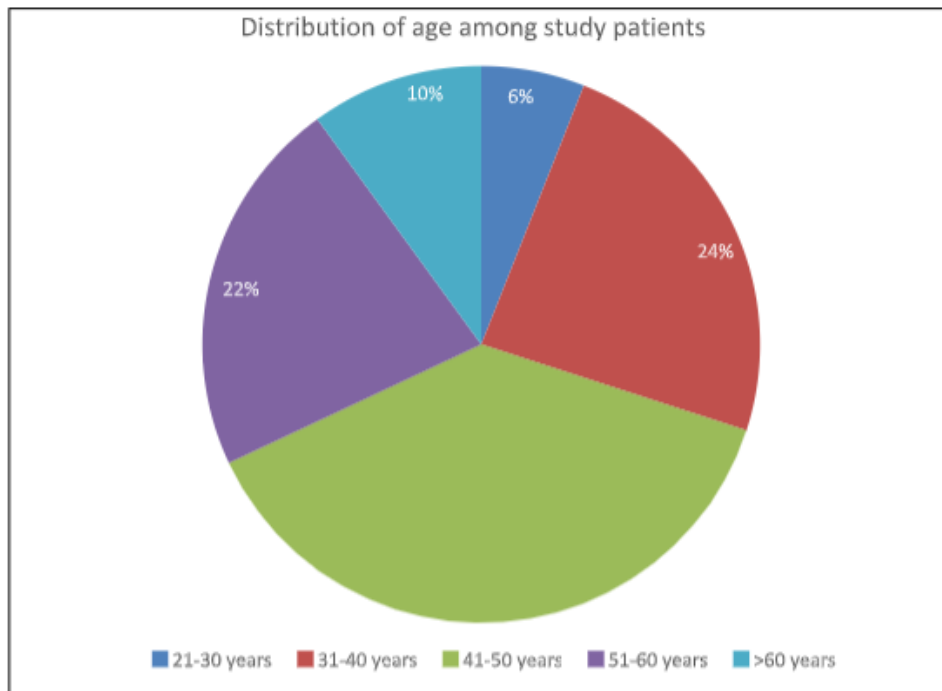
Distribution of gender among study patients			
Variable	Category	n	%
Gender	Males	32	64%
	Females	18	36%

Majority of the patients in our study, i.e. 19 patients (38 %) were in the age group of 41-50 years, the majority of people

are over 40 years (70 %).

Of the total number of 50 patients, 32 (64%) were males and

18 (36 %) were females i.e. there was an overall male preponderance seen in this study.

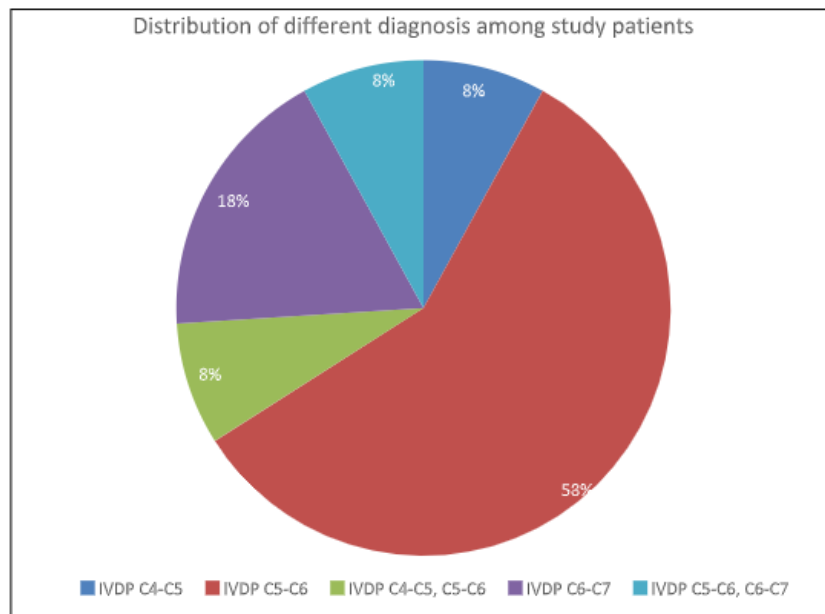


Level of Involvement

Distribution of different diagnosis among study patients			
Variable	Category	n	%
Diagnosis	IVDP C4-C5	4	8%
	IVDP C5-C6	29	58%
	IVDP C4-C5, C5-C6	4	8%
	IVDP C6-C7	9	18%
	IVDP C5-C6, C6-C7	4	8%

IVDP at C5-C6 level was seen to be the most common level of involvement and was seen in 29 of the 50 patients (58%). Nine patients (18%) had IVDP C6-C7, four patients (10%) had IVDP C4-C5 and Eight patients (16 %) had a 2 level disc prolapse. (4 patients had IVDP C4-C5, C5-C6 and 4 patients

had IVDP C5-C6, C6-C7). All patients underwent anterior cervical discectomy and fusion with bone grafting and anterior plating. There was no worsening of neurology in any of the patients following surgery



Comparison of mean Neck Disability Index scores b/w different time intervals using Friedman's Test						
Time	N	Mean	SD	Min	Max	P-Value
Pre-Op	50	29.84	6.16	20	46	<0.001*
6 Weeks	50	21.90	6.28	13	39	
3 Months	50	12.54	4.91	6	25	
6 Months	50	8.56	3.52	4	23	
9 Months	50	7.22	3.25	4	21	

* - Statistically Significant

Multiple comparison of mean difference in Neck Disability Index scores b/w diff. time intervals using Mann Whitney post hoc Test					
(I) Time	(J) Times	Mean Diff. (I-J)	95% CI for Diff.		P-Value
			Lower	Upper	
Pre-Op	6 Weeks	7.94	5.10	10.78	<0.001*
	3 Months	17.30	14.93	19.67	<0.001*
	6 Months	21.28	18.74	23.82	<0.001*
	9 Months	22.62	20.07	25.17	<0.001*
6 Weeks	3 Months	9.36	7.96	10.76	<0.001*
	6 Months	13.34	11.30	15.38	<0.001*
	9 Months	14.68	12.33	17.03	<0.001*
3 Months	6 Months	3.98	2.55	5.41	<0.001*
	9 Months	5.32	3.49	7.15	<0.001*
6 Months	9 Months	1.34	0.25	2.43	0.007*

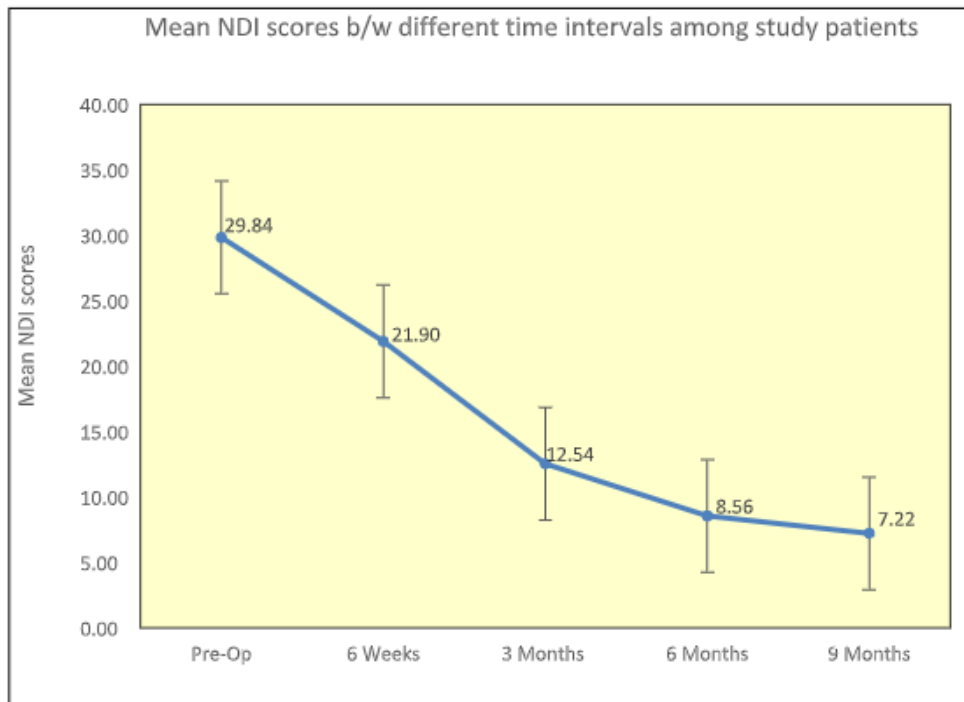
* - Statistically Significant

The test results demonstrated the mean neck disability scores at different time intervals. The mean NDI scores at pre-op period was 29.84 ± 6.16 , at 6 weeks' post-operative period was 21.90 ± 6.28 , at 3 months was 12.54 ± 4.91 , at 6 Months was 8.56 ± 3.52 and at 9 months period, it was 7.22 ± 3.25 . This difference in the mean Neck disability scores between different time intervals was statistically significant at $P < 0.001$.

Multiple comparison of mean difference in the neck disability scores between different time intervals revealed that the mean NDI scores was significantly least at 9 Months' as compared

to other study time intervals at $P < 0.001$ and with 6 Months at $P = 0.007$.

This was followed by 6 Months post-operative period showing significantly lesser mean NDI scores as compared to other time period at $P < 0.001$. This in turn was followed by 3 months showing significantly lesser NDI scores as compared to 6 weeks' post-operative periods and both in turn showing significantly lesser mean NDI scores compared to pre-operative period at $P < 0.001$. This infers that the mean NDI scores significantly reduced from pre-operative to 6 months' post-operative period among the study patients.

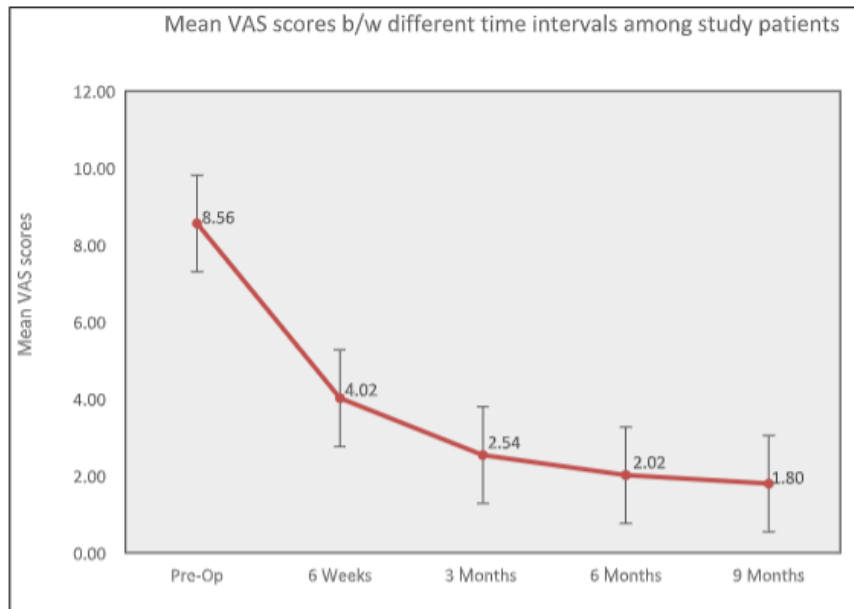


Comparison of mean VAS scores b/w different time intervals using Friedman's Test						
Time	N	Mean	SD	Min	Max	P-Value
Pre-Op	50	8.56	1.62	2	10	<0.001*
6 Weeks	50	4.02	1.52	1	9	
3 Months	50	2.54	1.49	1	8	
6 Months	50	2.02	1.44	1	7	
9 Months	50	1.80	1.07	1	6	

* - Statistically Significant

The test results demonstrated the mean Visual analogue scores at different time intervals. The mean VAS scores at pre-op period was 8.56 ± 1.62 , at 6 weeks' post-operative period was 4.02 ± 1.52 , at 3 months' was 2.54 ± 1.49 , at 6

Months was 2.02 ± 1.44 and at 9 months period, it was 1.80 ± 1.07 . This difference in the mean VAS scores between different time intervals was statistically significant at $P < 0.001$.



Multiple comparison of mean difference in VAS scores b/w diff. time intervals using Wilcoxon Signed Rank post hoc Test					
(I) Time	(J) Times	Mean Diff. (I-J)	95% CI for Diff.		P-Value
			Lower	Upper	
Pre-Op	6 Weeks	4.54	3.98	5.11	<0.001*
	3 Months	6.02	5.33	6.71	<0.001*
	6 Months	6.54	5.85	7.23	<0.001*
	9 Months	6.76	6.13	7.39	<0.001*
6 Weeks	3 Months	1.48	1.15	1.81	<0.001*
	6 Months	2.00	1.65	2.35	<0.001*
	9 Months	2.22	1.82	2.62	<0.001*
3 Months	6 Months	0.52	0.29	0.75	<0.001*
	9 Months	0.74	0.43	1.05	<0.001*
6 Months	9 Months	0.22	0.01	0.43	0.04*

* - Statistically Significant

Multiple comparison of mean difference in the VAS scores between different time intervals revealed that the mean VAS scores was significantly least at 9 Months as compared to other study time intervals at $P < 0.001$ and with 6 Months at $P = 0.04$. This was followed by 6 Months post-operative period showing significantly lesser mean VAS scores as compared to other time period at $P < 0.001$.

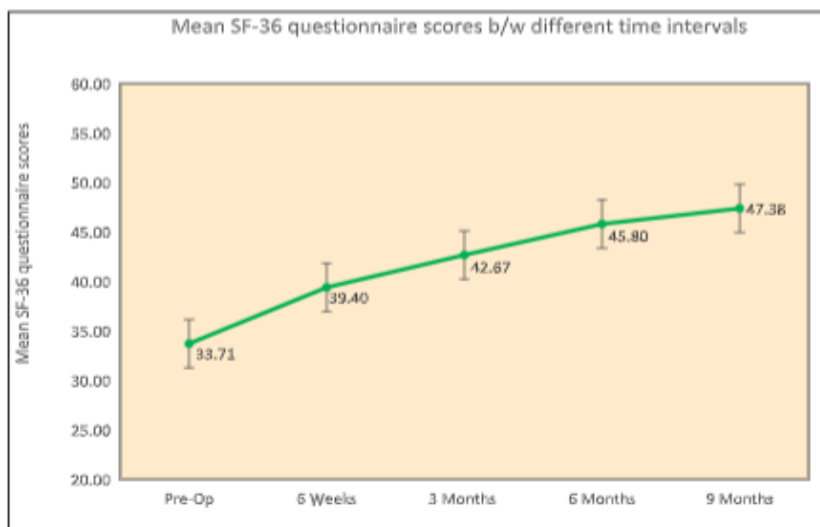
This in turn was followed by 3 months showing significantly lesser VAS scores as compared to 6 weeks post-operative periods and both in turn showing significantly lesser mean VAS scores compared to pre-operative period at $P < 0.001$. This infers that the mean VAS scores significantly reduced from pre-operative to 6 months post-operative period among the study patients.

Comparison of mean SF-36 questionnaire scores b/w different time intervals using Repeated Measures of ANOVA Test						
Time	N	Mean	SD	Min	Max	P-Value
Pre-Op	50	33.71	3.11	27.7	39.4	<0.001*
6 Weeks	50	39.40	2.73	34.4	44.5	
3 Months	50	42.67	2.58	37.4	48.2	
6 Months	50	45.80	2.33	40.9	49.7	
9 Months	50	47.38	1.69	43.1	49.8	

* - Statistically Significant

The test results demonstrated the mean SF-36 scores at different time intervals. The mean SF-36 scores at pre-op period was 33.71 ± 3.11 , at 6 week's post-operative period was 39.40 ± 2.73 , at 3 month's was 42.67 ± 2.58 , at 6 month's

was 45.80 ± 2.33 and at 9 month's period, it was 47.22 ± 1.69 . This difference in the mean SF-36 scores between different time intervals was statistically significant at $P < 0.001$.



Multiple comparison of mean difference in SF-36 questionnaire scores b/w diff. time intervals using Bonferroni's post hoc Test					
(I) Time	(J) Times	Mean Diff. (I-J)	95% CI for Diff.		P-Value
			Lower	Upper	
Pre-Op	6 Weeks	-5.69	-6.27	-5.11	<0.001*
	3 Months	-8.96	-9.64	-8.28	<0.001*
	6 Months	-12.09	-12.80	-11.38	<0.001*
	9 Months	-13.67	-14.54	-12.80	<0.001*
6 Weeks	3 Months	-3.27	-3.52	-3.03	<0.001*
	6 Months	-6.40	-6.81	-6.00	<0.001*
	9 Months	-7.98	-8.64	-7.33	<0.001*
3 Months	6 Months	-3.13	-3.50	-2.76	<0.001*
	9 Months	-4.71	-5.32	-4.10	<0.001*
6 Months	9 Months	-1.58	-2.00	-1.16	<0.001*

* - Statistically Significant

Multiple comparison of mean difference in the SF-36 scores between different time intervals revealed that the mean SF-36 scores was significantly least at 9 Month's as compared to other study time intervals at $P < 0.001$. This was followed by 6 Months post-operative period showing significantly lesser mean SF-36 scores as compared to other time period at $P < 0.001$. This in turn was followed by 3 month's showing significantly lesser SF-36 scores as compared to 6 week's post-operative periods and both in turn showing significantly lesser mean SF-36 scores compared to pre-operative period at

$P < 0.001$.

This infers that the mean SF-36 scores significantly reduced from pre-operative to 9 month's post-operative period among the study patients.

All 50 patients showed an improvement in the radiculopathy and neurological outcome when compared to their pre-operative status. SF-36 scores, NDI and VAS score have a constant improvement during follow-up, with greatest scores presenting at 9 months with values of 47.22 ± 1.69 , 7.22 ± 3.25 and 1.80 ± 1.07 respectively.

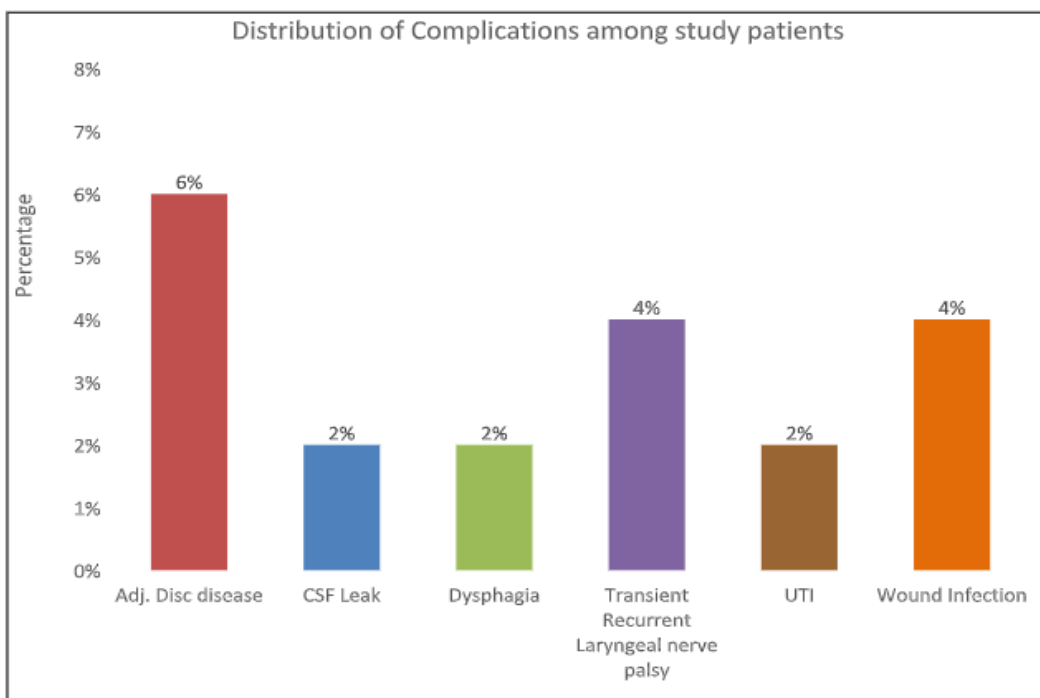
Distribution of Complications among study patients			
Variable	Category	n	%
Complication	Adjacent Disc disease	3	6%
	CSF Leak	1	2%
	Dysphagia	1	2%
	Transient Recurrent Laryngeal nerve palsy	2	4%
	UTI	1	2%
	Wound Infection	2	4%

Of the total number of 50 patients at the first follow up visit after 6 weeks, none of the patients had any morbidity at the donor site, which was the left iliac crest.

However, the following complications occurred: Two postoperative wound infections requiring regular dressing and was healed with secondary intention. One patient with mild dysphagia which was no longer present at the first follow up.

Two patients had transient recurrent laryngeal nerve palsy was no longer present at the first follow up.

Adjacent disc disease was developed in three patients and CSF Leak in one patient who developed mild headache which reduced by the end of 4th post-operative day. Postoperatively, patients did not wear any cervical collar.



Preoperative X ray (lateral view) and T2 wt MRI Suggestive of Cervical cord Compression at C5-6 level



Post-operative X ray following ACDF with Tricortical iliac crest graft at C5-6 level.

Discussion

Intervertebral disc prolapse is a common condition affecting middle and older age group of people with no sex predilection. Fraser et al. in their study found the mean age of patients were 46.7 years with 46.6% females and 53.5% males [6]. In accordance with this study, our study also showed an overall male preponderance with 64% males and 36% females and a mean average age of 47.2 years (28 to 75 years).

Gore DR et al. in their study noted that majority of the patients had an IVDP at the C5-C6 level [7]. Similarly, 29 patients (58%) in our study had IVDP at C5-C6 level, 9 patients (18%) had IVDP at C6-C7 level, 4 patients (8%) had IVDP at C4-C5 and 8 patients (16 %) had a 2 level disc prolapse.

Anterior cervical discectomy followed by fusion is a widely accepted surgical procedure for the treatment of degenerative cervical spine disease. The primary goal of these techniques is to decompress the spinal cord and the affected nerve roots while restoring cervical alignment at the same time. The autologous iliac crest bone graft is still probably the most commonly used material for creating bone connection of 2 adjacent vertebra [8, 9].

McConnell et al. in their comparison of coralline hydroxyapatite with autograft referred 22 % of short and long term morbidity associated to bone harvesting from the iliac crest [10]. Gore et al. in their study noted a donor site complication of 13%. [7] However no such negative clinical experience with autograft harvesting and donor site morbidity, were noted in our study Connolly et al. in their study noted that plating not only acts as a buttress preventing graft extrusion, but decreases the extent of graft collapse and subsidence, preventing the formation of post-operative cervical kyphosis [11]. It also maintains sagittal balance and preserves the normal biomechanics of the unfused cervical segments, contributing to a decreased incidence of post-operative axial neck pain and reduced potential for adjacent-level disease.

Fraser et al. in their study noted that the fusion rates were maximum in the group with plating. The overall fusion rate was 84.9% for ACD, 92.1% for ACDF and 97.1% for ACDFP. [6] Mobbs et al. in their study noted a higher fusion rate in the ACDFP group (99%) than in the ACDF group

(93%) [5].

Lofgren et al. in their study noted that the VAS score reduced from a median of 66 in the neck and 60 in the arm before surgery to 36 and 28 at 1 year, and to 24 and 28 after 2 years of surgery in the group with autograft [12]. The number of patients showing clinically relevant improvement in neck pain was 63% and in arm pain 58%. The follow up VAS scores at 4, 12 and 24 months in both neck and arm showed statistically significant improvement with a p value of <0.05.

In our study, the mean VAS score at pre-operative stage was 8.56 ± 1.62 , which reduced to a mean of 4.02 ± 1.52 at 6 weeks follow up and further reduced to a mean of 2.54 ± 1.49 , 0.02 ± 1.44 and 80 ± 1.07 at 3 months, 6 months and 9 months follow up respectively which was statistically highly significant with a p value <0.05. Using the Wilcoxon signed rank test, it showed that there is a highly significant reduction in VAS score when compared to adjacent time intervals. $P < 0.05$

In a study conducted by Lofgren et al. it was noted that the NDI improved from median of 44 pre operatively to 25 in the 2 year follow up which was found to be statistically significant [12]. Clinically relevant improvements in the NDI were found in 61% of patients. At all follow ups, the reduction in NDI was found to be significant In a study conducted by Li et al. it was noted that the NDI, VAS and SF-36 improved from mean of 17.0 ± 2.9 , 6.1 ± 1.6 and 29.1 ± 7.1 pre operatively to 10.5 ± 2.1 , 1.8 ± 0.5 and 50.6 ± 7.1 in a final 2 year in anterior cervical plate group which was found to be statistically found to be significant.

Similarly, in our study, the mean the NDI, VAS and SF-36 in the pre-operative group was found to be 29.84 ± 6.16 , 8.56 ± 1.62 and 33.31 ± 3.11 which reduced to a mean value of 7.22 ± 3.25 , 1.8 ± 0.5 and 47.38 ± 1.69 follow up respectively which is highly significant with a $P < 0.05$. The NDI, VAS and SF-36 scores were seen to be highly significant when compared to adjacent time intervals using the Mann Whitney test. Although the NDI and VAS scores with 6 month and final follow-up are not statistically significant.

The results of our study are in accordance with the above studies with a statistically significant improvement in the VAS, NDI and SF-36 scores

Conclusion

Anterior cervical plating plays an important role in influencing the post-operative cervical spine alignment and also the clinical outcome of patients ^[65]. Cervical plating should be considered for patients undergoing an ACDF to decrease the rate of pseudoarthrosis. The use of anterior plating after anterior cervical discectomy and fusion with autologous bone graft greatly enhances arthrodesis ^[58].

Thus this study shows that the improved clinical outcome and fusion and low complication rate associated with anterior cervical plating may justify its use for cervical disc herniation.

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