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A comparative study of adjacent segment degeneration following discectomy and instrumented fusion in lumbar Spine

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Abstract

Adjacent segment degeneration following lumbar spine fusion and lumbar discectomy remains a widely known problem, but due to insufficient knowledge regarding the factors that contribute to its occurrence it is difficult to diagnose considering the fact that it has variable presentation in terms of the symptoms it produces, the time frame for its occurrence and radiological changes. Our study shows that both in single level discectomy and post instrumented fusion and is marginally more in post single level discectomy without fusion. In both groups cephalic segment is more affected as compared to the caudad segment. There is a significant relationship between radiological degeneration and the clinical adjacent segment degeneration. It has been seen that there is a significant relation between degeneration and chronic smokers both radiologically and clinically. Since there is only marginally difference, we hold on to our hypothesis that the role of natural degeneration is more compared to the role of instrumented fusion causing adjacent segment degeneration. Thus we have to rule out natural and post surgical causes of adjacent segment degeneration leading to different clinical complaints of the patient and manage it accordingly.

Keywords: adjacent segment degeneration, modified pfirrmann grading, facet joints

Introduction

Adjacent segment degeneration (ASD) following lumbar spine fusion and lumbar discectomy remains a widely known problem, but due to insufficient knowledge regarding the factors that contribute to its occurrence it is difficult to diagnose considering the fact that it has variable presentation in terms of the symptoms it produces, the time frame for its occurrence and radiological changes^[1].

Another of the challenges is to distinguish it from the more common age-related degenerative process. Our understanding of biomechanics of spine is increasing hence the indication of adjacent segment degeneration is increasing by the day.

Also, indication for spinal surgery are increasing hence there is increase incidence of degeneration. A concern regarding posterior lumbar spine fusion is the potential for adjacent segment degeneration cephalad or caudad to the fusion segment. The degeneration has to be seen in a segment above and below. Many new instrumentation and technique are being marketed with a goal to halt progress of asd or prevent it. So, it would be worth for every spine surgeon to be familiar with the topic and new instrumentation.

This study is an attempt to explore the possibility of adjacent segment degeneration after index Surgery, its time pattern and its clinical behavior.

This study also explore current views on newer fusion technique and its impact on outcome of ASD. Adjacent segment degeneration in the lumbar and lumbosacral spine has been studied and Radiographic signs of degeneration of disc spaces adjacent to the site of a lumbar fusion discectomy may lead to clinical symptoms of radiculopathy, discogenic pain, or stenosis referable to that level.

Materials and Methods

This is a retrospective study of patients who underwent discectomy and instrumented

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Fusion of Lumbar Spine in Kempegowda institute of medical sciences and Hospital, Bangalore for Study Period Of 2012to 2017. This study has been reviewed by the ethical committee and all the cases have been well informed about the study and written informed consent were taken from all the cases.

Inclusion criteria

1. All patients who underwent fusion and those who underwent discectomy in lumbar region will be included
2. Minimum 2 year period of follow up is the requirement

Exclusion criteria

1. Pre-operative disc degeneration of more the grade III (Modified Pfirrmans classification).
2. Any form of surgical intervention in the same or adjacent segment.
3. Patient who have undergone revision discectomy or instrumentation after primary surgery.

In Our Study We Have Taken Into Consideration The Associated Co Morbidities Of The Patient, Any Complications Post Surgery, Occupational Changes Which Have Been Made And The Adjacent Segment Degeneration Has Been Graded By Modified Pfirrmann’ s Grading On Mri With The Clinical Outcome Correlated With Vas And Oswestry Scoring System

Results

Chi Square test was used to compare the study variables like

habit characteristics, co-morbidities, Post-op occupational changes, complications, modified pfirrmann gradings for cephalic & Caudad and Oswestry Disability Scores between the discectomy & Instrumentation groups.

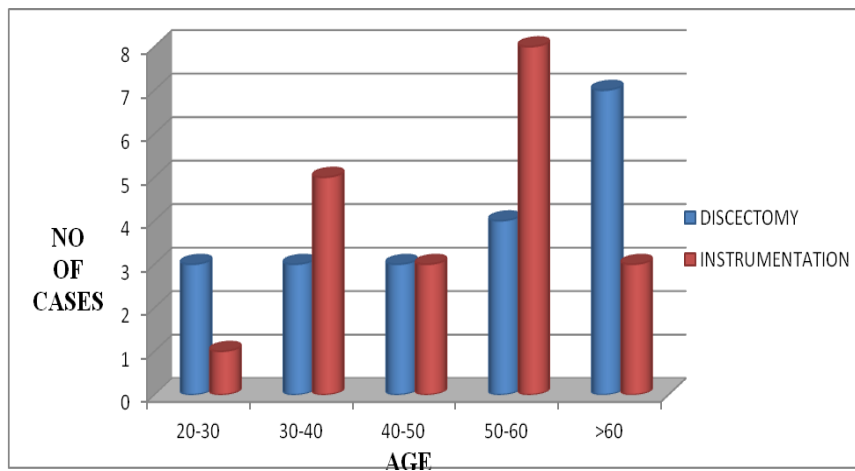
Independent Student t test was used to compare the mean VAS scores between the discectomy & Instrumentation groups.

AGE

Age	Discectomy	
	No. of Cases	Percentage
20-30	3	15%
30-40	3	15%
40-50	3	15%
50-60	4	20%
>60	7	35%

Age	Instrumentation	
	No. of Cases	Percentage
20-30	1	5%
30-40	5	25%
40-50	3	15%
50-60	8	40%
>60	3	15%

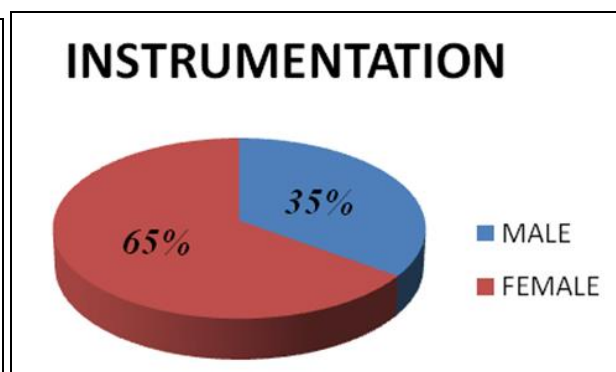
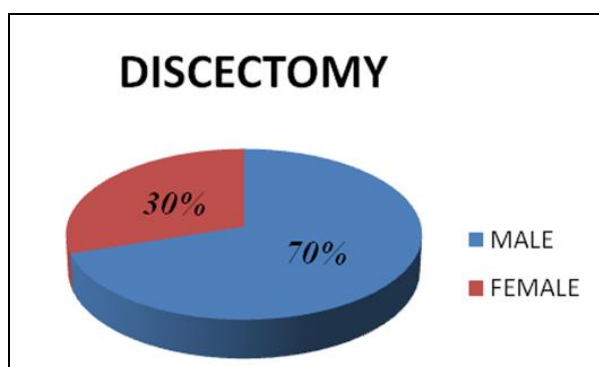
In Our Study For Discectomy Maximum Patients are Above 60 Years of Age and For Instrumentation Maximum Patients Are in the Age Group of 50-60 Years of Age



Sex

Sex	Male	%	Female	%
Discectomy	14	70	6	30
Instrumentation	7	35	13	65

In Our Study For Discectomy Male Patients Constitute Maximum of 70 Percent of the Cases While For Instrumentation Female Patients Constitute 65%

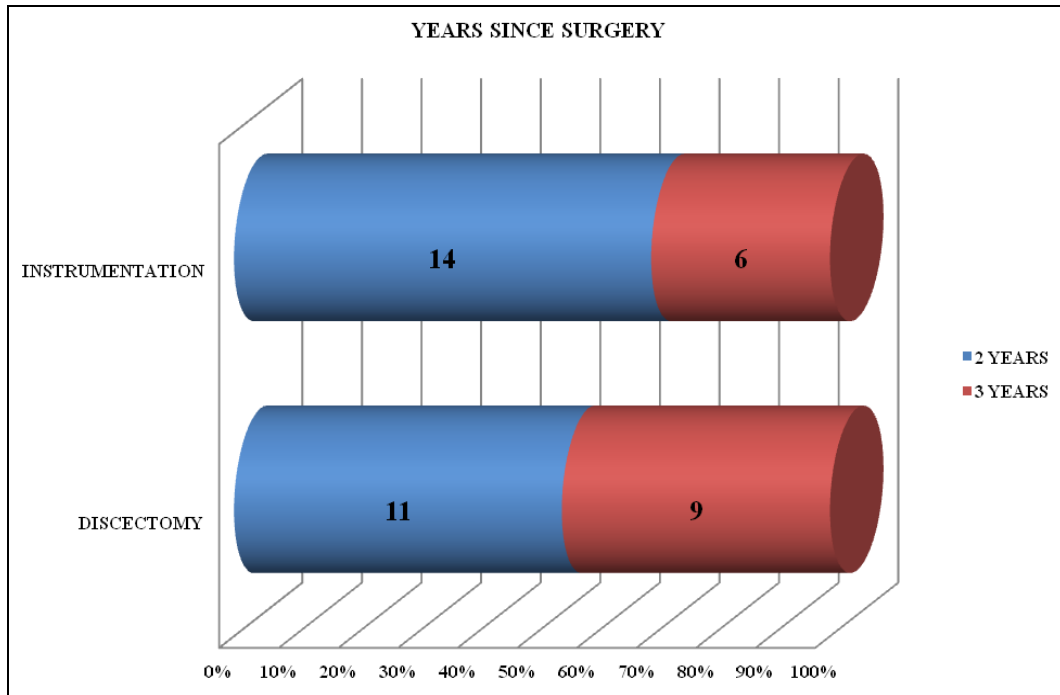


Duration since Surgery

Years Since Discectomy		
2	11	55%
3	9	45%

Years Since Instrumentation		
2	14	70%
3	6	30%

In This Retrospective Study We Have Taken 20 Cases Of Discectomy In Which 55% Patients Under Study Are 2 Years Post Discectomy And 20 Cases Of Instrumentation Have Been Considered For Which 70% Of The Patients Are 2 Years Post Instrumentation

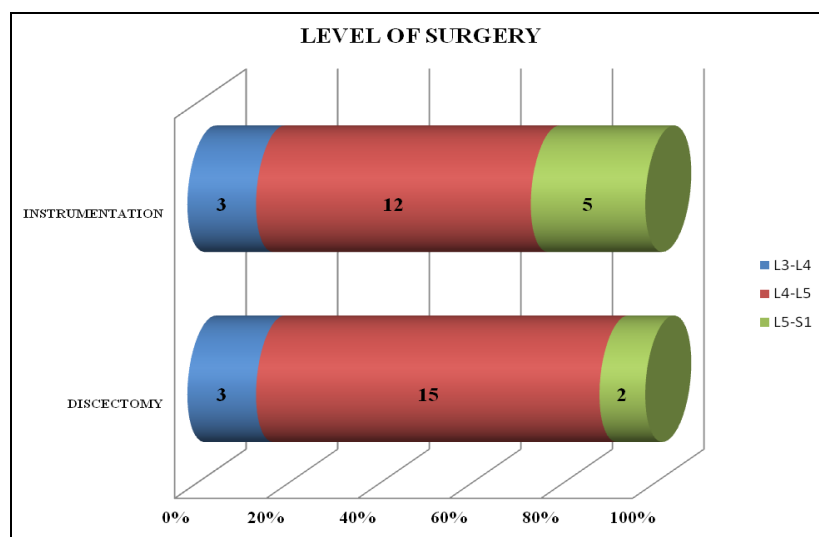


Level of Surgery

Level of discectomy	No. of cases	%
L3-L4	3	15
L4-L5	15	75
L5-S1	2	10

Level of instrumentation	No. of cases	%
L3-L4	3	15
L4-L5	12	60
L5-S1	5	25

In the 20 cases of discectomy in our study 15 cases are of L4-L5 discectomy while out of 20 cases of instrumentation 12 cases are of L4-L5 Fixation



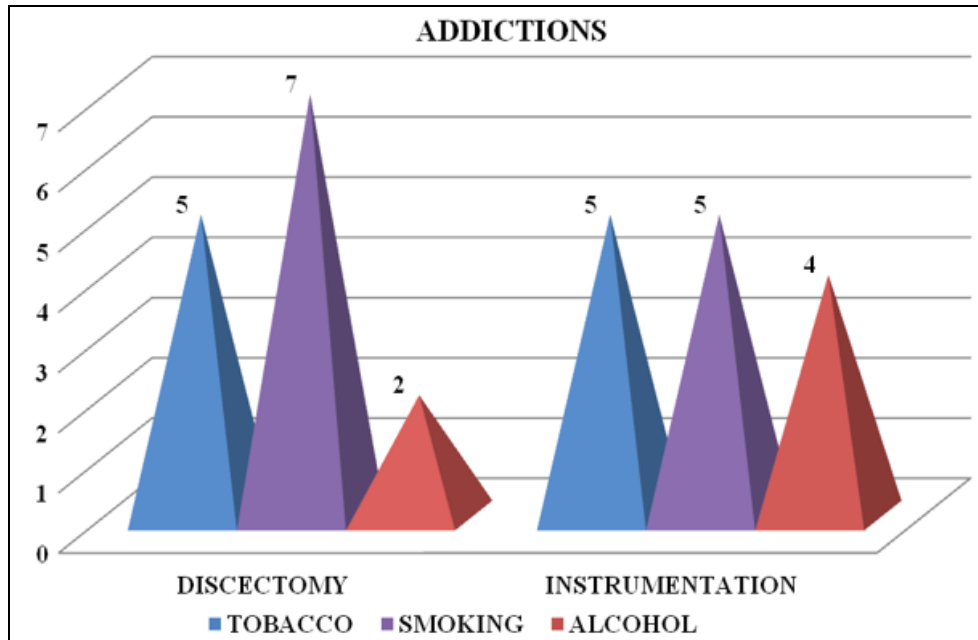
Addictions

Addictions	Discectomy			
	Cases	%	M	F
Tobacco	5	25%	4	1
Smoking	7	35%	7	0
Alcohol	2	10%	2	0

Addictions	Instrumentation			
	CASES	%	M	F
Tobacco	5	25%	4	1
Smoking	5	25%	5	0
Alcohol	4	20%	4	0

In our study of 20 cases of discectomy 25% percent patients were addicted to tobacco, 35% were addicted to smoking and 10% to alcohol, on the other hand instrumented cases tobacco

and smoking addiction were present in 25% each cases while 20% cases were addicted to alcohol.



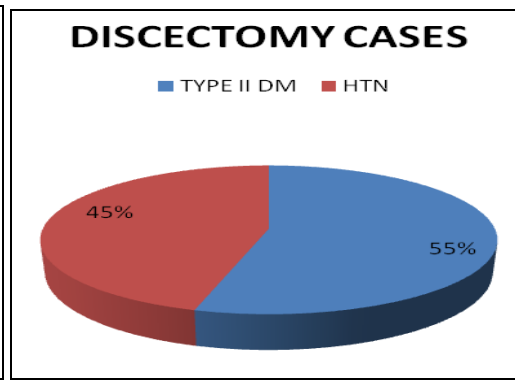
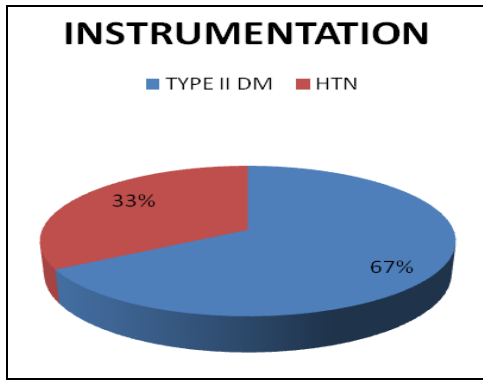
Distribution of Habit Characteristics among study patients in 02 groups							
Variables	Categories	Discectomy		Instrumentation		χ ² Value	P-Value
		n	%	n	%		
Addictions	Yes	10	50%	6	30%	1.667	0.20
	No	10	50%	14	70%		
Tobacco	Yes	5	25%	5	25%	0.000	1.00
	No	15	75%	15	75%		
Smoker	Yes	7	35%	5	25%	0.476	0.49
	No	13	65%	15	75%		
Alcohol	Yes	2	10%	4	20%	0.784	0.38
	No	18	90%	16	80%		

Comorbidities

Comorbidities	Discectomy			
	CASES	%	M	F
TYPE II DM	6	30%	4	2
HTN	5	25%	5	0
Comorbidities	Instrumentation			
	CASES	%	M	F
TYPE II DM	6	30%	1	5
HTN	3	15%	2	1

In our study co morbidities such as type ii dm is present in 30% of post discectomy cases with a male pre dominance and hypertension in 25% of the cases with male predominance In instrumentation cases 30 percent of the cases are with type

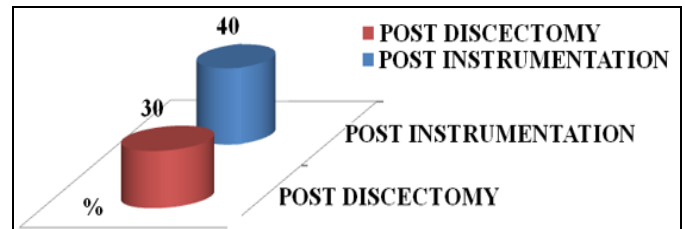
ii dm with female pre dominance and 15 percent of the cases are associated with hypertension with male pre dominance.



Distribution of Co-morbidities among study patients in 02 groups							
Variables	Categories	Discectomy		Instrumentation		χ ² Value	P-Value
		n	%	n	%		
Co-morbidities	Yes	10	50%	5	25%	2.667	0.10
	No	10	50%	15	75%		
T2DM	Yes	6	30%	6	30%	0.000	1.00
	No	14	70%	14	70%		
HTN	Yes	5	25%	6	30%	0.125	0.72
	No	15	75%	14	70%		

Occupational Changes

Occupational Changes	No. Of Cases	%
Post Discectomy	6	30
Post Instrumentation	8	40



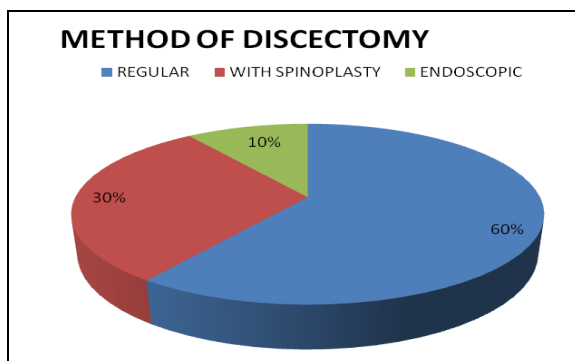
In our study 6 patients (30%) of the patients have changed there occupation post discectomy and 8 (40%) patients have changed there occupation post instrumentation.

Distribution of Post Op Occupational changes among study patients in 02 groups							
Variables	Categories	Discectomy		Instrumentation		χ ² Value	P-Value
		n	%	n	%		
Occupational change	Yes	6	30%	8	40%	0.440	0.51
	No	14	70%	12	60%		

Method of Discectomy

Method Of Discectomy	No. Of Cases	%
Regular	12	60
With Spinoplasty	6	30
Endoscopic	2	10

Out of the 3 methods followed in our institute for the 20 cases of discectomy 60% were operated by regular discectomy method, 30 percent underwent spinoplasty post surgery and 10% were operated with endoscopic method



Modified Pffirrmann Grading For Cephalic Segment

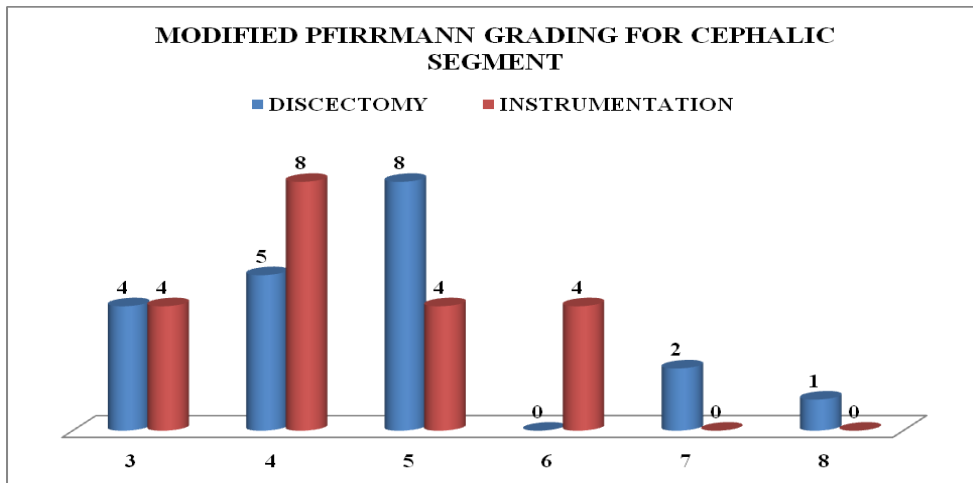
Discectomy		
Grades	Cases	%
3	4	20
4	5	25
5	8	40
6		
7	2	10
8	1	5

Modified Pffirrmann Grading For Cephalic Segment

Instrumentation		
Grades	CASES	%
3	4	20
4	8	40
5	4	20
6	4	20
7	-	-
8	-	-

In Our Study We Have Considered Grading Of Cephalic Segment By Modified Pffirrmann Grading And Found That Post Discectomy 85% Of The Patients Are Below Grade 6

While In Post Instrumentation 100% Of Cases Are Below Grade 6



Modified pfirrmann grading for caudad segment

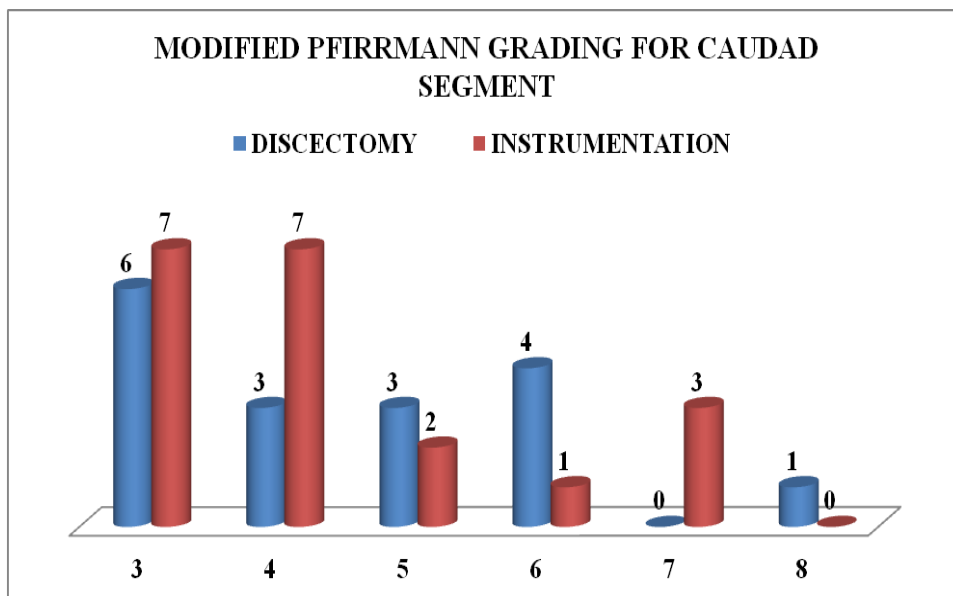
Discectomy		
Grades	Cases	%
3	6	30
4	3	15
5	3	15
6	4	20
7	-	-
8	1	5

Modified pfirrmann grading for caudad segment

Instrumentation		
Grades	Cases	%
3	7	35
4	7	35
5	2	10
6	1	5
7	3	15
8	-	-

In our study we have considered grading of caudad segment by modified pfirrmann grading and found that post

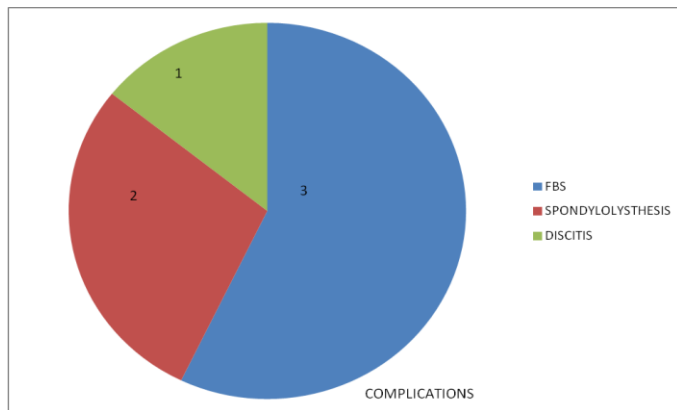
discectomy there are 45% of patients below grade 4 while post instrumentation 70% of patients are below grade 4.



Distribution of Modified Pfirrmann Gradings among study patients in 02 groups							
Variables	Categories	Discectomy		Instrumentation		χ ² Value	P-Value
		n	%	n	%		
Cephalic	Grade 3	4	20%	4	20%	9.026	0.11
	Grade 4	5	25%	8	40%		
	Grade 5	8	40%	4	20%		
	Grade 6	0	0%	4	20%		
	Grade 7	2	10%	0	0%		
Caudad	Grade 3	6	35%	7	35%	7.483	0.19
	Grade 4	3	18%	7	35%		
	Grade 5	3	18%	2	10%		
	Grade 6	4	24%	1	5%		
	Grade 7	0	0%	3	15%		
	Grade 8	1	6%	0	0%		

Complications

Complications	No. of Cases	Percentage
Failed Back Syndrome(Fbs)	3	15%
Spondylolysthesis	2	10%
Discitis	1	5%

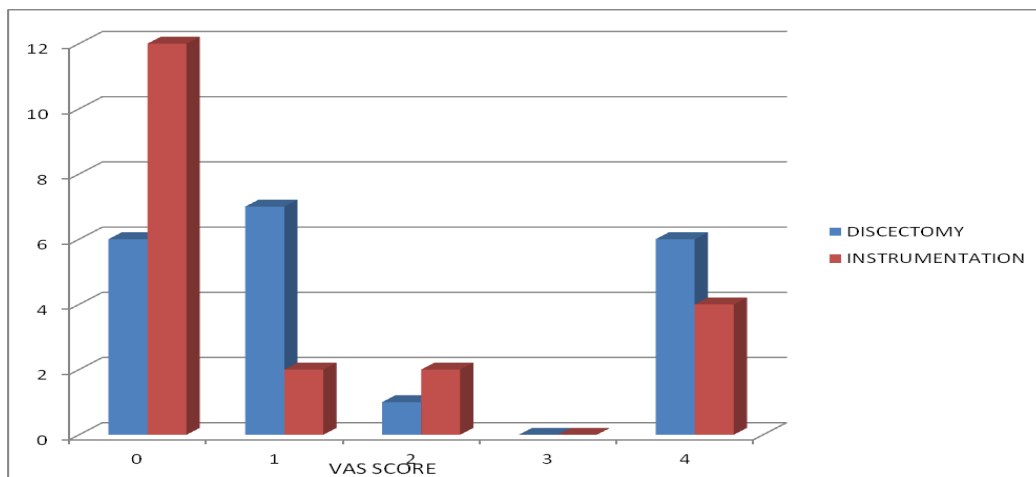


Vas Scoring

Vas Scoring		
Discectomy		
Score	Cases	%
0	6	30
1	7	35
2	1	5
3	-	-
4	6	30

Vas Scoring		
Instrumentation		
Score	Cases	%
0	12	60
1	2	10
2	2	10
3	-	-
4	4	20

In our study we considered vas scoring for clinical outcome of the patient post discectomy and instrumentation and found out maximum patients in both the groups were under the score of 1



Comparison of mean VAS scores for pain between 02 groups using Independent Student t test						
Group	N	Mean	SD	Mean Diff	t	P-Value
Discectomy	20	1.65	1.66	0.75	1.445	0.16
Instrumentation	20	0.90	1.62			

Oswestry Scoring		
Discectomy		
Score	Cases	%
1	12	60

2	2	10
3	3	15
4	3	15
5	-	-

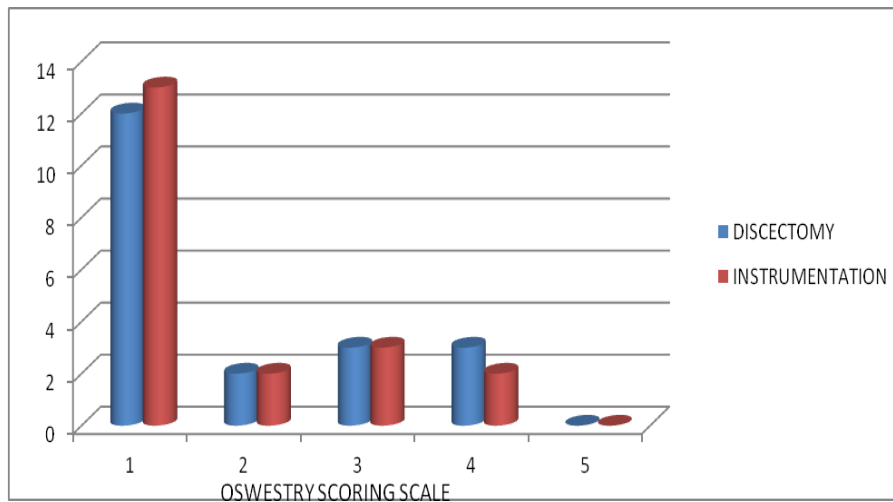
Oswestry Scoring

Instrumentation		
SCORE	CASES	%
1	13	65
2	2	10
3	3	15
4	2	10
5	-	-

Oswestry Scoring

For our study we have taken oswestry scoring for clinical

outcome in patients with spine pathology and found that maximum cases from each group are at grade 1



Distribution of Oswestry disability scores among study patients in 02 groups							
Variables	Categories	Discectomy		Instrumentation		χ ² Value	P-Value
		n	%	n	%		
Oswestry Disability Scores	Score 1	12	60%	13	65%	0.240	0.97
	Score 2	2	10%	2	10%		
	Score 3	3	15%	3	15%		
	Score 4	3	15%	2	10%		
	Score 5	0	0%	0	0%		

Discussion

In our retrospective study from 2012 to 2017, a total of 40 cases of post single level discectomy (20) and post instrumented fusion (20) were taken into consideration who fulfilled our inclusion criterias and were analysed

accordingly.

The average age among the discectomy group was 49 years (20-70 years) and for instrumented fusion was 54(20-70 years).

	Mean age	Symptomatic ASD	Sample Size	Years Of Follow Up	
	Discectomy	Instrumented Fusion			
Our study	49 yrs	54yrs	2.5%	40	3
Jinqian Liang, Yulei Dong and Hong Zhao et.al	61.4yrs	62.1yrs	0.74%	3799	10

- In our study for discectomy male patients constitute maximum of 70 percent of the cases while for instrumentation female patients constitute 65%
- In our study of 20 cases of discectomy 25%percent patients were addicted to tobacco, 35% were addicted to smoking and 10% to alcohol, on the other hand instrumented cases tobacco and smoking addiction were present in 25% each cases while 20% cases were addicted to alcohol.

As far as co morbid status is considered, in discectomy group 6 had T2DM and 5 had hypertension while in instrumented fusion group 6 had T2DM and 6 had hypertension

	Sample Size	Significant Association With Type 2 Diabetes Mellitus
Our Study	40	YES(P>0.05)
Mez et al.	836	YES(P>0.05)

The average follow up period among discectomy patients was 2.45years (2-3 years) and for instrumented fusion 2.3 years

(2-3 years)

Of the 20 cases in consideration for discectomy 5 were addicted to tobacco chewing, 7 to smoking and 2 to alcohol

while 20 cases in consideration for instrumented fusion 5 were addicted to tobacco and 5 to smoking and 4 to alcohol.

Study	sample size	years since surgery	significant association of smoking on disc degeneration
Our Study	40	2	Yes
Sanden <i>et al.</i> [2]	1345	2	Yes
Glassmann <i>et al.</i> [3]	71	4	Yes
Pearson <i>et al.</i> [4]	53	5	Yes

In our retrospective study of 40 cases we found that disc degeneration is naturally aggravated with smoking which is co relatable to other studies and is significant cause of degeneration In our study of the 20 discectomy cases, discectomy done at L3-L4 level were 3(15%),L4-L5 15(75%) and L5-S1 2(10%) And of instrumented fusion at L3-L4 level 3(15%), L4-L5 level 12(60%) and L5-S1 5(25%).

Level Of Discectomy	No. Of Cases	%
L3-L4	3	15
L4-L5	15	75
L5-S1	2	10

Level Of Instrumentation	No. Of Cases	%
L3-L4	3	15
L4-L5	12	60
L5-S1	5	25

Discectomy Study	L3-L4	L4-L5	L5-S1
Our Study	3(15%)	15(75%)	2(10%)
Okuda <i>Et al</i> ⁵	58(67%)	25(29%)	4(4%)

Instrumented Fusion	L3-L4	L4-L5	L5-S1
Our Study	3(15%)	12(60%)	5(25%)
Okuda <i>Et al</i>	87(42%)	103(49%)	17(9%)
Radcliff <i>Et al</i>	53(33%)	72(46%)	31(21%)

In our study for discectomy we have a maximum cases for discectomy were at 14-15 level while in comparison to okuda *et al* which had maximum cases operated at 13-14 level In our study for instrumented fusion we have a maximum cases for discectomy were at 14-15 level while in comparison to okuda *et al* and Radcliff *et al* which also had maximum cases operated at 14-15 level In our study 6 patients (30%) post discectomy have changed there occupation and 8(40%) patients have changed their occupation post instrumented fusion

Occupational Changes	No. Of Cases	%
Post Discectomy	6	30
Post Instrumentation	8	40

In our study Patients who underwent discectomy were followed up and had the following complications i.e. failed back syndrome 2 (10%), failed back syndrome+ spondylolysthesis 1(5%), and spondylolysthesis 1(5%)

Complications	Failed Back Syndrome (Fbs)		Spondylolysthesis		Discitis	
	No.	%	No.	%	No.	%
Post Discectomy	4	20%	2	10%	1	5%

Our study was graded using modified pfirrmann grading⁶. Both the groups cephalic and caudad segment degeneration were considered. In post discectomy cases cephalic segment had grade 3-4 (20%),grade 4-5 (25%),grade 5-8 (40%),grade

6-0, grade 7-2(10%) and grade 8-1 (5%) while cephalic grading post instrumentation had grade 3-4 (20%),grade 4-8(40%),grade 5-4 (20%), grade 6-4 (20%) cases.

Modified Pfirrmann Grading For Cephalic Segment

Discectomy			Instrumentation		
Grades	Cases	%	Grades	Cases	%
3	4	20	3	4	20
4	5	25	4	8	40
5	8	40	5	4	20
6			6	4	20
7	2	10	7	-	-
8	1	5	8	-	-

On the other hand grading of caudad segment for discectomy is as follows grade 3- 6(30%),grade 4-3(15%),grade 4-3(15%), grade 5-3(15%), grade 6-4(20%), grade 8-1(5%) while for instrumented fusion was grade 3-7(35%),grade 4-7(35%), grade 5-2(10%), grade 6-1(5%), grade 7-3(15%),grade 8-0.

Modified Pfirrmann Grading For Caudad Segment

Discectomy			Instrumentation		
Grades	Cases	%	Grades	Cases	%
3	6	30	3	7	35
4	3	15	4	7	35
5	3	15	5	2	10
6	4	20	6	1	5
7	-	-	7	3	15
8	1	5	8	-	-

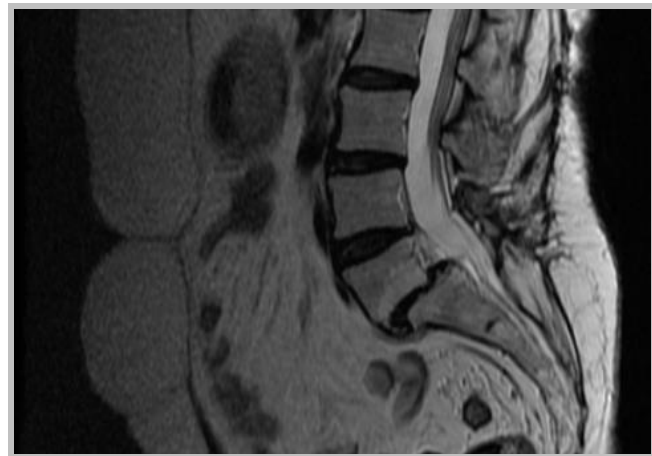
Radiological Images



L4-15 discectomy Modified Pfirrmann grading cephalic segment-6
Modified Pfirrmann grading caudad segment-3



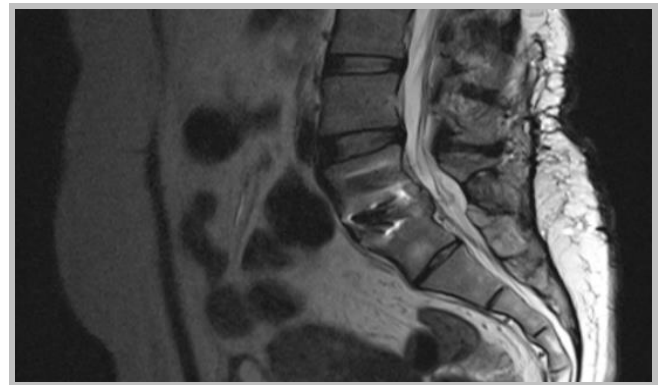
L4-15 discectomy Modified Pfirrmann grading cephalic segment-4
Modified Pfirrmann grading caudad segment-6



L4-15 discectomy WITH post-operative complication of
spondylolisthesis Modified Pfirrmann grading cephalic segment-6
Modified Pfirrmann grading caudad segment-8



Instrumentation At L4-L5 Level Modified Pfirrmann Grading
Cephalic-5 Modified Pfirrmann Grading Caudad-4



Instrumentation At L4-L5 Level Modified Pfirrmann Grading
Cephalic Segment-4 Modified Pfirrmann Grading Caudad Segment-
3



Instrumentation At L3-L5 Level (Trauma At L4 Level) Modified Pfirrmann Grading Cephalic Segment-4 Modified Pfirrmann Grading Caudad
Segment-3

Conclusion

Adjacent segment degeneration occurs both in single level discectomy and post instrumented fusion and is marginally more in post single level discectomy without fusion. In both groups cephalic segment is more affected as compared to the caudad segment. There is a significant relationship between radiological degeneration and the clinical adjacent segment degeneration.

It has been seen that there is a significant relation between degeneration and chronic smokers both radiologically and clinically. Since there is only marginally difference, we hold on to our hypothesis that the role of natural degeneration is more compared to the role of instrumented fusion causing adjacent segment degeneration. Finally we conclude that longer duration of study with more number of cases would probably throw more light on adjacent segment degeneration and might be helpful for further research and scientific purposes.

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