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Management of Lumbar Spondylolysis

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ABSTRACT

Background: Spondylolysis is a fatigue fracture which occur in the pars interarticularis due to repetitive mechanical stresses on the lumbar spine.

Objective: This work was aimed to discuss the different methods in management of spondylolysis, regarding the conservative treatment and surgical procedures.

Patients and methods: This study included 30 cases with spondylolysis at Al-Azhar University Hospitals. 13 cases were operated upon in El-Sayed Galal Hospital of Al-Azhar University and 12 cases were operated upon in El-Hussin Hospital of Al-Azhar University with 5 cases were managed by conservative treatment between August 2017 and July 2019. Follow up was done for average one year.

Results: The improvement of radiculopathy in our study was ranging into 3 category: Fair improvement (2 cases, 20%) with conservative treatment, Good improvement (2 cases, 20%) with decompression and fixation, and Excellent improvement (6 cases, 60%) also with decompression and fixation, so there was a statistical significant relation between both strategy (p-value=0.007), which indicate that the spondylolysis with radicular pain is better managed by decompression and fixation. In our study, we used the Visual Analogue Scale (VAS) in the all cases pre management and post management to assess the outcome. In our study, there was a significant change in Mean VAS score with mean VAS pre-management 7.1, mean VAS post management 2.6 and mean difference in VAS 4.5. Indicating a significant improvement of pain intensity (P<0.001).

Conclusion: Spondylolysis is common in young females at L5 pars and presented with LBP in most cases. Different surgical procedure is safe and effective in management than conservative treatment.

Keywords: Management, Lumbar Spondylolysis.

INTRODUCTION

Spondylolysis occurs in 6 % of general population and approximately 75 % of these will develop spondylolisthesis. Spondylolysis is more common in children and teens participating in sports (athletic population 23-63 %) that place a lot of stress on the lower back or cause a constant over-stretching (hyperextending) of the spine, such as gymnastics, weightlifting, and football [(1)].

Vertebrae consist of the vertebral body and a bony ring or arcus which protects the spinal cord. The arcus is formed by two pedicles which attach to the dorsal side of the vertebral body and two laminae, which complete the arch. The area between the pedicle and the lamina is called the pars interarticularis and is in fact the weakest part of the arcus. It is the pars interarticularis that is affected in spondylolysis [(2)].

The cause of spondylolysis is unknown, but is likely multifactorial. One theory points to genetics (heredity) as a factor, suggesting that some people are born with thin vertebrae, which places them at higher risk for fractures. Many authors feel that repetitive mechanical stress specifically with hyperextension and trunk rotation plays a primary role [(3)].

In most cases, spondylolysis is asymptomatic. If there are any symptoms, they often have following characteristics: Focal low back pain with radiation into the buttock or proximal lower limb. Symptoms can increase with movement specifically lumbar extension or rotation. Children under 13 years old show tenderness or pain on extension and Children can present a postural deformity or abnormal gait pattern [(4)].

The golden standard for the diagnosis of spondylolysis is the combination of Dynamic X-ray and CT. MRI shows promising results in detecting spondylolysis but can also be used to determine the state of the disc above and below the affected vertebra [(5)].

Many lines of treatment have been used to treat pars defect including conservative treatment. While recent surgical trends are directed towards surgical repair of the defect rather than segmental fusion to preserve motion segments [(6)].

Many surgical techniques for direct repair of pars defect have been described since Kimura described his technique in 1968. In 1970, Buck used a screw across the pars interarticularis defect. In 1998 **Songer *et al*** reported the use of a hook screw construct. The most recent technique is repairing the pars defect using a cable-screw constructand percutaneous placement of pedicle screws [(7)].

This work was aimed to discuss the different methods in management of spondylolysis, regarding the conservative treatment and surgical procedures.

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PATIENTS AND METHODS

This non-randomized study included a total of 30 cases with spondylolysis, attending at Al-Azhar University Hospitals. 13 cases were operated upon in El-Sayed Galal Hospital, 12 cases were operated upon in El-Hussin Hospital and 5 cases were managed by conservative treatment.

Ethical approval:

Approval of the ethical committee was obtained. Written informed consent from all the subjects were obtained. This study was conducted between August 2017 and July 2019. Follow up was done for average one year.

This study was performed to illustrate the different ways of management of spondylolysis.

Inclusion criteria: All cases of spondylolysis

Exclusion criteria:

- All cases of spondylolisthesis.
- Iatrogenic post-operative spondylolysis.
- Recurrent disc with fracture pars.

All cases were subjected to the following:

A) History Taking and clinical examination:

The personal history taking and symptomatology including pain (Site, Radicular and or Claudicating), motor, sensory and sphincter affection. Clinical examination was done. **Investigations:**

1. Laboratory investigations:

All cases were subjected preoperatively to CBC, fasting plasma glucose, liver and kidney function tests, coagulation profile, ESR and CRP.

2. **Radiological investigations.**

B) Management:

The primary objectives are pain control, preventing a pars defect from progressing to a frank fracture, and preventing slippage. Conservative care outcomes are usually good-excellent and reported to be as high as 95%**.**

The treatment approach requires avoiding sports or activities that require repetitive flexion and extension and may require bracing.

Operative procedures:

A) Technique:

1- Decompression and fixation.
2- Decompression and fixation with inter-body fusion.
3- Percutaneous fixation**.**

B) Surgical planning:

Preoperatively, radiographic studies are obtained including plain x-ray anteroposterior, latter with dynamic views, CT and MRI.

C) Exposure:

A general anesthetic was administered, and the patients were positioned in the prone position on the operating room table. The C- arm allows used to confirm the level of the pathology.

Postoperative management:

- Antibiotics and Non-steroidal anti-inflammatory drugs were used for average 14 days.
- Patients were ambulant in the same post-operative day.
- Postoperative radiological studies were done to the patients to assess the integrity of the operation.

Follow up:

All patients were followed up for average 6 months after management:

- Clinically by assessment of the subjective symptoms as (Back pain and radiculopathy) and assessment of the functional outcome by visual analog scale and Oswestry Disability Index (ODI).
- Radiological by plain x-ray and CT.

Statistical analysis

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

The following tests were done:

- Independent-samples t-test of significance was used when comparing between two means.
- Paired sample t-test of significance was used when comparing between related sample.
- Chi-square (x^2) test of significance was used in order to compare proportions between two qualitative parameters.
- The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following:
- Probability (P-value)

- P-value $\leq$0.05 was considered significant.
- P-value $\leq$0.001 was considered as highly significant.
- P-value >0.05 was considered insignificant.

RESULTS

Table (1): Age and Sex distribution of the study group.

Demographic Data		
Age: (years)		
Total number	30	
Mean±SD	29.93±5.010	
Sex:	**N**	**%**
Male	10	33.33
Female	20	66.67
Total	30	100.00

This table shows that the age 30 patients, 10 female (66.6%) and 20 male (33.3%).

Table (2): Management of spondylolysis with radiculopathy.

	Radiculopathy						Chi-Square	
	Yes		No		Total			
	N	%	N	%	N	%	X^2	P-value
Conservative Treatment	2	20.00	3	15.00	5	16.67	0.120	0.729
Decompression & Fixation	8	80.00	11	55.00	19	63.33	1.794	0.180

This table shows that the Cases of spondylolysis with radiculopathy was managed in our study by 2 ways: Conservative treatment (2 cases, 20%), and Surgical treatment "Decompression and Fixation" (8 cases, 80%).

Table (3): The relation between the management plan and Improvement of Radiculopathy**:**

		Improvement of Radiculopathy			Chi Square
		Excellent	Good	Fair	
Management plan	Decompression and fixation	6	2	0	p-value =0.007
	Conservative management	0	0	2	
TOTAL		6	2	2	

This table shows that there is 2 cases (20%) of spondylolysis with radiculopathy in our study group which managed by conservative treatment, and their improvement were **Fair**. While the other 8 cases were managed by surgical interfernce "Decompression and fixation" and their improvement were: **Good** in 2 cases (20%), and **Excellent** in 6 cases (60%).

Table (4): The relation between sex and the improvement of radiculopathy.

Sex	Improvement Of Radiculopathy								Chi-Square	
	Fair		Good		Excellent		Total			
	N	%	N	%	N	%	N	%	X^2	P-value
Male	0	0.00	0	0.00	1	16.67	1	10.00	0.741	0.690
Female	2	100.00	2	100.00	5	83.33	9	90.00		
Total	2	100.00	2	100.00	6	100.00	10	100.00		

This table shows that our study has only 1 male case of spondylolysis with radiculopathy, and it´s improvement was **Excellent** (10%).While, the remaining 9 cases were female, and there improvement were: **Fair** in 2 cases (20%), **Good** in 2 cases (20%), and **Excellent** in 5 cases (50%).
Not significant difference (X^2=.741P=.690479)

Table (5): The relation between sex and pars fracture:

		L5 fracture pars	L4 fracture pars		Pearson chi square	
Sex	Female	15	5	20	t	p-value
	Male	8	2	10	0.093168	.751
Total		23	7	30		

Statistically insignificant p-value =.751

Table (6): The relation between the level of fracture pars and improvement of radiculopathy.

Level Of Fracture Pars	Improvement Of Radiculopathy								Chi-Square	
	Fair		Good		Excellent		Total			
	N	%	N	%	N	%	N	%	X^2	P-value
L4	0	0.00	1	50.00	0	0.00	1	10.00	4.444	0.108
L5	2	100.00	1	50.00	6	100.00	9	90.00		
Total	2	100.00	2	100.00	6	100.00	10	100.00		

This table shows that there is only one case of spondylolysis with radiculopathy at the level of L4, and it´s improvement was Good (10%), While the other 9 cases were at the level of L5, and their improvement were: Faire in 2 cases (20%), Good in 1 case (10%), and Excellent in 6 cases (60%).

Table (7): Showing the difference in VAS pre and post management:

Time	V.A.S						Differences		Paired Test	
	Range			Mean	±	SD	Mean	SD	T	P-value
Pre-Management	6	-	9	7.167	±	0.874	4.500	1.280	19.259	<0.001*
Post-Management	1	-	6	2.667	±	1.093				

*Indicating a significant improvement of pain intensity (P<0.001)

There is a significant change in Mean VAS score with mean VAS pre management 7.1, mean VAS post management 2.6, and mean difference in VAS4.5.

Table (8): Relation between Improvement of both radiculopathy and VAS difference:

V.A.S		Improvement Of Radiculopathy									ANOVA	
		Faire			Good			Excellent			F	P-value
Pre-Management	Range	7	-	8	8	-	8	6	-	8	2.380	0.163
	Mean ±SD	7.500	±	0.707	8.000	±	0.000	6.833	±	0.753		
Post-Management	Range	4	-	4	2	-	3	1	-	3	5.320	0.039*
	Mean ±SD	4.000	±	0.000	2.500	±	0.707	2.167	±	0.753		
Differences	Mean ±SD	3.500	±	0.707	5.500	±	0.707	4.667	±	1.211		
Paired Test	P-value	0.090			0.058			<0.001*				

DISCUSSION

Lumbar spondylolysis is a defect in the pars interarticularis, and primarily involves the L5 vertebra, accounting for 85-95% of all cases. L4 vertebra is the next most commonly affected level, accounting for 5-15%, and more proximal lumbar levels are affected much less often [(8)]. While, the majority of fracture pars in our study are located at L5 (23 cases, 76.67%), the remaining cases are located at the L4 (7 cases, 23.3%). Lumbar spondylolysis almost always occurs bilaterally, thus dividing the vertebra into two parts. The antero-superior part consists of the vertebral body with pedicles, transverse processes, and superior articular processes. The poster inferior part consists of the inferior articular processes, laminae, and spinous process[(9)].

The incidence of lumbar spondylolysis is amazing and has been estimated to be approximately 6% in the general population.

However, the incidence varies considerably according to ethnicity and sex. A 2009 study by **Kalichman *et al.*** [(9)] utilizing CT imaging in an unselected community-based population demonstrated a prevalence of 11.5% in the United States. Also, in the United States, **Belfi *et al.*** [(10)] found a 5.7% incidence of spondylolysis in 510 asymptomatic patients using abdominal and pelvic CT scans.

The incidence of spondylolysis in the general Japanese population was 5.9%. Spondylolysis is more common in the Eskimo population with a high incidence of 50%. Most studies reported that the incidence is higher in male than in female. While in our study that included 30 patients, the females: males ratio is 2:1 (67% : 33%).With no statistically significant gender variation. The incidence increased in young athletes, especially in those involved in sports requiring repetitive flexion/extension and/or hyperextension. **Harvey *et al.*** [(11)] reported an incidence of spondylolysis in the general population ranging from 4 to 8% that increased to 23-63% in those engaging in certain sporting activities.

The pathogenesis of lumbar spondylolysis remains controversial. The most probable mechanism of lumbar spondylolysis is multifactorial with a stress fracture occurring through a congenital failure of fusion of two ossification centers or a hyper flexion injury at birth, but spondylolysis had never been founded in embryos, fetus and at birth[12].

Pain is the most common initial symptom. Symptoms were correlated to radiographic pathology. Risk factors for sever low back pain and need for treatment were great than 25% slipping, low lumbar index in L5 Spondylolysis, Spondylolysis at the L4, increased lumbar lordosis, early disc degeneration and early beginning of symptoms[9]. All cases in our study were presented by low back pain, which range in severity according to visual analogue score (VAS). Some cases in our study were suffering from radicular pain (10 cases 33.3%) according to the level of the fracture pars.

Spondylolysis diminishes the stabilizing ability of the posterior elements in the spinal motion segment and may lead to isthmic spondylolisthesis. Spondylolisthesis is a common complication of spondylolysis. Approximately 25% of radio graphically detected spondylolysis is accompanied by spondylolisthesis [12]. When discussing the natural history of spondylolysis and spondylolisthesis, two important questions need to be concerned: how frequently does the slippage in spondylolisthesis progress? How often is pain a problem? **Beutler *et al.*** [13] carried out a 45-year follow up evaluation for the natural history of spondylolysis and spondylolisthesis in a population unselected for pain. They found that progression of spondylolisthesis slowed with each decade, and no subject has reached 40% slip. **Ohmori *et al.*** [14], studies 22 adult patients with spondylolysis. When comparing the initial presentation with follow-up approximately 12 years later, they found that of 18 patients without a listhesis initially, 13 still had no slip, and 5 had progressed to an average of 16.6%slip. There was only an average of 6% increase in slip among those patients who had anterolithesis initially. Saraste in a study of at least 20 years in 255 patients with spondylolysis and spondylolisthesis found that the slip progression was small and not correlated to age at diagnosis and initial degree of slip. The mean slip was 7.0 mm initially, and the average progression over the observation period was only 4.0 mm.

How can spondylolysis be correlated to low back pain? An active pars lesion that can be either an impending stress fracture or a newly completed one may indicate a painful spondylolysis. All cases in our study are investigated by MRI L.S.S, Dynamic x-ray and sometimes CT L.S.S. Early spondylolysis has been described as a stress reaction evidenced by increased signal intensity on T2 weighted images, indicating bone marrow edema secondary to pars micro-fractures. Acute fracture also may demonstrate bone marrow edema along with disruption of the cortex [15].

Single photon emission computed tomography (SPECT) has consistently been showed to be more sensitive than plain radiograghy and planar bone scan alone. **Lenone *et al.*** [8] have found that a positive bone scan or SPECT correlates with a painful pars lesion [8]. Impending stress fractures are negative on plane radiography or CT scan but show high radionuclide uptake on bone scintigraphy. A new stress fracture would be seen on radiography and would be hot on bone scintigraphy. A symptomatic pars lesions are not likely to be undergoing high levels of osteoplastic activity at the defect area, so the ability to achieve osseous healing is unlikely. Early diagnosis of lumbar spondylolysis is important regarding management decisions since stress reactions, incomplete, or complete acute fractures can respond to conservative treatment. Conversely, delayed diagnosis and treatment may progress to a non-union. A pars defect develops into a chronic non-union, and becomes bridged by tissue composed of a combination of fibrous, cartilaginous, or osseous material. In this circumstance, the origin of chronic low back pain could be in the scar and connective tissue rich in nociceptive nerve endings that bridge the gab of the pars defect [16].

Extra load exerted on the motion segment may cause disc degeneration, which is therefore an accompanying disorder of spondylolysis. The prevalence of progressive disc degeneration in the involved level is markedly increased in the adult spondylolytic patients who often appear low back pain later in life, after an asymptomatic childhood. Clinical decision made for patients presenting with spondylolysis principally include concerns for future progression of the spondylolisthesis and issues concerning pain. Most patients with spondylolysis respond to conservative treatment. The plan of management will defer depending on the clinical presentation of the patient. In an asymptomatic spondylolytic patient, treatment of any sort will not be necessary. Cessation of aggravated sporting activities and a spinal brace are necessary for promoting osseous healing for the patients with stress reactions, incomplete, or complete acute fractures in the area of the pars [17].

Hu *et al.* [17] estimated that between 75 and 100% of acute lesions heal, all unilateral acute lesions heal, 50% of acute bilateral lesions heal. **Peterson *et al.*** [18], reports that there is midlevel evidence that stopping sports activity for ≥ 3 months is associated with better pain improvement than stopping sports for < 3 months.

Conservative treatment for adults with symptomatic spondylolysis may have benefit. However, osseous healing is impossible, because the evidence from histological specimens showed that the spondylolytic gap is filled with fibro fatty tissue and dense collagenous scar which is consistent with a pars pseudoarthrosis. The surgical treatment for spondylolysis is generally thought for patients who fail

to respond to conservative treatment. The methods of surgical treatment are varied and multiple[17].

In our study, Conservative cases were 5 patients and surgical cases were 25 patients (16.6% and 83.3% respectively). These surgical maneuver were: posterior decompression and fixation 19 cases (76%), percutanous fixation 5 cases (20%) and inter-body fusion with fixation 1 case (4%).

With the advent and development of minimally invasive spine surgery (MISS), some techniques have been used successfully in the treatment of spinal fractures. **Snyder *et al.* [19],** estimated that percutanous fixation has been used in some centers with exciting results and additional advantages such as pain reduction, less damage to the soft tissues, and shorter hospital stay**.** In our study group, there were 5 patients which managed by percutanous fixation. All these cases are presented by Low back pain only without radiculopathy. There is an improvement for the post-operative V.A.S with accepted V.A.S difference for all cases.

In our study, the cases of spondylolysis with radiculopathy are 10 cases. The majority of these cases are managed by surgical interference "Decompression and fixation" (8 cases, 26.6%), while the remaining are managed by conservative treatment (2 cases, 6.6%).

The improvement of radiculopathy in our study is ranging into 3 category: Fair improvement (2 cases, 20%) with conservative treatment, Good improvement (2 cases, 20%) with decompression and fixation, and Excellent improvement (6 cases, 60%) also with decompression and fixation, so there is a statistical significant relation between both strategy (p-value=.007), which indicate that the spondylolysis with radicular pain is better managed by decompression and fixation.

In our study, we used the Visual Analogue Scale (VAS) in the all cases pre management and post management to assess the outcome. In our study. There is a significant change in Mean VAS score with mean VAS pre-management 7.1, mean VAS post management 2.6 and mean difference in VAS 4.5. Indicating a significant improvement of pain intensity (P<0.001).

CONCLUSION

It could be concluded that spondylolysis is common in young females at L5 pars and presented with LBP in most cases. Different surgical procedure is safe and effective in management than conservative treatment.

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