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High Degree Spondylolisthesis in Adults: Monosegmental Reduction and Fixation in Our Perspective

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Abstract **Original Research Article**

Objective: To evaluate a method to reduce high degree spondylolisthesis in adults with *monosegmental* fixing preserving the adjacent level and the improvement of sagittal balance. ***Methods:*** A prospective study, with 8 adult patients with high degree spondy\olisthesis (III and IV) in adults who underwent surgery by the same team. We included 5 women and 3 men with a mean age of 37 years that had no improvement with conservative treatment. The surgical technique used was total or partial reduction by Spondylolisthesis Reduction Instrument SRI System. ***Results:*** The L5-S1 level was involved in five patients, L4-L5 in two and VT-S1 in one patient. Isthmic type predominated in five patients, followed by dysplastic type in two and one a-spondytolisthesis. These patients were assessed by the Oswestry scale. Which showed a preoperative average of 59% and postoperative average of 12.4%. ***Conclusion:*** The method of high- grade spondylolisthesis reduction with instrumentation only at the affected level is a treatment option with good results, with control of the pain profile and functional improvement in patients.

Keywords: Monosegmental, spondytolisthesis, olisthesis.

INTRODUCTION

Spondylolisthesis is characterized by the slippage of one vertebra over another, was first observed by *Herbiniaux, a Belgian obstetrician, in 1782, and described by Killian in 1854.* Wiltse *et al.*, who identify five types: Type I: Dysplastic; Type II: Isthmic; Type III: Degenerative; Type IV: Traumatic; Type V: Pathological; and Type VI: Iatrogenic [1].

There is also the Meyerding radiological scale, which differentiates the percentage of slippage as Grade I from 0% to 25% (GI), Grade II from 26% to 50%, (GII), Grade III from 51% to 75%, (GIII), and Grade IV from 76% to 100%, GI and GII considered low grade and, GIII and GIV considered high grade [2].

Based on the *Wiltse et al.*, classification,-five patients were of the Isthmic type two of the Dysplastic type, and one of the Iatrogenic type [1].

High grade spondylolistheses are the greatest concerns are: *sagittal balance*. It can completely alter the biomechanics of the spine; it has risks of neurological lesions and pseudoarthrosis, which can be decisive in the choice of surgical method.

In the low-grade type, arthrodesis in situ is considered the procedure of choice, as it does not involve the above mentioned concerns. There is agreement as to the surgical treatment for high grade symptomatic spondylolisthesis but the surgical technique to be used is still much debated.

Several types described in the literature with great similarity in the outcomes. Among the different techniques, we can cite Posterior arthrodesis in situ, posterior decompression, Postero-lateral arthrodesis without reduction, Antero- posterior circumferential arthrodesis in situ, a combination of anterior reduction and posterior stabilization and Vertebrectomy L5 with posterior stabilization of L4 to S1.

OBJECTIVES

To report on the surgical treatment of high grade symptomatic spondylolisthesis performed via a posterior approach associated with reduction and monosegmental arthrodesis.

METHODS

A prospective study was conducted from 2019 to 2022, evaluating 8 patients over the age of 26 years with spondylolisthesis, who did not respond to clinical treatment. There were 3 men and 5 women, with an average age of 37 years. The average follow-up was 26 months. All patients had high grade spondylolisthesis, classified as grade III or IV according to the Meyerding classification system. All patients had lower back pain that worsened with physical exertion. Sciatic pain was present in 7 patients, one of whom had a motor deficit of the root of L5. Seven patients had sensory deficits associated with lower back pain. None of them had cauda equina syndrome.

Inclusion Criteria

- High grade spondylolisthesis,
- Severe lower back pain without improvement after clinical treatment,
- Progression of subluxation,
- Progressive motor deficit, or
- Cauda equina syndrome.

Surgical Technique

The surgical technique used was total laminectomy associated with a complete or partial reduction of the spondylolisthesis with the S.R.I. system (Spondylolisthesis Reduction Instrument). P.L.I.F. (Posterior Lumbar Interbody Fusion) technique with a cage or bone graft, associated with postero-lateral arthrodesis with pedicle screws, with instrumentation of only one level, thereby preserving the adjacent level. An autologous graft from the iliac crest was used in all patients. The patients were clinically evaluated using the Oswestry Disability Index (ODI) scale. This evaluation method takes both pain and physical activity into account.

The patients were evaluated radiographically for loss of reduction, sacral angle, angle of the slippage, complications from the instrumentation, and consolidation of the arthrodesis.

RESULT

Table 1: Age, percentage of slippage in pre- and post-operative and follow-up

Patient	age	Percentage of slippage in pre and post op	Follow up (months)
1	26	51%-0%	36
2	33	52%-0%	20
3	42	54%-0%	10
4	37	51%-0%	14
5	28	53%-10%	32
6	41	52%-25%	17
7	45	55%-5%	30
8	44	55%-0%	25
Average	37	53%-5%	23

The *Wiltse et al*., (Table 1) classification was used for the 8 patients in the series. Five with the isthmic type, two with the dysplastic type, and one with the iatrogenic type of spondylolisthesis. The most often affected level was L5-S1 in five patients, followed by L4-L5 in two patients and S1 in only one patient. The average initial percentage of slippage was 53% and after surgery it dropped to 5% (with $p<0.001$). The angle of slippage improved from $22^0(20\text{-}35^0)$ to $8^0(0\text{-}9^0)$ in the post-operative period. There was an increase in this angle in one patient, from 2^0 in the immediate post-operative period to 7^0 in the 6^{th} month of follow up; however, it remained stable over the next two years.

Table 2: Pre and post-operative radiological assessment

Radiological finding	Preoperative	Post oprative after 12 month	P value
Percentage of slip	51%-55%	3-5%	<0.001
Slip angle	22.10±5.01	8.80±4.60	<0.001
Disc height(mm)	2. 95±1.64	5.90±1.17	<0.001
Spinopelvic parameters			
Pelvic tilt (%)	26.10±6.82	25±6.96	<0.001
Sacral slope(0)	40±11.22	36.1±10.63	<0.001
Lumber lordosis(0)	40.5±6.71	37.2±6.12	<0.001

Amazing changes was observed in percentage of slip, slip angle, disc height and spino-pelvic parameters (SS, PT, PI and LL) after 12 months of operation.

Table 3: Modified ODI scoring

ODI Score (%)	Level of Disability
0-20	Minimal disabilty
21-40	Moderate disability
41-60	Severe disability
61-80	Criple, pain impingeson all aspects of patient's life
81-100	Patient are bed bound or exaggerating their symptoms

The total modified ODI score from each patient was expressed as a percent. The modified ODI scoring and relevant level of disability is summarized in table 1.

Table 4: Inoue's Criteria

Grading	Criteria
Excellent	Full recovery of symptom
Good	Residual or occasional symptom but able to perform normal activities
Fair	Partial recovery of symptom
Poor	No recovery or worsening of symptom

3 years after surgery one patient developed listhesis in the level above and underwent a new surgery using the same technique with good result.

Table 5: Functional outcome assessment by inoue's criteria

Grading	Criteria
Grading	N-8
Excellent	5(62.5%)
Good	2(25%)
Fair	1(12.5%)
Poor	0
Satisfactory	7(87.5%)
Unsatisfactory	1

In Inoue's criteria 62.5% were excellent and 87.5% were satisfactory.

DISCUSSION

High grade spondylolisthesis is a very debilitating clinical condition for the patient. It is a major challenge for the spine surgeon, because of the divergence between the best surgical techniques and the complexity of its classification. As it is not common in our clinics, only a few surgeons have a large case series to report. The objectives of the treatment of high grade symptomatic spondylolisthesis include resolution of lower back pain and improvement of the radicular symptoms associated with arthrodesis of the affected levels and restoration of sagittal balance. The current methods for achieving these objectives include a range of surgeries that vary from isolated posterior fusions in situ to aggressive antero- -posterior combinations with circumferential procedures, including vertebrectomy.7- The level most affected by high grade spondylolisthesis in adults is L5-S1, occurring in rare cases in L5-VT and L4-L5.20 In our case series, the high predominance of level L5-S1 was in agreement with the literature, but due to the small number of patients in the studies, reliable comparison is difficult.

The Wiltse classification shows that the isthmic type of spondylolisthesis is predominant,particularly in adults, which occurred in our statistics [1]. No cases of iatrogenic spondylolisthesis were reported in any of the studies reviewed. It is known that today, bone Boos fusion in situ is the surgical procedure used in children. However, it has the following problems: a high rate of pseudoarthrosis, ranging from 0% to 19%; the fact that fusion is extended to the level above it; and the progression of all the parameters of deformity, especially the angle of slippage. On the other hand, instrumented and non-instrumented reductions followed by fusion have been reported with rates of pseudoarthrosis of 0% to 8%. In adults, posterior fusion in situ is not a viable situation. The inability of most isolated posterior procedures to achieve stabilization of the anterior spine may contribute to the increased rates of pseudoarthrosis, with rates of 17% to 50% being reported.

Boos *et al.*, report on 10 patients with high grade spondylolisthesis, 50% of whom had pseudoarthrosis [3]. They conclude that there needs to be anterior support to complement the arthrodesis, and that this was correlated with biomechanical laboratory tests. There is still significant controversy concerning reduction in spondylolisthesis in adult patients. This procedure should be considered in patients with evidence of an unstable segment, or when there is a change in sagittal balance. It has already been recognized that to improve sagittal balance, a partial reduction of the angle of slippage is more important.

Bradford and Brochie mention several advantages of reduction in high grade spondylolisthesis, among them, the reduction of the angle of slippage, which allows for neurological decompression, improvement of the lumbosacral sagittal orientation, and an improvement in the patient's overall condition [4]. This partial correction of the lumbosacral angulation not only enables greater anterior compression (improving the probability of arthrodesis), but also improves both the overall sagittal balance and the cosmetic appearance, through the spontaneous correction of thoracic hypokyphosis and lumbar hyperlordosis [5]. When the overall sagittal balance of the patient is improved, this enables erect posture and better biomechanical conditions of the spine [6]. Other advantages are low rates of pseudoarthrosis as compared to arthrodesis in situ, and better neurological decompression [7]. The disadvantages of reduction are the greater surgical time, higher neurological risk, and loss of reduction [8].

Harms reported excellent results in 112 patients, using a one- -level reduction arthrodesis technique and only L4 for the reduction [9]. He showed an improvement of the angle of slippage in 92.5%, and of the degree in 92%. There was a lower percentage of restoration of the sacral angle as compared to the other parameters, with a 62% improvement, obtaining smaller sacral angles than the norm of 35%.

Shufflebarger and Geck showed an improvement similar to that of Harms in 18 patients using the same technique, with an improvement in the sacral angle, which remained above 35%. One patient evolved with an increase of the progression, stabilizing in six months, and no cases of pseudoarthrosis were reported [10].

CONCLUSION

The method of high grade spondylolisthesis reduction with instrumentation only at the affected level is a treatment option with good results, with control of the pain profile and functional improvement in patients. It has the advantages of saving levels and improving sagittal balance.

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