Reduction Versus Non-Reduction Technique in Low Grade Spondylolisthesis; Functional Outcome

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ABSTRACT:

BACKGROUND:

Spondylolisthesis is a condition in which a vertebra slips anteriorly in relation to the vertebra below as a result of pars defect or degenerative disease. The slipped segment produces abnormal positioning of the vertebrae in relation to each other along the spinal column that causing back pain and neurologic deficit.

OBJECTIVE:

There are debates about surgical maneuvers regarding low grade spondylolisthesis (grades I and II according to Meyerding classification) whether to reduce the slipped segment or not, the aim of this study is to determine the short and long term difference in the functional outcome between these methods.

PATIENTS AND METHODS:

This randomized prospective study consist of ٣٢ patients aged between ٤٢-٦٣ years old (١١ males and ٢١ females) treated for symptomatic low grade spondylolisthesis between October ٢٠٠٩ to November ٢٠١١ and followed up for ٢٤ months. All patients were randomly divided into two groups: Group I (١٥ patients) underwent surgical reduction of the slipped segment, and Group II (١٧ patients) who underwent in-situ fusion without reduction. Both groups had the same pre and postoperative management.

RESULTS:

Early postoperative minor complications including one case in each group had superficial wound infection (٦,٦٪ and ٥,٨٪ in Group I and II respectively) which was controlled in the hospital, and one case in each group (٦,٦٪ and ٥,٨٪ in Group I and II respectively) had dural tear intraoperatively that was repaired during the operation; none of patients had CSF leak postoperatively. There were two cases in Group I (١٣,٣٪) and one case in Group II (٥,٨٪) had postoperative transient sciatic pain due to nerve irritation. Depending on the Oswestry Disability Index (ODI), there was a significant statistical difference between both groups in the short term (p-value = ٠,٠٤), but there was no significant statistical difference in the long term follow up between them (p-value =٠,٣٣) regarding the functional outcome.

CONCLUSION:

Surgical treatment of low grade symptomatic spondylolisthesis usually include neural decompression, fixation and fusion; however reduction of the slipped segment is not necessary for these patients as the ultimate outcome is similar to those who underwent in-situ fusion only.

KEYWORDS: spondylolisthesis, vertebral reduction, in-situ fusion

INTRODUCTION:

Lumbar spondylolisthesis is a common spinal disorder in adults affecting approximately ٤-٦٪ of the general population[١].

Clinical presentation is usually variable and ranging from mild to severe pain and disability which are related to the spinal instability and neural compression. Slipping of the cranial vertebra generally leads to a deformation of the neural foramen morphology and subsequent nerve root entrapment with radiculopathy. Furthermore the resultant spinal instability leads to spinal canal stenosis and neurogenic claudication[٢,٣].

Medical treatment is usually the first line of management such as physiotherapy, body weight reduction, lumbar belts, and life style modification. Surgical options are preserved for patients that are not responding to medical therapy or those with overt neurologic deficit[٤].

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Various surgical techniques have been advocated to deal with symptomatic spondylolisthesis; the main perception of these techniques focused on spinal fixation, neural decompression and fusion[٥].

There are arguments about reduction versus in-situ fusion in low grade spondylolisthesis. Those who are against reduction emphasized higher risk of neurologic complications due to increased tension on the nerve root during reduction maneuver[٥,٦]. However; those with reduction claim that restoring sagittal balance will reduce the tensile and compressive forces across the arthrodesed spinal segment[٧].

PATIENTS AND METHODS:

This prospective randomized study of ٣٢ patients (١١ males and ٢١ females) with symptomatic low grade spondylolisthesis, age ranges from ٤٢-٦٣ years (mean ٥٨ years), and their BMI (body mass index) was between ٢٨,٤-٣٠,٨ (mean ٣٠,١), all patients were non-smokers and were treated in the Medical City Complex in Baghdad from October ٢٠٠٩ to November ٢٠١١. All patients were followed up for ٢٤ months.

Inclusion criteria included symptomatic patients (those with severe and chronic low backache, sciatica, sensory disturbances, with or without muscle weakness and neurologic claudication) who failed to respond to conservative treatment at least for three months (medical treatment included strong pain killers, physiotherapy, lumbar belts and life style modification), BMI less than ٣٥, with grade I and grade II degenerative and isthmic types of spondylolisthesis according to Meyerding classification system[٨] that was evident by plain radiographs.

Exclusion criteria included patients with high grade (III and IV), traumatic, pathologic spondylolisthesis, BMI more than ٣٥ (morbid obesity), patients with iatrogenic spondylolisthesis and congenital malformation.

Those who met the inclusive criteria were admitted to the hospital for treatment. Investigations included all routine lab studies, plain radiographs in standing anteroposterior and lateral views, dynamic views were performed, and oblique views as well. CT scan and MRI are also evaluated.

Preoperative and postoperative clinical assessments were obtained depending on the ODI (Oswestry Disability Index) system[٩].

All cases were treated surgically by same surgical team to reduce bias effect. The patients were randomly selected and divided into two groups; all patients in both groups had the same surgical approach and underwent neural decompression, fixation and fusion:

a. Those who had surgical reduction and fixation were labeled as Group I
b. Those who had in-situ fusion without reduction were labeled as Group II

In Group I the surgical reduction of the slipped vertebra was achieved by applying reduction screw with neural decompression and fusion. Whereas in Group II only surgical fixation, neural decompression and fusion was performed.

Surgical Technique

- Using general anesthesia and hypotensive technique
- Prone positioning of patient
- Midline skin incision
- Exposure by stripping the paraspinal muscles lateral to the tip of transverse process
- Pedicle screws were inserted in the slipped and non-slipped vertebra in form of:
  - Reduction screw (double head) in Group I (reduction group) patients (figure ١)
  - Ordinary pedicle screw in Group II (non-reduction group) patients (figure ٢)
- Decompression laminectomy usually performed and fusion was done.

Postoperative radiographs were obtained for all patients, early physiotherapy and walking exercise started two days after the day of surgery. Patients were evaluated in outpatient clinic on regular basis of two weeks interval for ٣ months, ٣ months interval for ١ year, and then ٦ months interval for ٢ years.

Data collection and analysis of outcome based on the Oswestry Disability Index (ODI) severity score system as follows:

١. Poor outcome (٠,٦١-١,٠٠): patients who experience the same preoperative symptoms or symptoms that have worsened after surgery; they are bed bounded with exacerbating symptoms.
٢. Fair outcome (٠,٤١-٠,٦٠): pain has improved less than ٥٠٪ compared to the preoperative status, yet still requiring postoperative strong analgesics; mild improvement in neurologic deficit and patients still in pain that impedes their life activities.
٣. Good outcome (٠,٢١-٠,٤٠): when patients having significant improvement in backache, sciatica pain that required occasional analgesics, and they experience less neurologic symptoms with some difficulty in sitting lifting and standing, while social activity and sleeping are not grossly affected.

٤. Excellent outcome (٠-٠,٢٠): no more pain or neurologic symptoms. The usual daily activity can be cooperated with full satisfaction from the patient.

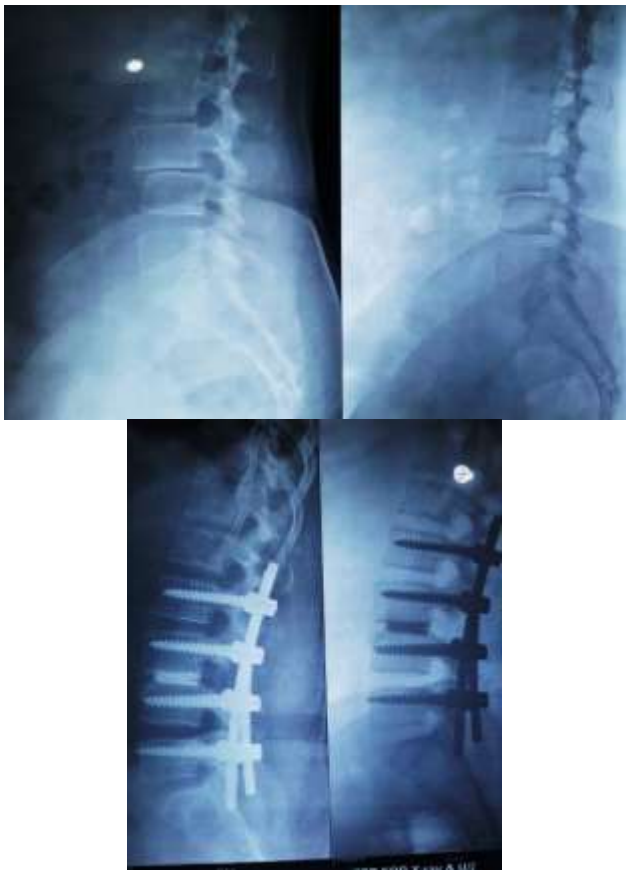


Figure ١a-Figure ١b
Figure ١a: preoperative degenerative spondylolisthesis at L٣-L٤ level grade ٢
Figure ١b: same patient ١ month postoperatively with reduction.

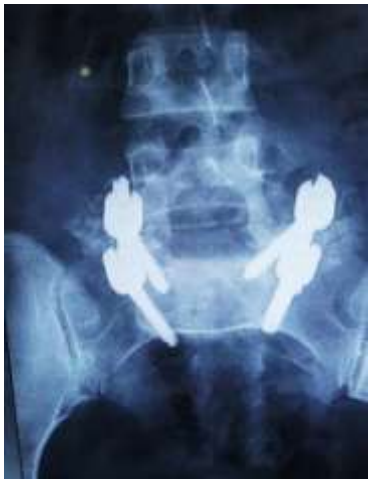


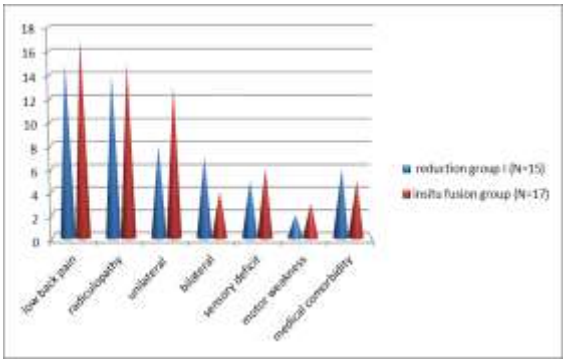
Figure: ٢a **Figure: ٢b** **Figure: ٢c**

Figure ٢a: preoperative isthmic spondylolisthesis at L٥-S١
Figure ٢b: postoperative lateral view ١ month in-situ fusion
Figure ٢c: anteroposterior view of the same patient

RESULTS:

Group I total cases number ١٥ (٤ males and ١١ females) age ٥٢-٦٣ years (mean ٥٨,٤ yeas) were treated by reduction of the slipped vertebra, with neural decompression and fusion; Group II total cases number ١٧ (٧ males and ١٠ females) age ٤٢-٥٧ years (mean ٥٠,٥ years) were treated by only in-situ fusion in addition to neural decompression and fixation without reduction of the slipped segment.
There are minor differences between both groups regarding their clinical presentation, clinical sings and preoperative medical co-morbidities. (Table ١)

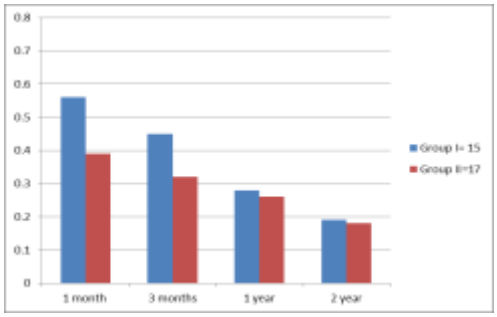
Table ١: Clinical presentation of both groups



Hospitalization time was ٧-١٠ days for both groups (average ٨,٥ days); operation time was between ٣-٥ hours (average ٤ hours) in both groups.
There was no difference in complications during and after operation in both groups. However; dural tear had occurred in one patient in each group that was repaired at time of surgery (٦,٦٪ and ٥,٨٪ in Group I and II respectively). None of these patients had CSF leak postoperatively.
Minor postoperative complications like superficial wound infection (٦,٦٪ in Group I and ٥,٨٪ in Group II) and also transient sciatic nerve pain due to irritation of nerve root during operation (١٣,٣٪ in Group I, and ٥,٨٪ in Group II).
According to the ODI system there was significant difference at the initial postoperative period (Group I mean ODI score was ٠,٥٦ and in Group II it was ٠,٣٩), with the end of follow up time (٢ years) the

ODI score system declines linearly significantly and both groups had almost similar outcome (mean ODI score in Group I was ٠,١٩ and in Group II was ٠,١٨) (Table ٢).

Table ٢: Disability scale of both groups according to the ODI system in post-operative follow up



Immediately postoperatively up to ١ month, ٨ patients (٥٣,٣٪) of Group I patients and ١٠ patients (٥٨,٨٪) of Group II had excellent outcome, ٢ patients in both groups (١٣,٣٪ and ١١,٧٪ in Group I and II respectively) had fair results with ١ patient (٦,٦٪) in Group I and none in Group II had poor outcome.

Three months' follow up: ٩ patients (٦٠٪) of Group I and ١١(٦٤,٧٪) of Group II patients had excellent outcome with one patient (٦,٦٪) of Group I and non in Group II had poor results.

In ١ year follow up there was١٠ (٦٦,٦٪) and ١٣ (٦٧,٤٪) patients had excellent outcome in both groups respectively. The rest of the patients experienced good results (٣ patients in each group; ٢٠٪ in Group I and ١٧,٦٪ in Group II).

Over the ensuing time (٢ years follow up) patients of both groups displayed a significant improvement that ended with excellent results reaching up to ٨٦,٦٪ and ٨٨,٢٪ (١٣ and ١٥ patients) in Group I and II respectively with no fair or poor outcome in both groups (Table ٣). All patients are radiographically had fusion at the end of follow up time.

Table ٣: Follow up patients in both Groups according to results.

Follow up	Group I Reduction group Total ١٥ (١٠٠٪)	Group II in-situ fusion group Total ١٧ (١٠٠٪)
١ month		
Excellent	٨ (٥٣,٣٪)	١٠ (٥٨,٨٪)
Good	٤ (٢٦,٦٪)	٥ (٢٩,٤٪)
Fair	٢ (١٣,٣٪)	٢ (١١,٧٪)
Poor	١ (٦,٦٪)	٠ (٠٪)
٣ months		
Excellent	٩ (٦٠٪)	١١ (٦٤,٧٪)
Good	٣ (٢٠٪)	٤ (٢٣,٥٪)
Fair	٢ (١٣,٣٪)	٢ (١١,٧٪)
Poor	١ (٦,٦٪)	٠ (٠٪)
١ year		
Excellent	١٠ (٦٦,٦٪)	١٣ (٧٦,٤٪)
Good	٣ (٢٠٪)	٣ (١٧,٦٪)
Fair	١ (٦,٦٪)	١ (٥,٨٪)
Poor	١ (٦,٦٪)	٠ (٠٪)
٢ years		
Excellent	١٣ (٨٦,٦٪)	١٥ (٨٨,٢٪)

Good	٢ (١٣,٣٪)	٢ (١١,٧٪)
Fair	٠ (٠٪)	٠ (٠٪)
Poor	٠ (٠٪)	٠ (٠٪)

Statistical Analysis:

In each group the p-value was conducted independently as follows:

In the initial follow up Group I had excellent results in ٥٣,٣٪ of patients and ٦,٦٪ of them had poor outcome compared with the same period in Group II where ٥٨,٨٪ had excellent results and ٠,٠٪ had poor result, so the p-value = ٠,٠٤٢ between the in-fusion and the reduction groups (where the set point of p-value is < ٠,٠٥٠) using the student T-test.

At ٢ years follow up time results were excellent in ٨٦,٦٪ and poor in ٠,٠٪ for Group I patients whereas excellent in ٨٨,٢٪ and poor results in ٠,٠٪ in patients of Group II, yet there was no significant differences between the in-situ fusion and the reduction group at ٢ years (p-value = ٠,٤١) where the set point of p-value is < ٠,٠٥ using the student T-test (Table ٤).

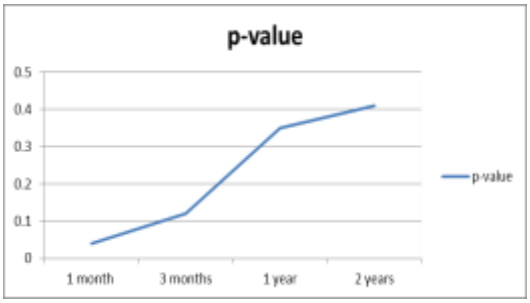


Table ٤: linear significant difference in p-value between patients in Groups I and II during the follow up time

DISCUSSION:

Reduction versus in-situ fusion in the treatment of low grade spondylolisthesis is still debatable since long time, and the effect of each technique and functional ability of patients still questionable[١٠].

Poussa et al concluded that patients who had surgical fixation without reduction ended with better outcome compared with those who underwent surgical reduction and fixation[١١]. In their study, there was no nerve root irritation during in-situ fusion in the short term follow up (which occurred at the same period in the reduction group).

On the other hand; other authors advocated that correction of sagittal spinal deformity in conjunction with arthrodesis will enhance the spinal biomechanics and results in the nerve root decompression, by providing a mechanical protection for the spinal fusion from tensile and shearing forces[١٢،١٣].

Benli et al prospectively compared patients with and without reduction in low grade spondylolisthesis who underwent a posterior instrumentation and fusion[١٤]. In their study, after a mean follow up of ٣٨ months no statistically significant differences in clinical outcome could be established between these groups.

We have used the ODI scoring system for our patients as it takes into consideration the parameters of pain, disability and life styles which are important factors that affect the patients' ability and function for daily social life.

We followed our patients for up to two years as we believe it is a good time for judgment on the fusion, this element per se is essential in determining the functional outcome as we look for it as a final target for both groups that will improve the functional results.

All our patients had solid fusion by ٢ years so it is not a factor that will change our final assessment.

In our study, we found that in the early functional outcome (٣ months follow up) for in-situ fusion group ٨٨,٢٪ of patients having satisfactory results and return to activity, and ١١,٧٪ had moderate disability, none of them had severe disability. While for the same period in the reduction group ٨٠٪ of patients having excellent to good outcome, yet there was ١٩,٩٪ of this group experience severe disability (fair and poor results), which might be due to manipulating the long standing anatomic adaptive changes that occurred in the slipped vertebra.

At the end time of our follow up (٢ years after surgery) both groups displayed minor differences in the excellent outcome and return to full activity with no analgesic requirement and an appealing life style (٨٦٪ and ٨٨٪ in Groups I and II respectively). None of patients in both groups had poor or fair results. Our results are consistent with that of Benli et al.

The results are analyzed statistically using the student T-test which showed that there was significant statistical difference between the two groups in favor of the in-situ fusion (Group II) which had better results than those of the reduction group (p-value = ٠,٠٤) at initial postoperative period, while at ٢ years follow up there was no significant statistical difference in both groups (p-value =٠,٤١).

Although patients' number in our study is less than that of other studies, the patients were non homogenous (both isthmic and degenerative spondylolisthesis all were of low grade), as well as the follow up time was shorter, all these variables were not causing major influence on our results that are consistent with these studies.

CONCLUSION AND RECOMMENDATION:

Although the reduction maneuver is theoretically and radiographically more appealing, yet no clinical evidence shows that it is positively affecting the clinical outcome in the long term follow up and it appears less effective than in-situ fusion without reduction in the early functional outcome.

We recommend performing in-situ fusion rather than reduction in cases of low grade spondylolisthesis.

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