Adjacent Segment Degeneration (ASD) Following Lumber Arthrodesis; Risk Factors and Management.

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Abstract

Background Data: Spinal bony fusion is considered to be a good method for treating deformity, trauma, and degenerative lesions. Fusion rates have a good outcome due to improvements in instrumented fixation and bone graft sources. In contrast, numerous complications of fusion surgery may occur and are considered as the predisposing factors for clinical failure after instrumented lumbar fusion. Adjacent segment disease after lumbar spine fusion has been found to occur nowadays with a variable incidence. The risk factors for ASD have not been precisely documented.
Purpose: To identify the possible risk factors responsible for adjacent segment affection following lumbosacral fixation and review the literature about their most suitable management.
Study Design: A retrospective descriptive clinical case study.
Patients and Methods: seventeen patients with lumbosacral fixation for spondylolisthesis or disc degeneration were identified to have de novo adjacent segment degeneration one to four years following fusion surgery. They were studied as regard age, primary pathology, number of levels and type of fusion and the duration of the lucid interval between the primary surgery and the revision management. Patients were studied radiologically by whole imaging techniques. They were followed up both clinically and radiologically for at least one and half years after revision management.
Results: the risk factors include fixation of more than one level, overweight and preexisting facet degeneration in the adjacent segment. The incidence of distal ASD was much lower than that of proximal ASD.
Conclusion: longer periods of follow up are needed to determine which of the accused risk factors are responsible for increasing the incidence of ASD and until solid conclusions are established, we should try to minimize the number of risk factors. (2013ESJ037)
Key Words: lumber spine, arthrodesis, disc degeneration, adjacent segment disease.

Introduction

The adjacent segment affection after lumbar spine fusion has been found to occur nowadays with a variable incidence, and the risk factors for these conditions have not been precisely documented. Spinal bony fusion is considered to be a good method for treating deformity, trauma, and degenerative lesions. Fusion rates have a good outcome due to improvements

in instrumented fixation and bone graft sources. In contrast, numerous complications of fusion surgery may occur and considered as the predisposing factors for clinical failure after instrumented lumbar fusion. Adjacent segment disease (ASD) is considered as one of the most important factors leading to this secondary failure. Lumbar fusion may lead to increase loading and hypermobility in segments up or down the fused ones and this may lead to degeneration of these adjacent segments and the development of ASD. Till now these are not documented and some authors considered this degeneration to be a natural aging process.[3,6,11,17,20]

This study aims to identify the possible risk factors responsible for upper or lower segment affection following lumber or lumbosacral fixation and review the literature about their most suitable management.

Patients and Methods

This retrospective study was done in Alexandria university main hospital from February 2009 to October 2010 on 96 patients operated upon by fusion surgery over a period of 4 years (2004-2008). Seventeen patients with lumber or lumbosacral fixation for spondylolisthesis or disc degeneration were identified to have de novo adjacent segment degeneration one to four years following fusion surgery. The inclusion criteria included any patient developed symptomatic fresh level degeneration after previous fusion surgery, so all 17 patients developed new symptoms of back pain with or without sciatica after being well in the lucid interval after the primary surgery. Pre-operative assessment was carried out on all patients similarly. This included plain and dynamic lumbosacral spine X-rays, lumbosacral spine MRI and routine lab work. The grades of disc degeneration were measured by radiographic system for grading disk degeneration on antero-posterior and lateral radiographs according to Mimura et al,[14] Oswestry Disability Index (ODI) was used for pre and post-operative disability assessment in all cases. All 17 patients were treated conservatively by rest, physiotherapy, analgesics, anti-inflammatory and neurotonics for at least 2 months before the decision of surgery was taken. To reduce bias and ensure adequacy of surgical management and outcome; all cases were operated upon by one surgeon.

The data of the patients were recorded as regard; age of the patient at the time of primary surgery, gender of the patient, history of smoking, diabetes, steroids, primary pathology, disc degenerative status proximal or distal to the fused level, type and length of fusion, instrumentation configuration (rigid or dynamic), lumbar lordosis restoration, duration of the lucid interval between primary surgery and presentation, proximal or distal ASD, the revision management.

Results

Seventeen patients were included in this study. The age ranged from 25 to 59 years with mean age of 43.3 years. Eleven patients were females and 6 were males. Three patients were smokers, 4 were diabetics and one patient was on steroid therapy. Fourteen patients were operated upon for spondylolisthesis while 3 patients were operated upon for degenerated discs disease. Single-level fusion was performed in 7 patients and two-level fusion in 10 patients. All patients were operated upon using the rigid pedicle screw fixation (Figure 1).

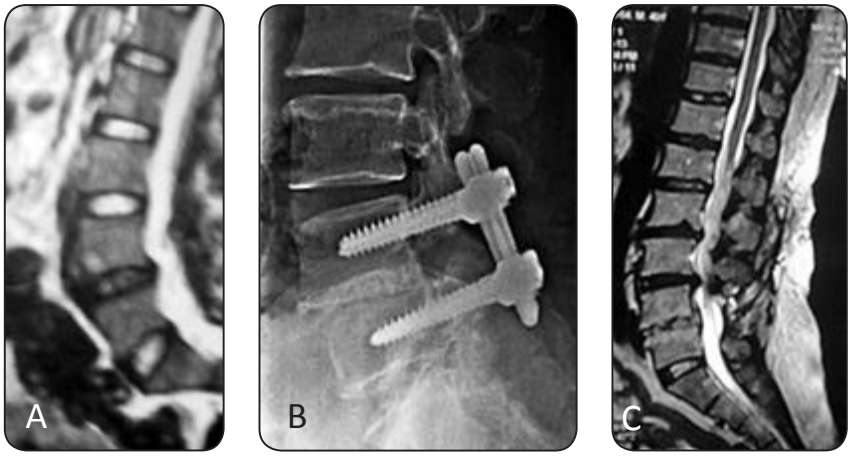

Figure (1).
A: Pre-operative T2 sagittal MRI of L4/L5 degenerative spondylolisthesis.
B: Lateral radiograph 3 years postoperative showing rigid fixation and sound bony fusion.
C: T2 sagittal view MRI showing proximal double level disc disease.

No reduction was attempted in any patients with spondylolisthesis in this study. Duration of the lucid interval between the primary surgery and the presentation ranged from 12 to 48 months with mean 33.4 months. Proximal segment affection was reported in 11 patients, proximal and distal segment affection in 3 patients, and distal segment affection in 3 patients. (Table 1)

Table (1). Descriptive Data of the Study Patients.

No.	Age	Gender	Pathology	Level	Grade	Comorbidity	Fused levels	lucid interval /months	ASD	ASD /grade
1	47	F	Slip	L4/L5/S1	I		2	48	P	II
2	39	F	Slip	L4/L5	II	Diabetes	1	43	P+D	II
3	41	F	Slip	L3/L4/L5	I		2	39	D	I
4	33	M	Slip	L4/L5/S1	I	Smoker	2	39	P	I
5	47	F	Slip	L4/L5/S1	I		2	35	P	II
6	49	M	DDD	L4/L5	II	Diabetes	1	30	P	II
7	25	M	Slip	L4/L5/S1	I	Smoker	2	22	P	III
8	59	M	DDD	L4/L5	II	Smoker	1	21	D	II
9	40	F	Slip	L4/L5/S1	II		2	19	P	II
10	34	F	Slip	L4/L5	II	Steroid	1	19	P+D	II
11	51	F	Slip	L4/L5/S1	I		2	18	P	III
12	44	F	Slip	L4/L5/S1	I		2	18	P	I
13	49	F	Slip	L4/L5/S1	II		2	18	P	II
14	48	M	Slip	L4/L5	II	Diabetes	1	16	D	II
15	54	F	Slip	L4/L5/S1	I		2	15	P	II
16	37	M	DDD	L4/L5	I		1	15	P	III
17	40	F	Slip	L4/L5	II	Diabetes	1	12	P+D	I

NB: No; number, F; female. M; Male, DDD; degenerative disc disease, ASD; adjacent segment disease, Slip; spondylolisthesis, P; proximal. D; distal.

The management of these patients was as follow; 8 patients were managed successfully conservatively and were followed up for at least one year with acceptable improvement in their clinical conditions, 9 patients were in need for decompressive laminectomy and bony fusion with extension of the instrumentation to the affected segment. Those revised patients were as follow; 6 patients with degenerated disc prolapse leading to moderate to severe canal stenosis and 3 patients with degenerative spondylolisthesis leading to canal stenosis and roots compression and /or stretch.

Discussion

The rate of degenerative changes occurring in the proximal or distal segments following lumbar arthrodesis vary much depending on the studies and the duration of the follow up and were estimated to be approximately 24-49%.[2,11]

Fixation with rigid instrumentation has an advantage as it helps early daily activity/ rehabilitation with the end result of solid bony fusion. After lumber spine fixation using the rigid systems followed by bony fusion, the movements at this segment are abolished and the range of motion at each segment must be increased to compensate for the lost movement. This leads to increased stress over all structures of the non-fused segments and allows the degenerative changes in all structures to start and progress.[11,16,18] Some authors[9,13,22] considered that radiographic changes associating ASD to be just an aging process not more and these changes could appear in patients without fusion or

fixation. Umehara et al,[21] studied the relationship between the spinal fixation and the shear stress applied over the structures of the posterior column of the proximal and distal non fused segment and they concluded that these shear forces are significantly increased leading to these degenerative changes in the non-fused adjacent segments.

Park et al,[17] have studied the risk factors responsible for the development of ASD and they found some sort of relations between female gender, patient age ,non-reduction, decompressive laminectomy, rigid fixation, primary degenerative changes and increased length of fusion. Several investigators[9,22] have concluded that there is an increase in the incidence of ASD as age advances. Park et al,[17] studied the female gender and if is it is a potential risk factor for the development of ASD. They concluded that there is some relationship between both. Ha et al,[11] concluded that there is increased incidence of these degenerative changes among women in the post- menopausal state as higher expression of the estrogen receptor might aggravate the degenerative changes in the facet articular cartilage.

The immediate stabilization attained by rigid instruments adds more shear stress leading to accelerated degenerative changes at the non-fused levels.[22,12] Position of the superior pedicle screw which differs according to the entry point selected, can harvest and override the facet of an adjacent segment.[2,22] Multi-segmental instrumented fusions cause more loads over the structures of the remaining adjacent non fused segments.[4,5] Etebar and Cahill[9] found a higher rate of segments degeneration in patients with ASD had fusions of two or more segments.

Ekman et al,[8] reported a higher incidence of occurrence of postoperative adjacent segment degeneration occurred when the patients were operated upon by formal laminectomy and posterior fusion with fixation, and that its incidence was significantly decreased when the laminae were saved.

Kumar et al,[13] reported a significantly increased rate high of radiographic ASD with an abnormal inclination of the sacrum and less lumber lordosis. Same conclusions have been reported by Rahm et al,[19] and Djurasovic et al,[7] Many authors[1,13,21] focused on the correlation between ASD and abnormal sagittal lumbar alignment. Umehara et al,[21] reported that alteration in sagittal malalignment leading to changing in the biomechanics with increased loading of the posterior column and abnormal distribution of the shear force at the proximal segment next to fused one after transpedicular posterolateral fusion in human cadavers. Kumar et al,[13] also reported that there is increased incidence of adjacent segment affection in instrumented posterolateral fusions with abnormal sagittal alignment. Akamaru et al,[1] concluded that normal lordotic alignment of the fused spine is mandatory to maintain the normal range of flexion-extension motion applied at the superior adjacent segment to minimize the effect of hypermobility.

The radiographic findings of ASD not necessarily match with the clinical and functional outcome. The radiological ASD was reported to vary from 5.2 to 49%.[17] Many authors[10,15] have reported that degenerative changes occurred more proximal than distal to the fusion level.

Recently many talks about the efficacy and validity of Dynamic stabilization and its role in decreasing ASD as many investigators[3,6,11,17,20] thought that it preserves some range of motion (ROM) and decreases the over load on adjacent non fused levels compared with rigid fixation.

Conclusion

Longer periods of follow up are needed to determine which of the accused risk factors are responsible for increasing the incidence of ASD and until solid conclusions are established, we should try to minimize the number of risk factors.

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الملخص العربي

فساد الغضروف القطنى المجاور لمنطقة التحام عظمى للفقرات القطنية وعوامل الخطورة والتعامل معها

المقدمه: فساد الغضروف القطنى المجاور لمنطقة التحام عظمى للفقرات القطنية وجد انه يحدث بصورة ملحوظة بعد اجراء التحام عظمى مكان الغضروف القطنى وعوامل الخطورة لم تتحدد بعد بصورة واضحة. وقد حدث تحسن فى الالتحام العظمى بعد اضافة التثبيت باستخدام الشرائح والمساميرو على الرغم من ذلك قد تحدث بعض التوابع ومنها موضوع البحث.

الغرض: وكان الغرض من البحث هو محاولة التعرف على العوامل التى تؤدى لمثل تلك التوابع وكذلك محاولة البحث عن انسب طرق العلاج والمتابعة

الطريقه: وقد اجريت الدراسة على ١٧ مريض كان قد اجرى لهم جراحات سابقة للتثبيت باستخدام الشرائح والمسامير ثم ظهر فيهم فساد الغضروف القطنى وانزلاقة اعلى او اسفل اللحام العظمى فى مدة تتراوح بين السنة الى ٤ سنوات بعد الجراحة الاولى. تمت دراسة تلك الحالات بالنسبة الى السن،المرض الاصلى،عدد المستوياي التى اجريت لها عمليات اللحام العظمى والمدة بين المرض الاصلى وظهور توابع اللحام العظمى.و تمت دراسة هؤلاء المرضى بالاشعات والمتابعة الاكلينكية.

النتائج: وقد اظهرت نتائج الدراسة ان فساد الغضروف القطنى المجاور لمنطقة التحام عظمى للفقرات القطنية يحدث اكثر فى المنطقة اعلى اللحام اكثر من المنطقة اسفل اللحام , ومع تثبيت اكثر من مستوى , ومع زيادة الوزن, ومع وجود التهابات مزمنة بمفاصل الفقرات وايضا عدم استرجاع الفقرات المنزلقة يساهم فى حدوث فساد الغضروف القطنى المجاور لمنطقة التحام عظمى للفقرات القطنية.