Orthopaedics & Traumatology: Surgery & Research 100 (2014) 347–351

Available online at

ScienceDirect

www.sciencedirect.com

Elsevier Masson France

EM|consulte

www.em-consulte.com/en

Case report

Surgical management of multilevel lumbar spondylolysis: A case report and review of the literature

A. Darnis*, O. Launay, G. Perrin, C. Barrey

Service de neurochirurgie C et chirurgie du rachis, hôpital neurologique P. Wertheimer, université Claude Bernard Lyon 1, 59, boulevard Pinel, 69003 Lyon, France

ARTICLE INFO

Article history:
Accepted 12 December 2013

Keywords:
Multilevel lumbar spondylolysis
Spinal fusion
Direct repair
Isthmic spondylolysis
MRI

ABSTRACT

Multilevel lumbar spondylolysis accounts for less than 6% of the cases of lumbar spondylolysis and its treatment, as reported in the literature, has not been consistent. Fewer than ten cases presenting triple lumbar spondylosis have been published. We describe the case of a 33-year-old male presenting bilateral L3, L4, and L5 isthmic lysis with no spondylolisthesis or disc degeneration. The MRI and CT of the lumbar spine were decisive elements in the therapeutic choice and the surgical treatment performed was bilateral L3 and L4 isthmic repair via a combined anterior and posterior L5S1 approach. The clinical and radiological results were good at the last follow-up visit.

1. Introduction

Spondylolisthesis is defined by the anterior slipping of a vertebral body in relation to the subjacent vertebra. Wiltse et al. [1] classified spondylolisthesis into five categories: dysplastic, degenerative, traumatic, pathological, and isthmic, the latter being the most frequent cause. The incidence of lumbar spondylolysis in the adult population is approximately 6% [2] and in more than 90% of cases involves the L5 level [3]. Multilevel lumbar spondylolysis is rare: it can account for up to 5.6% of lumbar spondylolysis cases and in more than 60% involves two levels, L4 and L5[4]. To our knowledge, fewer than ten cases of three-level lumbar spondylolysis have been reported in the literature. We review the management choices made in these cases and present a case of triple lumbar bilateral spondylolysis.

2. Clinical case

A 33-year-old male presented with lower back pain over the previous 5 years with sciatic irradiation to the lower left limb.

He was employed as an electrician and his history included a motorcycle accident 10 years before and obesity: BMI = 32. Medical treatment with antalgesics, anti-inflammatory medications, and myorelaxants did not improve the situation, nor did a L4–L5 and L5–S1 joint infiltration. The clinical examination revealed a positive Lasègue sign in the left leg at 45°, with no sensory-motor deficit.

The lumbar spine CT showed bilateral L3, L4, and L5 isthmic lysis with no spondylolisthesis (Figs. 1 and 2). No abnormality of the posterior arches, dysplasia, or spina bifida was found. A lumbar MRI found the L3L4 and L4L5 discs intact with no nerve root compression and the L5–S1 disc with early signs of discopathy. The spinal x-rays showed three bilateral isthmic lyses on a type 4 back according to the Roussouly classification [5]: pelvic incidence, 57°; sacral slope 51° (Fig. 3).

Given this patient's considerable functional discomfort and the failure of the medical treatment, the indication for surgical management with L3 and L4 isthmic repair and L5–S1 arthrodesis was retained. The surgical intervention was performed in two phases. The first operative phase was L5–S1 fusion using a combined approach. After placing an L5–S1 cage via a retroperitoneal approach, the patient was turned over to the ventral decubitus position and L5–S1 stabilization was performed via a posterior approach as well as bilateral L3 and L4 isthmic repair. After bilateral L5–S1 arthrectomy, the arthrodesis was performed by placing two contoured titanium rods with four pedicular screws. The L3 and L4 isthmi were identified and the lysis area was curetted, freshened, and then grafted with autologous bone substance (Fig. 4). The isthmus was placed under compression with a pedicular screw connected to a sublaminar hook by a short rod (Fig. 5).

Immediate postoperative recovery was uneventful, with no neurological deficit. A brace was placed for 3 months. Follow-up x-rays (Fig. 6) and CT were taken on postoperative day 3 and the clinical and radiological progression were favorable 6 months after surgery.

* Corresponding author. Tel.: +33 6 76 82 45 29.
E-mail address: alice.darnis@icloud.com (A. Darnis).

http://dx.doi.org/10.1016/j.otsr.2013.12.021
1877-0568/

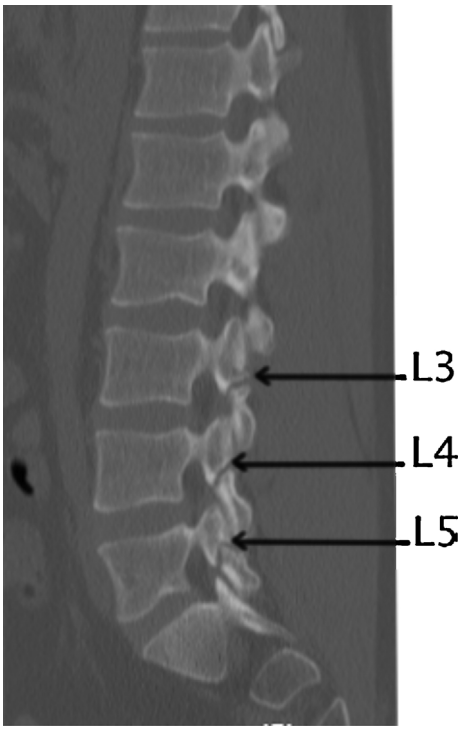

Fig. 1. Sagittal lumbar CT view. L3, L4, and L5 isthmic lysis.

3. Discussion

Lumbar spondylolysis is frequent, in more than 90% of cases located in L5 [3]. However, multilevel isthmic lyses are rare.

Two factors can explain isthmic lysis, both genetic and mechanical. No specific genetic variation was identified, but it would seem, according to Willis [6] and Wiltse [7], that a genetic predisposition to this pathology may exist. The frequency of lumbar spondylolysis can reach up to 54% in certain ethnic groups [8]. From a mechanical point of view, heavy work and repeated injuries seem to favor the appearance of spondylolisthesis through isthmic lysis: in the series reported by Ravichandran [9], five patients presented symptoms following an injury. Some authors [10] liken isthmic lysis to stress fractures. In their case report, Hersh et al. [11] assumed that the physical occupation of their female patient promoted the appearance of her triple bilateral spondylolysis and that a fall had aggravated the symptoms.

Several studies have found a correlation between the development of isthmic lysis spondylolisthesis and certain parameters defining the morphotype. Marty et al. [12] as well as Labelle [13] and Vialle [14] found greater significant pelvic incidence (PI) and sacral slope (SS) in patients presenting spondylolisthesis.

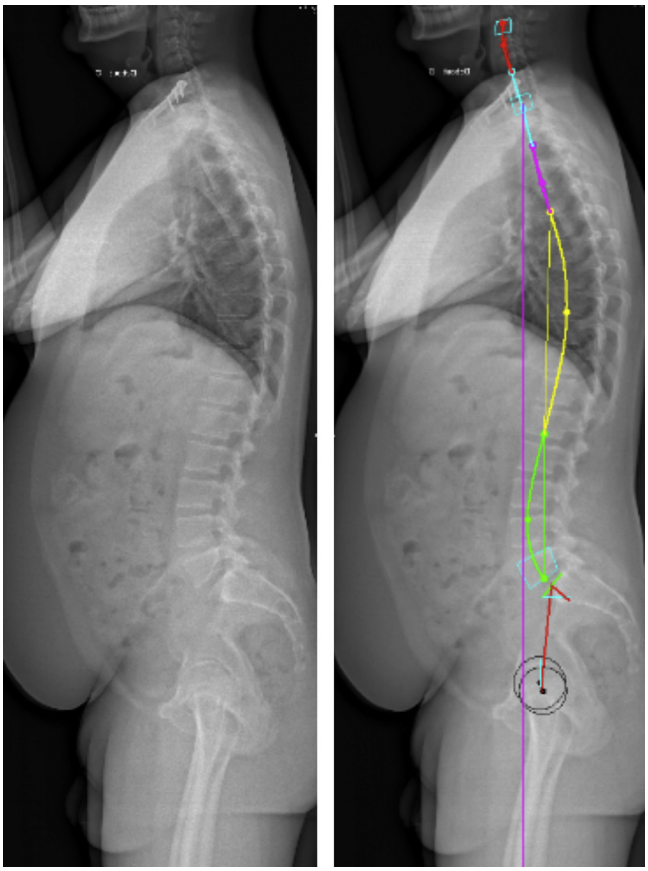

Fig. 3. EOS® lateral x-rays of the entire spine. PI = 57; PT = 6; SS = 51; lumbar lordosis (LL) = 43; thoracic kyphosis (CT) = 32°.

Pelvic incidence, constant in each individual after growth has been completed, is related to sacral slope and pelvic tilt parameters (PT) through the relation:

PI = PT + SS [15].

Roussouly [5] classified the spinal morphotypes of the general population into four groups according to the sacral slope value. Type 4, defined by a value greater than 45°, seems to predispose the individual to developing L5–S1isthmic lysis spondylolisthesis [16]. The patient reported herein presented high pelvic incidence (57°) and sacral slope (51°) values, explaining the development of spondylolysis. However, the pelvic tilt value was low (6°): this anteversion may have increased his sacral slope, with pelvic incidence being constant, finally classifying this patient in morphotype 3. A recent study [17] also found high pelvic incidence in isthmic lysis spondylolisthesis as well as degenerative spondylolisthesis. This factor may well promote spondylolysis, by hyperlordosisand hyperextension, with the L5 isthmus squeezed between the supe-

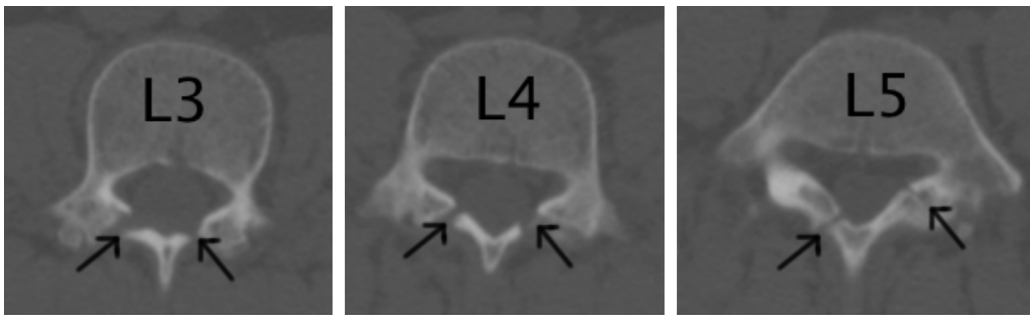

Fig. 2. Transversal lumbar CT view. Bilateral isthmic lyses.

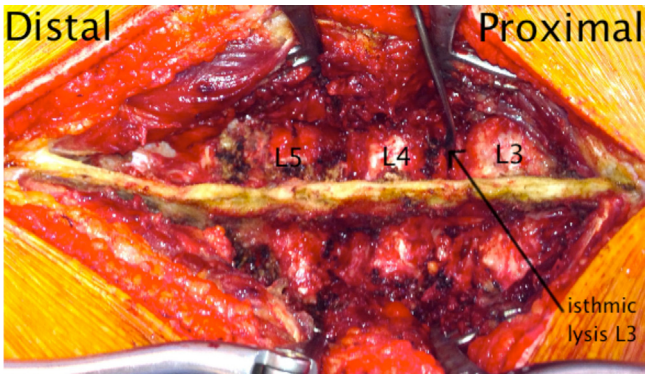

Fig. 4. Left L3 isthmic lysis demonstrated.

rior S1 joint and the inferior L4 joint, or via the sacral slope through shearing of the L5 isthmus abutting the S1 joint. One hypothesis can be postulated concerning the influence of lordosis on the morphological development of the posterior arches: when the lordosis is severe, the posterior arches have less room to develop and can therefore be less high and shorter than when lordosis is less severe and thus less resistant from a mechanical point of view.

Treatment of multilevel spondylolyses has not met with consensus. A brace can be proposed but seems to provide little improvement [9,10,18,19]. In case of medical and orthopaedic treatment failure, or as first-line treatment, surgical treatment can be recommended [10]. Two options can be discussed: fusion and isthmic repair.

Al-Sebai [20] presented a case of bilateral L2, L3, L4 spondylolysis with L4 spondyloptosis and sacralization of L5 treated with L4–L5 laminectomy and then L4 corporectomy and posterior L2–L5 arthrodesis. Park [18] treated a case of asymmetrical spondylolysis with posterior L2–L4 fusion.

Several surgical techniques can be proposed for isthmic repair. Ravichandran [9] performed direct isthmic repair as reported by Buck [21]. In Ogawa et al.'s series [10], the surgical treatment was repaired using metal wire and bone grafting. Eingorn and Pizzutillo [19] treated a case of unilateral L2and bilateral L3 and L4 spondylolysis with isthmic repair by wiring and bone grafting. The series found in the literature are summarized in Table 1 [9–11,18–20,22–24].

In 2010, Hersh et al. [11] reported a case resembling the case reported herein. A 46-year-old female presented lower back pain with sciatic pain after a fall. The CT found bilateral L3, L4, L5

Fig. 6. Postoperative AP and lateral x-rays of the spine.

isthmic lysis with grade 1 spondylolisthesisin L4–L5 and L5–S1. The MRI showed degenerative discopathy with a L4–L5 median hernia and L5–S1paramedian hernia on the left. Management consisted of L4–L5 and L5–S1 fusion through a combined approach, and direct L3 isthmic repair using pedicular screws connected to a sublaminar hook in compression. In the present case, the absence of major discopathy led us to choose arthrodesis at a single level so as to preserve maximum mobility of the lumbar segment in this young patient.

Therapeutic management of multilevel spondylolysis is therefore not homogenous. Surgical treatment varies between fusion, isthmic repair, and combined management associating two procedures at different levels.

Several factors should be taken into account. In a young patient, extensive arthrodesis should be avoided, particularly if the discs are normal. A spinal MRI seems indispensable for making the decision. If there is a malformation of the posterior arch, isthmic repair can be compromised. In the present case, the patient was young with

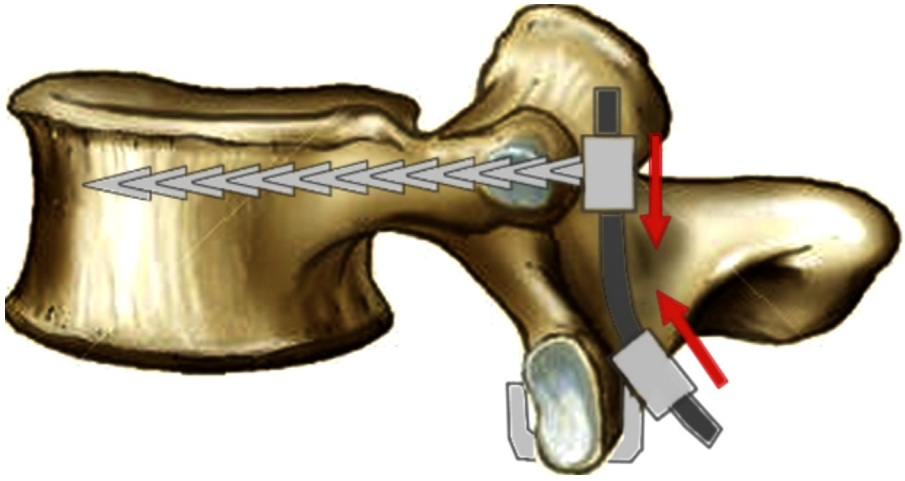

Fig. 5. Compression of the isthmus.

Table 1
Review of the literature of the surgical management choices for multilevel spondylolysis.

Author	Gender	Age	Levels involved	Type of surgery	Results
Ravichandran	M	33	L3 + L4 + L5	L3–S1 intertransverse fusion	Excellent
	M	18	L4 + L5	L4–S1 intertransverse fusion	Excellent
	M	33	L3 + L5	L2–L4 intertransverse fusion	Poor
	M	43	L2 + L4	L4–S1 interspinous fusion + L2 Buck	Poor
Eingorn and Pizzutillo	F	18	Unilateral L2 + L3 + L4	Isthmic repair with metal wire + bone grafting	Excellent
Al-Sebai and Al-Khawashki	F	15	L2 + L3 + L4 L4 spondyloptosis	Release + L4 corporectomy + L2–L5 fusion	Good
Ogawa et al.	5 M, 2 F	19–37	5 cases: 2 levels 2 cases: 3 levels	Isthmic repair with metal wire + bone grafting	5 Excellent 1 Good 1 Fair
Park et al.	F	19	Left: L2 + L3 + L4 Right: L1 + L2 + L3	L2–L4 posterior arthrodesis	Good
Hersch et al.	F	46	L3 + L4 + L5	L4–S1 posterior arthrodesis, discectomy	Good
Chang et al.	6 M		5 cases: 2 levels 1 case: 3 levels	Screw & hook isthmic repair	1 Good 1 Fair
Arai et al.	M	45	L3 + L4 + L5	Screw & hook isthmic repair	Good
Chung et al.	M	21	L3 + L4	Screw & hook isthmic repair	Good
	M	24	L3 + L4		Good
	M	25	L3 + L4		Excellent
	M	22	L3 + L4		Excellent
	M	20	L3 + L5		Excellent
	M	20	L3 + L5		Excellent

good discs and a normal posterior arch. L3–S1 fusion did not seem warranted and three-level isthmic repair was deemed excessively risky. The method used for isthmic repair allowed us to compress the lysis area but was relatively cumbersome. A less cumbersome technique could be more appropriate to isthmic repair at several adjacent levels.

4. Conclusion

Few cases of multilevel lumbar spondylolysis have been described in the literature and their management varies. Orthopaedic treatment with a brace does not seem adapted to these patients. Surgical management can be isthmic repair, arthrodesis, or an association of the two. We believe that a satisfactory surgical solution was chosen for our patient, with good clinical and radiological results at the last follow-up. It would be useful to pursue the clinical and radiological follow-up over the long term to better appreciate the progress of the segments treated as well as the adjacent segments.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References

[1] Wiltse LL, Newman PH, Macnab I. Classification of spondylolisis and spondylolisthesis. Clin Orthop Relat Res 1976;117:23–9.
[2] Fredrickson BE, Baker D, McHolick WJ, Yuan HA, Lubicky JP. The natural history of spondylolysis and spondylolisthesis. J Bone Joint Surg Am 1984;66:699–707.
[3] Sakai T, Sairyo K, Suzue N, Kosaka H, Yasui N. Incidence and etiology of lumbar spondylolysis: review of the literature. J Orthop Sci 2010;15:281–8.
[4] Stewart TD. The age incidence of neural-arch defects in Alaskan natives, considered from the standpoint of etiology. J Bone Joint Surg Am 1953;35-A:937–50.
[5] Roussouly P, Berthonnaud E, Dimnet J. Geometrical and mechanical analysis of lumbar lordosis in an asymptomatic population: proposed classification. Rev Chir Orthop Reparatrice Appar Mot 2003;89:632–9.
[6] Willis TA. The separate neural-arch. J Bone Joint Surg Am 1931;13(4):709–21.
[7] Wiltse LL. Etiology of spondylolisthesis. Clin Orthop 1957;10:48–60.
[8] Simper LB. Spondylolysis in Eskimo skeletons. Acta Orthop Scand 1986;57:78–80.
[9] Ravichandran G. Multiple lumbar spondylolyses. Spine 1980;5:552–7.
[10] Ogawa H, Nishimoto H, Hosoe H, Suzuki N, Kanamori Y, Shimizu K. Clinical outcome after segmental wire fixation and bone grafting for repair of the defects in multiple level lumbar spondylolysis. J Spinal Disord Tech 2007;20:521–5.
[11] Hersh DSD, Kim YHY, Razi AA. Multilevel spondylolysis. Bull N Y U Hosp Jt Dis 2010;69:339–43.
[12] Marty C, Boisaubert B, Descamps H, Montigny JP, Hecquet J, Legaye J, et al. The sagittal anatomy of the sacrum among young adults, infants, and spondylolisthesis patients. Eur Spine J 2002;11:119–25.
[13] Labelle H, Roussouly P, Berthonnaud E, Transfeldt E, O'Brien M, Chopin D, et al. Spondylolisthesis, pelvic incidence, and spinopelvic balance: a correlation study. Spine 2004;29:2049–54.
[14] Vialle R, Ilharreborde B, Dauzac C, Lenoir T, Rillardon L, Guigui P. Is there a sagittal imbalance of the spine in isthmic spondylolisthesis? A correlation study. Eur Spine J 2007;16:1641–9.
[15] Legaye J, Duval-Beaupère G, Hecquet J, Marty C. Pelvic incidence: a fundamental pelvic parameter for three-dimensional regulation of spinal sagittal curves. Eur Spine J 1998;7:99–103.
[16] Roussouly P, Pinheiro-Franco JL. Biomechanical analysis of the spinopelvic organization and adaptation in pathology. Eur Spine J 2011;20:609–18.
[17] Lim JK, Kim SM. Difference of sagittal spinopelvic alignments between degenerative spondylolisthesis and isthmic spondylolisthesis. J Korean Neurosurg Soc 2013;53:96.
[18] Park K-H, Ha J-W, Kim H-S, Moon E-S, Moon S-H, Lee H-M, et al. Multiple levels of lumbar spondylolysis – a case report. Asian Spine J 2009;3:35–8.
[19] Eingorn D, Pizzutillo PD. Pars interarticularis fusion of multiple levels of lumbar spondylolysis. A case report. Spine 1985;10:250–2.
[20] Al-Sebai MW, Al-Khawashki H. Spondyloptosis multiple-level spondylolysis. Eur Spine J 1999;8:75–7.

[21] Buck JE. Direct repair of the defect in spondylolisthesis. Preliminary report. J Bone Joint Surg Br 1970;52:432–7.
[22] Chang JH, Lee CH, Wu SS, Lin LC. Management of multiple level spondylolysis of the lumbar spine in young males: a report of six cases. J Formos Med Assoc 2001;100:497–502.
[23] Arai T, Sairyo K, Shibuya I, Kato K, Dezawa A. Multilevel direct repair surgery for three-level lumbar spondylolysis. Case Rep Orthop 2013;2013:1–6.
[24] Chung C-H, Chiu H-M, Wang S-J, Hsu S-Y, Wei Y-S. Direct repair of multiple levels lumbar spondylolysis by pedicle screw laminar hook and bone grafting: clinical CT, and MRI-assessed study. J Spinal Disord Tech 2007;20:399–402.