

腰椎斜外侧椎间融合术后融合器移位的发生特点与处理策略

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【摘要】 目的: 探讨斜外侧椎间融合术 (oblique lateral interbody fusion, OLIF) 治疗腰椎病变术后融合器移位的特点、处理策略和预防措施。方法: 回顾性分析 4 家医疗中心 2014 年 10 月至 2018 年 12 月采用 OLIF 治疗的 12 例腰椎病变术后出现融合器移位患者的临床资料, 其中男 4 例, 女 8 例; 年龄 53~81 岁; 腰椎间盘退行性病变 2 例, 腰椎管狭窄症 4 例, 腰椎退行性滑脱 3 例, 腰椎退行性侧后凸 3 例; 术前双能 X 线骨密度检测, T 值 > -1 SD 1 例, T 值 -1~-2.5 SD 5 例, T 值 < -2.5 SD 6 例; 单节段融合 9 例, 2 节段融合 1 例, 3 节段融合 2 例; 采用 Stand-alone OLIF 9 例, OLIF 联合后路椎弓根螺钉固定 3 例。分别于发生融合器移位时和末次随访时采用疼痛视觉模拟评分 (visual analogue scale, VAS)、ODI 功能障碍指数 (Oswestry disability index, ODI) 评价腰痛、腰椎功能恢复情况, 并根据随访时影像结果观察融合器沉降或再移位、内固定有无松动或断裂, 以及椎间融合情况, 测量并比较发生融合器移位节段椎间隙高度变化。结果: 再次手术的 10 例患者术后切口皮肤无坏死、无感染, 12 例患者获得随访, 时间 12~48 个月。腰痛 VAS 由融合器移位时的 3~8 分降至末次随访时 0~2 分; ODI 由发生融合器移位时的 31%~51% 恢复至末次随访时的 5%~13%。随访过程中未出现椎弓根螺钉系统松动或断裂现象, 11 例采用融合器植骨患者均出现融合器沉降, 融合器无进一步移位。椎间隙高度由发生融合器移位时的 9.0~12.7 mm 恢复至末次随访时的 8.0~11.8 mm。末次随访时除 1 例没有影像结果外, 其余均获得椎间融合。结论: OLIF 可用于腰椎病变的融合, 术后存在融合器移位的风险, 特别是多发生于术前存在骨量减少或骨质疏松、术中出现终板损伤, 以及采用 Stand-alone 方式病例, 且多发生于术后 3 个月内。对于初次手术采用 Stand-alone OLIF 方式所发生的融合器移位需要采取手术干预。虽然融合器移位经及时发现, 确切处理, 可获得良好的临床结果, 但仍要强调术前病例的精准选择、OLIF 方式的合适应用、术中的精细操作等预防融合器移位的措施。

【关键词】 腰椎; 固定; 椎间融合; 并发症; 再手术

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Characteristics and treatment measures of cages displacement after oblique lateral interbody fusion

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ABSTRACT Objective To explore characteristics, management strategies and preventive measures of fusion device displacement after oblique lateral interbody fusion (OLIF) in treating lumbar lesions. **Methods** The clinical data of 12 patients with fusion device displacement after OLIF for lumbar lesions in 4 medical centers from October 2014 to December 2018 were retrospectively analyzed, including 4 males and 8 females, aged from 53 to 81 years old; 2 patients with lumbar disc degeneration, 4 patients with lumbar spinal stenosis, 3 patients with lumbar degenerative spondylolisthesis and 3 patients with lumbar degenerative kyphosis; preoperative dual-energy X-ray bone mineral density (BMD) was detected in 1 patient with T-value > -1 SD, 5 patients with T-value > -1~-2.5 SD, and 6 patients with T-value < -2.5 SD; 9 patients with single-segment fusion,

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1 patient with 2-segment fusion, and 2 patients with 3-segment fusion; standalone OLIF was performed in 9 patients and OLIF combined with posterior pedicle screws in 3 patients. Visual analogue scale (VAS) and Oswestry disability index (ODI) were used to evaluate low back pain and lumbar function recovery at the time of fusion graft displacement and at the latest follow-up, respectively. In addition, according to imaging results during follow-up, the fusion device subsidence or redisplacement, loosening or fracture of internal fixation, and interbody fusion were observed, and the changes in the height of interbody space on the segment with fusion device displacement were measured and compared. **Results** There were no necrosis or infection in skin incision of 10 patients after reoperation, and 12 patients were followed up for 12 to 48 months. VAS for low back pain decreased from 3 to 8 points at the time of fusion device displacement to 0 to 2 points at the latest follow-up. ODI recovered from 31% to 51% at the time of fusion transfer to 5% to 13% at the latest follow-up. There was no loosening or fracture of the pedicle screw system during follow-up. All 11 patients with bone grafting with fusion apparatus had fusion apparatus subsidence and no further displacement of fusion apparatus. The vertebral space height recovered from 9.0 to 12.7 mm at the time of fusion graft displacement to 8.0 to 11.8 mm at the latest follow-up. Interbody fusion was obtained in all patients except 1 with no imaging results at the latest follow-up. **Conclusion** OLIF could be used for fusion of lumbar lesions, and there is a risk of fusion organ displacement after operation, especially in cases of bone loss or osteoporosis before surgery, end-plate injury during surgery, and Stand-alone mode, and most of them occur within 3 months after operation. Surgery is required for the transposition of the fusion apparatus in the Stand-alone OLIF mode during the primary operation. Although good clinical results could be obtained by timely detection and accurate treatment, it is still necessary to emphasize the precise selection of cases before operation, the appropriate application of OLIF, and precise operation during operation to prevent displacement of fusion device.

KEYWORDS Lumbar; Fixed; Interbody fusion; Complications; Reoperation

术后融合器移位是后路腰椎固定椎间融合器植骨较为少见而又无法避免的现象^[1-4]。融合器移位,轻者延长卧床或制动时间,严重者影响固定节段的稳定,导致椎间不融合、内固定失败,甚至融合器移位进入椎管或腹腔,压迫神经、血管^[5]或脏器,导致更加严重的后果。近年来,由于腰椎斜外侧椎间融合技术^[6](oblique lateral interbody fusion, OLIF)具有创伤小、出血少、不进入不干扰椎管、间接减压效果好、恢复快、融合率高等优点而在临床广泛应用^[7-14]。虽然 OLIF 技术所用的融合器体积和面积较大,且植入的入路和融合器放置位置有别于后路椎间融合,但同样存在术后融合器移位的现象^[15-16]。武警海警总队医院、浙江大学附属邵逸夫医院、丽水市中心医院、皖南医学院弋矶山医院自 2014 年 10 月至 2018 年 12 月应用 OLIF 技术治疗腰椎病变 1 542 例,其中采用 Stand-alone OLIF 方式 395 例,OLIF 联合后路椎弓根螺钉固定方式 1 147 例。术后出现融合器移位 12 例,融合器移位发生率 0.78%,其中发生于 Stand-alone OLIF 方式 9 例,OLIF 联合后路椎弓根螺钉固定方式 3 例。为探讨腰椎斜外侧椎间融合技术术后融合器移位的特点、处理策略、早期结果、预防措施,以减少融合器的移位,促进 OLIF 技术的更好应用,本研究回顾性分析 12 例融合器移位患者的临床资料,现报告如下。

1 资料与方法

1.1 病例选择

纳入标准:采用 Stand-alone OLIF 或 OLIF 联合后路椎弓根螺钉固定术治疗的腰椎病例;术后出现

融合器横向或前后向移位。融合器移位的判断标准:在腰椎正侧位 X 线片上,相较术后早期(即术后 3~5 d 的腰椎正侧位 X 线片)融合器的位置(腰椎正位 X 线片上以融合器左侧标记线为准,腰椎侧位 X 线片上以融合器后缘标记线为准),随访过程中融合器发生前后向或横向移动>3 mm。排除标准:融合器移位确诊后随访<6 个月;临床资料不全者。

1.2 一般资料

根据纳排标准共纳入 12 例腰椎 OLIF 术后融合器移位患者,男 4 例,女 8 例;年龄 53~81 岁;腰椎间盘退行性病变 2 例,腰椎管狭窄症 4 例,腰椎退行性滑脱 3 例(滑脱分度采用 MEYERDING^[17]制定的 Meyerding 分度法, I 度 2 例, II 度 1 例),腰椎退行性侧后凸 3 例;术前双能 X 线骨密度检测, T 值>-1 SD 1 例, T 值-1~-2.5 SD 5 例, T 值<-2.5 SD 6 例;采用 Stand-alone OLIF 9 例, OLIF 联合后路椎弓根螺钉固定 3 例;单节段融合 9 例, 2 节段融合 1 例, 3 节段融合 2 例;同种异体骨 8 例,人工骨(硫酸钙)+骨诱导蛋白(bone morphogenetic protein, BMP)4 例;术中出现终板损伤 9 例,终板无损伤 3 例。均于术后 3 个月内出现融合器移位,且合并腰部酸胀或疼痛,以久站和行走时明显。12 例患者临床资料见表 1。本研究经 4 个医疗中心伦理委员会批准同意(武伦 201935、邵科研 20200316-31、丽医伦 2018079、戈伦 2019062)。

1.3 治疗方法

9 例 Stand-alone OLIF 患者予后方肌间隙入路双侧椎弓根螺钉固定,置钉方法与既往文献^[10-12]报

表 1 腰椎斜外侧椎间融合术后融合器移位 12 例患者临床资料

Tab.1 Clinical data of 12 patients with translocation of fusion apparatus after lumbar oblique lateral interbody fusion

患者序号	性别	年龄/岁	临床诊断	骨密度 T 值/SD	手术方式	融合节段数	植骨材料	终板有无损伤	术后发生融合器移位/月
1	男	63	L _{4,5} 椎管狭窄症	-2.5	单纯 OLIF	单节段	同种异体骨	无	1.5
2	女	63	L ₄ 退行性滑脱	-2.7	单纯 OLIF	单节段	同种异体骨	有	2.0
3	男	53	L _{4,5} 椎间盘退行性病变	-0.8	单纯 OLIF	单节段	同种异体骨	无	1.5
4	女	59	腰椎退行性侧后凸	-1.7	单纯 OLIF	3 节段	硫酸钙+BMP	有	1.5
5	女	56	L ₄ 退行性滑脱	-1.5	单纯 OLIF	单节段	同种异体骨	无	1.5
6	男	69	L _{4,5} 椎管狭窄症	-2.8	OLIF+内固定	单节段	同种异体骨	有	1.5
7	女	81	L _{3,4} 椎管狭窄症	-2.9	单纯 OLIF	单节段	硫酸钙+BMP	有	1.5
8	女	68	L _{4,5} 椎间盘退行性病变	-2.1	OLIF+内固定	单节段	同种异体骨	有	1.5
9	女	66	腰椎退行性侧后凸	-2.5	单纯 OLIF	2 节段	硫酸钙+BMP	有	1.5
10	男	71	L ₄ 退行性滑脱	-2.6	单纯 OLIF	单节段	同种异体骨	有	2.0
11	女	63	腰椎退行性侧后凸	-2.7	单纯 OLIF	3 节段	硫酸钙+BMP	有	1.5
12	女	70	L _{4,5} 椎管狭窄症	-2.8	OLIF+内固定	单节段	同种异体骨	有	1.5

道相同;1 例 OLIF 联合后路椎弓根螺钉固定,其融合器内植骨采用的是同种异体骨,术后融合器移位原因考虑为排斥反应,予腰椎斜外侧入路行融合器取出、病灶清除、取自体髂骨结构性植骨、后路原切口进入行椎弓根螺钉取出换用直径更大的螺钉;另 2 例 OLIF 联合后路椎弓根螺钉固定患者予佩戴胸腰支具加强胸腰部外保护,严密随访。手术治疗的 10 例,术后卧床 3 d,再佩戴胸腰支具保护下床活动。12 例均于术后或发现融合器移位后的 1.5 个月开始腰背肌、腹肌锻炼,均佩戴胸腰支具 3 个月,分别于术后或发现融合器移位后 1.5、3、6、12 个月,随后每隔 12 个月进行门诊随访。

1.4 观察项目与方法

1.4.1 临床疗效评价 分别于发生融合器移位时和末次随访采用疼痛视觉模拟评分^[18](visual analogue scale, VAS)对腰痛程度进行评价;采用 ODI 功能障碍指数^[19](Oswestry disability index)从疼痛程度、生活自理能力、提物、坐、站立、行走、睡眠、性生活、社会活动、旅游等方面进行临床疗效评价。

1.4.2 影像学观察 10 例接受再次手术患者再次手术后及 2 例保守治疗患者确诊融合器移位并进行胸腰部外保护后定期复查腰椎正侧位 X 线片,随访 12 个月时增加腰椎过屈、过伸位 X 线片检查;再次手术后 2 例未手术患者在确诊融合器移位后 12 个月行 CT 平扫并二维、三维重建,观察融合器位置、随访过程中融合器沉降或再移位现象、内固定有无松动或断裂,以及椎间融合情况;测量并比较融合器移位时和末次随访时发生融合器移位节段椎间隙高度的变化。

1.4.3 并发症情况 观察再手术患者切口皮肤坏

死或切口感染情况。

2 结果

12 例患者获得随访,时间 12~48 个月。腰痛 VAS 由发生融合器移位时的 3~8 分降至末次随访时 0~2 分;ODI 由发生融合器移位时的 31%~51%恢复至末次随访时的 5%~13%。见表 2。随访过程中未出现椎弓根螺钉系统松动或断裂现象,11 例使用融合器植骨患者均出现融合器的沉降,融合器无进一步移位。椎间隙高度由发生融合器移位时的 9.0~12.7 mm 降至末次随访时的 8.0~11.8 mm。10 例接受再次手术患者切口皮肤无坏死、无感染。末次随访时除 1 例无影像结果(本例患者出院后出现老年痴呆,虽然定期门诊随访,但无法配合影像检查)外,其余均获得椎间融合。典型病例图片见图 1、图 2、图 3。

3 讨论

3.1 OLIF 术后融合器移位的发生

3.1.1 OLIF 术后融合器移位的发生率 无论是腰椎后路经椎板间入路椎间融合术 (posterior lumbar interbody fusion, PLIF)、腰椎后路经椎间孔入路椎间融合术 (transforaminal lumbar interbody fusion, TLIF) 或腰椎前路椎间融合术 (anterior lumbar interbody fusion, ALIF)、腰椎侧方椎间融合术 (direct lateral interbody fusion, DLIF)、OLIF 技术,采用融合器植骨是主要的融合方式,椎间融合术后融合器的问题主要包括融合器沉降和移位^[1-4,15-16,20-25],融合器沉降较为常见,且大部分不影响临床结果^[15-16,20-25],而融合器移位发生较少。ZENG 等^[16]报道 235 例患者,采用 Stand-alone OLIF 治疗 91 例,术后出现融合器移位 1 例,发生率为 1.1%;采用 OLIF 联合后路椎弓根螺钉固定治疗 144 例,术后融合器移位 1 例,发生率为

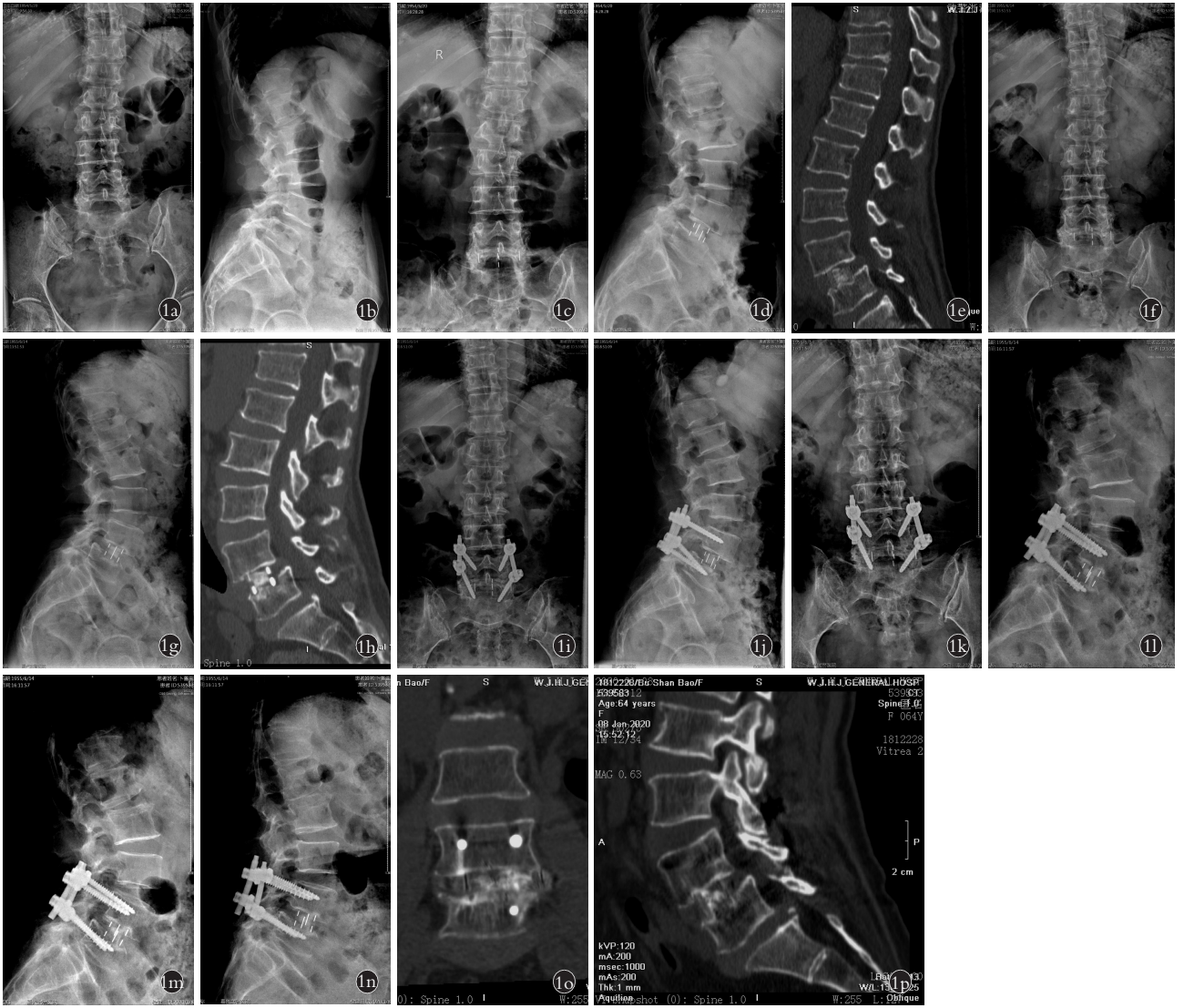


图 1 患者,女,63岁,L₄退行性滑脱症 I 度 **1a,1b**. 术前腰椎正侧位 X 线片示 L₄ 椎体向前滑移 I 度,L_{4,5} 椎间隙高度下降 **1c,1d**. 经斜外侧入路 L_{4,5} 椎间融合器植骨术后 3 d 腰椎正侧位 X 线片示 L₄ 椎体仍轻度向前滑移,L_{4,5} 椎间隙高度恢复良好,融合器在位 **1e**. 术后 3 d 腰椎 CT 平扫并矢状面重建示 L₅ 上终板损伤,L_{4,5} 椎间隙高度恢复良好,融合器在位 **1f,1g**. 术后 2 个月腰椎正侧位 X 线片示 L_{4,5} 椎间隙高度明显丢失,融合器向左侧横向移位 **1h**. 术后 2 个月腰椎 CT 平扫并矢状面重建示 L_{4,5} 椎间隙高度明显丢失,融合器切割 L₅ 上终板,部分嵌入 L₅ 椎体 **1i,1j**. 第 1 次术后 2 个月行后方肌间隙入路通道下 L_{4,5} 椎弓根螺钉固定术,再次手术后 3 d 腰椎正侧位 X 线片示 L_{4,5} 椎弓根螺钉及椎间融合器在位 **1k,1l**. 再次手术后 2 年腰椎正侧位 X 线片示 L_{4,5} 椎间隙高度获得较好维持,L_{4,5} 椎弓根螺钉在位,椎间融合器无进一步移位 **1m,1n**. 再次手术后 2 年腰椎过屈过伸侧位 X 线片示 L₄ 下终板和 L₅ 上终板角度无明显变化,L₄、L₅ 椎体无相对移位 **1o,1p**. 再次手术后 2 年腰椎 CT 平扫加冠状面、矢状面重建示 L_{4,5} 椎间融合较好

Fig.1 Patient, female, 63 years old, degenerative spondylolisthesis of L₄ with degree I **1a, 1b**. Preoperative AP and lateral X-ray films of lumbar spine showed L₄ vertebral body was sliding forward degree I, and the height of L_{4,5} intervertebral space decreased **1c, 1d**. AP and lateral X-ray films of L_{4,5} lumbar spine after oblique lateral interbody fusion at 3 days showed L₄ vertebral body was still slightly sliding forward, and the height of L_{4,5} intervertebral space recovered well, the fusion apparatus was in place **1e**. Postoperative plain CT scan and sagittal reconstruction of lumbar spine at 3 days showed injury of L₅ upper endplate, height of L_{4,5} intervertebral spaces recovered well, and the fusion apparatus was in place **1f, 1g**. Postoperative AP and lateral X-ray films of lumbar spine at 2 months showed significant loss of L_{4,5} intervertebral height, and lateral displacement of fusion apparatus to the left side **1h**. Postoperative CT scan and sagittal reconstruction of lumbar spine at 2 months showed obvious loss of L_{4,5} vertebral space height, the fusion apparatus cut the upper endplate of L₅ and partially embedded L₅ vertebral body **1i, 1j**. L_{4,5} pedicle screws were fixed under posterior intermuscular space approach at 2 months after the first operation, AP and lateral X-ray films of lumbar spine at 3 days after the second operation showed L_{4,5} pedicle screws and interbody fusion apparatus in place **1k, 1l**. AP and lateral X-ray films of lumbar spine at 2 years after reoperation showed L_{4,5} intervertebral space heights maintained well, L_{4,5} pedicle screws were in place, and interbody fusion apparatus was not further displaced **1m, 1n**. Lateral X-ray films of lumbar spine on hyperflexion and hyperextension position at 2 years after reoperation showed no significant changes in angle of L₄ and L₅ endplate, and no relative displacement of L₄ and L₅ vertebral bodies **1o, 1p**. CT scan of lumbar spine with coronal and sagittal reconstruction at 2 years after reoperation, showed good intervertebral fusion on L_{4,5}

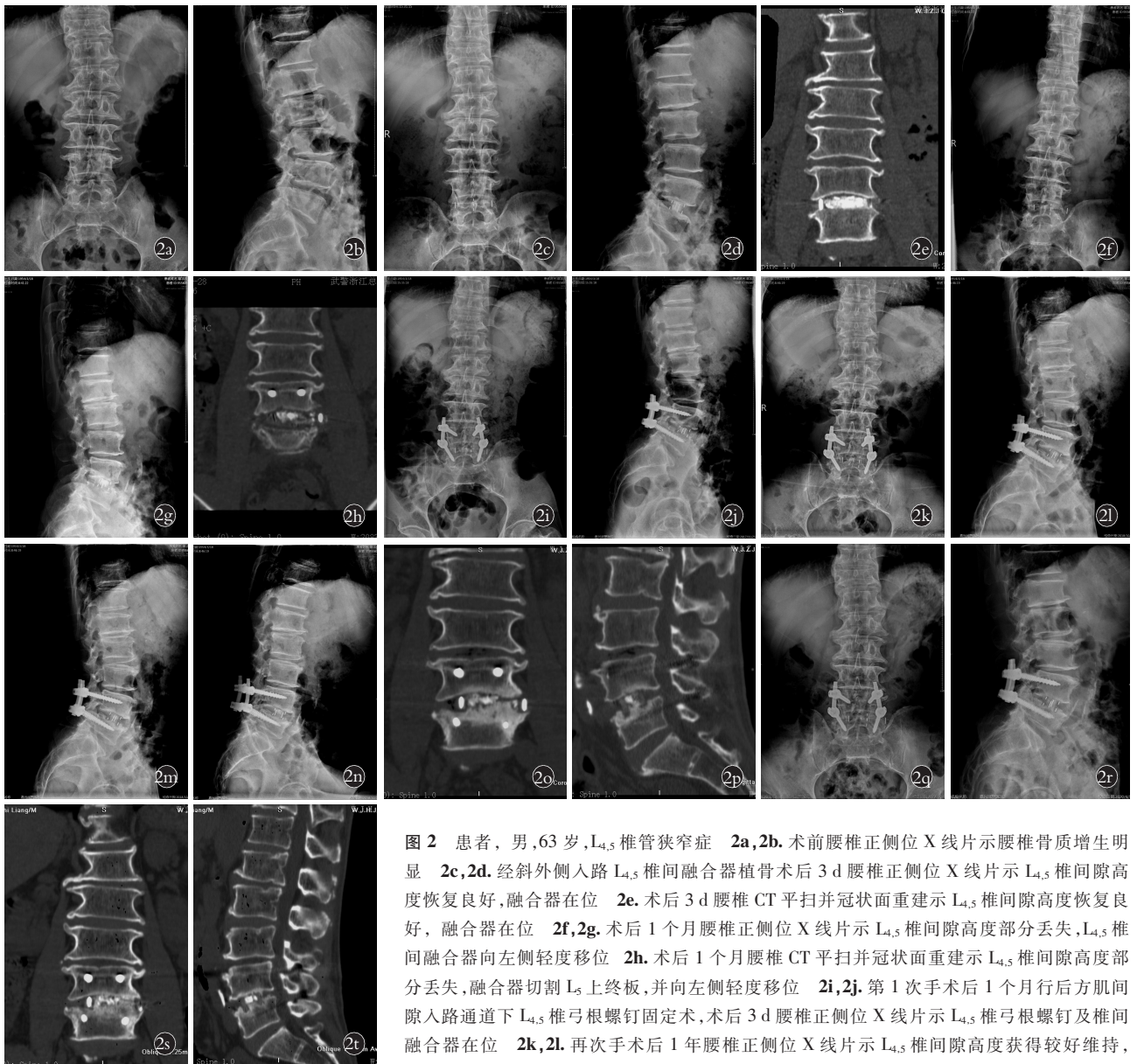


图 2 患者,男,63岁,L_{4,5}椎管狭窄症 **2a,2b**.术前腰椎正侧位X线片示腰椎骨质增生明显 **2c,2d**.经斜外侧入路L_{4,5}椎间融合器植骨术后3d腰椎正侧位X线片示L_{4,5}椎间隙高度恢复良好,融合器在位 **2e**.术后3d腰椎CT平扫并冠状面重建示L_{4,5}椎间隙高度恢复良好,融合器在位 **2f,2g**.术后1个月腰椎正侧位X线片示L_{4,5}椎间隙高度部分丢失,L_{4,5}椎间融合器向左侧轻度移位 **2h**.术后1个月腰椎CT平扫并冠状面重建示L_{4,5}椎间隙高度部分丢失,融合器切割L₅上终板,并向左侧轻度移位 **2i,2j**.第1次手术后1个月行后方肌间隙入路通道下L_{4,5}椎弓根螺钉固定术,术后3d腰椎正侧位X线片示L_{4,5}椎弓根螺钉及椎间融合器在位 **2k,2l**.再次手术后1年腰椎正侧位X线片示L_{4,5}椎间隙高度获得较好维持,L_{4,5}椎弓根螺钉及椎间融合器在位 **2m,2n**.再次手术后1年腰椎过屈过伸侧位X线片示L_{4,5}

下终板和L₅上终板角度无明显变化,L_{4,5}椎体无相对移位 **2o,2p**.再次手术后1年腰椎CT平扫并冠状面、矢状面重建示L_{4,5}椎间融合器内部分骨吸收,融合不甚良好 **2q,2r**.再次手术后30个月腰椎正侧位X线片示L_{4,5}椎间隙高度获得较好维持,L_{4,5}椎弓根螺钉及椎间融合器在位 **2s,2t**.再次手术后30个月腰椎CT平扫并冠状面、矢状面重建示L_{4,5}椎间融合良好

Fig.2 Patient,male,63 years old,L_{4,5} spinal stenosis **2a,2b**. Preoperative AP and lateral X-ray films of lumbar spine showed obvious bone hyperplasia **2c,2d**. AP and lateral X-ray films of L_{4,5} lumbar spine after oblique lateral interbody fusion at 3 days showed L_{4,5} intervertebral space height recovered well and fusion apparatus were in place **2e**. Postoperative CT scan and coronal reconstruction of lumbar spine at 3 days showed the height of L_{4,5} intervertebral spaces recovered well, and fusion apparatus was in place **2f,2g**. Postoperative AP and lateral X-ray films of lumbar spine at 1 month showed partial loss of L_{4,5} intervertebral space heights, and slight displacement of L_{4,5} intervertebral fusion apparatus to the left side **2h**. Postoperative CT scan and coronal reconstruction of lumbar spine at 1 month showed partial loss of L_{4,5} intervertebral height, the upper endplate of L₅ was cut by fusion apparatus and slightly shifted to the left side **2i,2j**. Fixation with L_{4,5} pedicle screws under posterior intermuscular space approach was performed at 1 month after the first operation, AP and lateral X-ray films of lumbar spine at 3 days after operation showed L_{4,5} pedicle screws and interbody fusion apparatus were in place **2k,2l**. AP and lateral X-ray films of lumbar spine at 1 year after reoperation showed L_{4,5} intervertebral space heights were well maintained, and L_{4,5} pedicle screws and interbody fusion apparatus were in place **2m,2n**. Lateral X-ray films of lumbar spine on hyperflexion and hyperextension position at 1 year after reoperation showed no significant changes in angle of L₄ and L₅ endplate, and no relative displacement of L₄ and L₅ vertebral bodies **2o,2p**. CT scan with coronal and sagittal reconstruction of lumbar spine at 1 year after reoperation showed bone resorption on L_{4,5} interbody fusion apparatus, and the fusion was not good **2q,2r**. AP and lateral X-ray films of lumbar spine at 30 months after reoperation showed L_{4,5} intervertebral space heights maintained well, and L_{4,5} pedicle screws and interbody fusion apparatus were in place **2s,2t**. Lumbar CT scan and coronal and sagittal reconstruction at 30 months after reoperation showed good intervertebral fusion on L_{4,5}

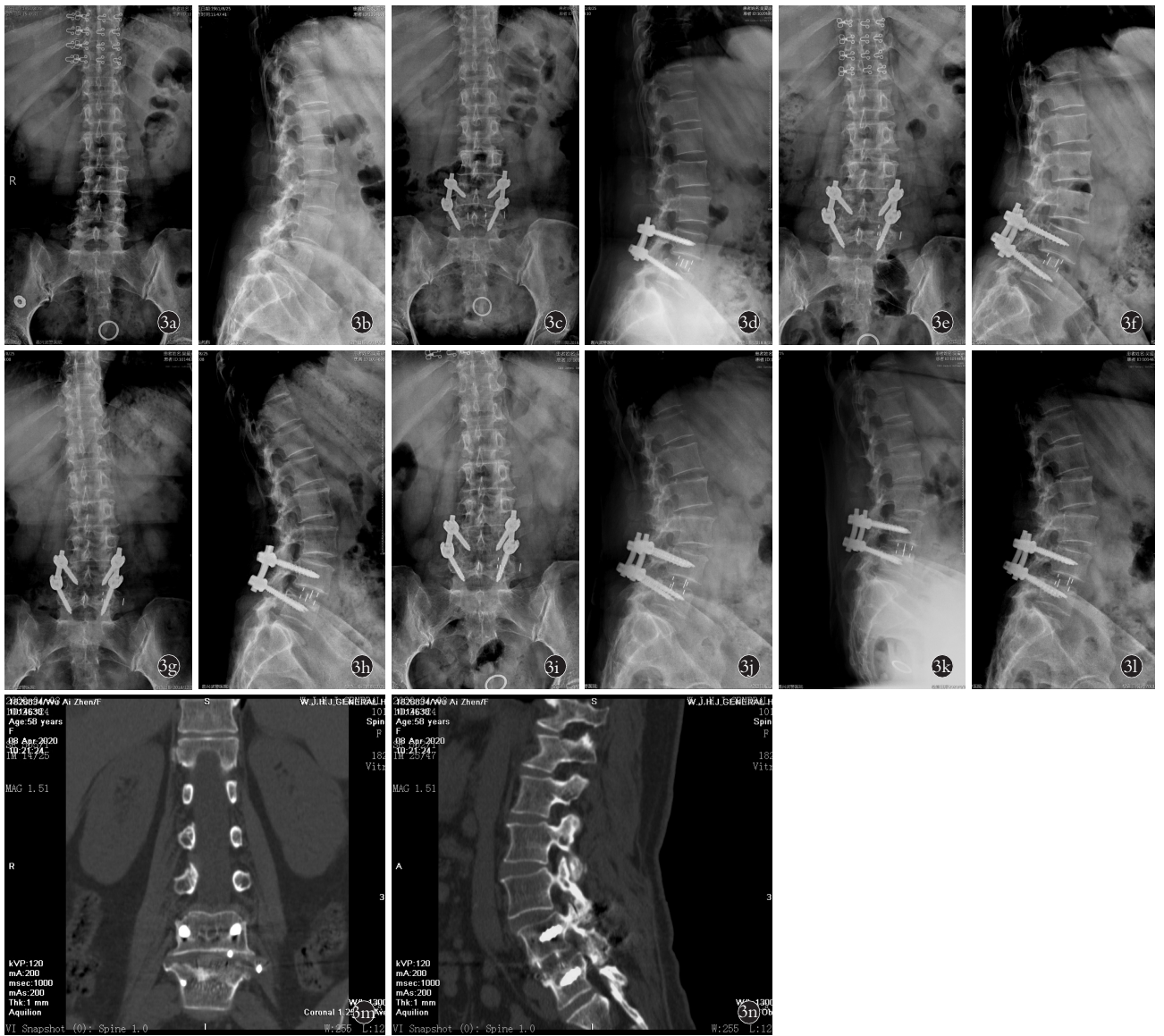


图 3 患者,女,56岁,L₄退行性滑脱症Ⅱ度 **3a,3b**.术前腰椎正侧位X线片示L₄椎体向前滑移Ⅱ度,L_{4,5}椎间隙高度下降 **3c,3d**.经斜外侧入路L_{4,5}椎间融合器植骨加后方肌间隙入路通道下双侧椎弓根螺钉固定术后3d腰椎正侧位X线片示L₄椎体复位良好,L_{4,5}椎间隙高度恢复良好,融合器未完全进入椎间隙,椎弓根螺钉在位 **3e,3f**.术后2个月腰椎正侧位X线片示L_{4,5}椎间隙高度部分丢失,融合器向左侧移位 **3g,3h**.术后4个月腰椎正侧位X线片示融合器向左侧进一步移位 **3i,3j**.术后18个月腰椎正侧位X线片示L_{4,5}椎间隙高度获得较好维持,椎间融合器无进一步移位,L_{4,5}椎弓根螺钉在位 **3k,3l**.术后18个月腰椎过屈过伸侧位X线片示L₄下终板和L₅上终板角度无明显变化,L₄、L₅椎体无相对移位 **3m,3n**.术后18个月腰椎CT平扫并冠状面、矢状面重建示L_{4,5}椎间基本融合

Fig.3 Patient, female, 56 years old, degenerative spondylolisthesis of L₄ with degree II **3a,3b**. Preoperative AP and lateral X-ray films of lumbar spine showed anterolateral slip of L₄ vertebral body with degree II and decreased height of L_{4,5} vertebral spaces **3c,3d**. After bilateral pedicle screw fixation through oblique lateral approach L_{4,5} intervertebral fusion apparatus and posterior intermuscular space approach at 3 days, AP and lateral X-ray films of lumbar spine showed good reduction of L₄ vertebra, good recovery of L_{4,5} intervertebral space heights, incomplete insertion of fusion apparatus into intervertebral space, and pedicle screws were in place **3e,3f**. AP and lateral X-ray films of lumbar spine at 2 months showed partial loss of L_{4,5} intervertebral height and left displacement of fusion apparatus **3g,3h**. Postoperative AP and lateral X-ray films of lumbar spine at 4 months showed further displacement of fusion apparatus to the left side **3i,3j**. Postoperative AP and lateral X-ray films of lumbar spine at 18 months showed L_{4,5} intervertebral space heights maintained well, the interbody fusion apparatus was not further displaced, and L_{4,5} pedicle screws were in place **3k,3l**. Postoperative AP and lateral X-ray films of lumbar spine on hyperflexion and hyperextension position at 18 months showed no significant changes in angle of L₄ and the L₅ endplate, and no relative displacement of L₄ and L₅ vertebral bodies **3m,3n**. Postoperative CT scan and coronal-sagittal reconstruction of lumbar spine at 18 months showed L_{4,5} vertebrae were basically fused

表 2 腰椎斜外侧椎间融合术后融合器移位 12 例患者发生融合器移位和末次随访时临床疗效比较

Tab.2 Comparison of clinical efficacy of 12 patients with fusion device displacement after lumbar oblique lateral interbody fusion and the final follow-up

患者序号	随访时间/月	VAS /分		ODI /%		椎间隙高度/mm	
		发生移位	末次随访	发生移位	末次随访	发生移位	末次随访
1	24	7	2	49	12	12.5	10.3
2	24	8	2	51	10	11.0	9.3
3	36	4	1	40	7	9.4	8.0
4	18	8	2	46	11	11.7	9.4
5	30	8	2	47	13	11.5	8.8
6	48	7	2	40	9	11.1	
7	12	5	1	39	8	10.3	8.5
8	24	3	0	35	5	12.7	11.8
9	18	4	1	33	7	11.8	9.8
10	24	7	1	46	9	9.0	8.0
11	12	6	2	41	10	10.4	8.7
12	36	4	1	31	6	12.3	10.6

0.69%。FUJIBAYASHI 等^[22]回顾了采用侧方椎间融合技术治疗的 1 003 例腰椎病变患者, 结果发现术后发生融合器移位 3 例, 发生率为 0.3%。KIM 等^[26]采用 OLIF 技术治疗 46 例 138 个节段融合的成人腰椎侧后凸的矫形治疗, 术后出现 1 例 1 个节段的融合器移位, 按节段数统计, 发生率为 0.73%。参与本研究的 4 家医疗中心, OLIF 术后融合器移位的总发生率为 0.78%。OLIF 术后较低的融合器移位发生率可能与其所采用的融合器的体积和面积较大有关。理论上, 融合器体积和面积越大, 与终板接触越多, 稳定性越好, 移位的风险越小。

3.1.2 OLIF 术后融合器移位的特点 本研究 12 例融合器移位有以下特点:(1)多发生于存在骨质疏松的老年患者, 年龄 53~81 岁。术前骨密度检查提示骨量减少 3 例, 骨质疏松 8 例。(2)部分病例存在术中终板损伤, 本研究 9 例患者存在。(3)融合器均为横向移位, 且大多自植入侧(左侧)退出。本研究融合器均自植入侧退出。(4)无论 Stand-alone OLIF 或 OLIF 联合椎弓螺钉固定方式均有发生, 但以前者为多。本研究 9 例 Stand-alone OLIF 和 3 例 OLIF 联合椎弓螺钉固定患者各自发生了融合器移位。(5)多发生于术后早期。本研究均发生于术后 3 个月内。(6)发生于 Stand-alone OLIF 的融合器移位均需采用手术干预。本研究 9 例采用 Stand-alone OLIF 患者进行了后路椎弓根螺钉固定, 而 3 例采用 OLIF 联合椎弓螺钉固定发生的融合器移位需根据具体情况决定,

1 例考虑为排斥反应进行了手术; 另 2 例予胸腰部支具外保护观察。

3.2 OLIF 术后融合器移位的原因

根据本研究 12 例患者发生融合器移位的发生特点, 结合文献^[16,27-30]报道, 分析 OLIF 术后融合器移位的原因有以下几点:(1)术前存在的骨量减少或骨质疏松。骨量减少或骨质疏松的存在必将降低融合节段的稳定性, 特别是采用 Stand-alone, 而且术中易出现终板损伤, 进一步影响局部的稳定性。(2)术中终板损伤。终板的损伤将会降低椎体的载荷能力, 影响融合器的稳定。(3)融合器选择过大、过小或过短。融合器过大可能难以完全植入椎间隙, 且易致终板损伤, 而融合器过小或过短, 均影响融合节段的稳定性。(4)多节段融合。从生物力学来看, 融合节段越多, 融合部位所承受的应力越大, 是融合器移位的重要影响因素。(5)采用 Stand-alone 方式。单纯 OLIF, 不联合任何内固定, 必将导致融合节段生物力学稳定性不足。

当然, OLIF 术后融合器移位的机制较为复杂, 还可能有肥胖、感染、排斥反应、外伤等因素。本研究 1 例融合器采用的是同种异体骨, 术后 3 个月内出现快速、持续的骨质吸收和融合器沉降、移位, 经充分检查后考虑为排斥反应。另外, 融合器的移位既可能是上述单一因素的作用结果, 也可能是多因素的叠加。

3.3 融合器移位的处理与预后

随访中一旦发现融合器移位, 应根据是否合并症状和移位原因采取相应的处理, 如初次手术采用的是 Stand-alone 方法, 且合并临床症状, 建议附加后方椎弓根螺钉固定; 如初次手术采用的是 OLIF 联合后方椎弓根螺钉固定, 可暂予腰部制动、胸腰支具保护等措施, 并严密观察。如果同时存在顽固性腰痛, 且影像检查提示内固定有松动迹象, 建议进行内固定翻修; 如存在融合器选用过小、融合器移位进展较快、融合器大部分位于椎间隙外、融合器移位压迫重要组织结构、融合器移位伴椎体骨缺损等情况, 则需进行椎间处理或融合器的翻修。当然, 融合器的翻修方法要根据初次手术时有无联合内固定、融合器移位的方向和程度、终板和椎体有无损伤或骨缺损、内固定有无松动等情况个体化施策。如终板或椎体完整, 可更换大号融合器; 否则, 需放弃使用融合器, 改行结构性植骨。本研究初次采用 Stand-alone 方法治疗的 9 例均加用椎弓根螺钉固定; 初次已联合椎弓根螺钉固定的 2 例予胸腰支具保护, 加强腰部制动; 另 1 例考虑为排斥反应者, 予椎间融合器和椎弓根螺钉翻修。术后随访未发现融合器进一步移位及

内固定无松动。11 例获得明确的椎间融合。

3.4 融合器移位的预防

OLIF 技术术后存在融合器移位的风险,特别是采用 Stand-alone 方法,风险相对较大^[16,23,31],而且融合器移位可能影响融合,导致手术失败。因此,需要加强预防。建议:(1)充分把握 OLIF 技术的设计特点和使用原则,术前严格的病例选择。(2)术中细致规范操作,做好终板保护,一旦发现终板损伤或椎体骨折,必要时改变植骨方式,同时加用椎弓根螺钉固定。(3)合适大小融合器的应用,包括融合器的高度和长度,融合器高度的确定以所用椎间撑开器进行椎间撑开时松紧适宜,或所用融合器试模需要一定的力量敲入,或融合器试模需要一定的力量拔出为宜。而所用融合器长度的确定,按照融合器要架在两椎体之间,而不是含在上下终板之内的原则,即要求融合器边缘尽量平齐椎体两侧。(4)选择合适的 OLIF 应用方式,严格 Stand-alone 方式的应用,对于存在骨量减少或骨质疏松、肥胖、椎间明显不稳(如退行性滑脱 II 度或以上,或存在腰椎弓峡部裂)、2 节段以上融合、术中发生终板损伤等,不建议采用 Stand-alone OLIF 方式。(5)术后必要的制动或胸腰部可靠的外保护,如术后判断融合部位稳定性不足,可适当延长卧床时间,或佩戴胸腰支具保护下床活动。(6)系统指导康复训练,严格定期随访,严密的影像学检查。

3.5 本研究的局限性

由于病例资料来自 4 家医疗中心,每家医疗中心初次手术病例选择标准、再手术适应证把握和处理方式可能存在差异,势必影响病例的同质性和可比性;而且病例数较少,可能对于融合器移位的分析有失偏颇。另外,未对融合器移位的危险因素进行统计学处理。

综上所述,OLIF 用于腰椎病变的融合存在融合器移位的风险,特别是采用 Stand-alone 方式。OLIF 术后融合器移位特点明显,如发现及时,处理得当,仍可获得良好的临床结果。由于融合器移位多需要再次手术,要加强预防,以减少或避免融合器移位的发生,提高 OLIF 的治疗效果。

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