

全内镜大通道单侧入路双侧减压治疗老年单节段腰椎管狭窄症的早期疗效

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【摘要】目的:评估脊柱全内镜大通道下单侧入路双侧减压(unilateral laminotomy for bilateral decompression, ULBD)治疗老年单节段腰椎管狭窄症的早期临床效果。**方法:**回顾性分析我院 2018 年 7 月~2020 年 7 月采用全内镜大通道下 ULBD 治疗的 37 例单节段腰椎管狭窄症患者。其中男 17 例,女 20 例;年龄 60~78 岁(66.8 ± 4.9 岁);手术节段:L3-4 7 例,L4-5 20 例,L5-S1 10 例。收集患者手术资料及术中并发症情况。术前及术后 1 周、3 个月、1 年采用疼痛视觉模拟评分(visual analog scale,VAS)评价腰腿痛,Oswestry 功能障碍指数(Oswestry disability index,ODI)评价下肢功能。术后 1 年采用 MacNab 标准对临床疗效进行评价。**结果:**所有患者手术顺利,手术时间 $75 \sim 155 \text{min}$ ($113.7 \pm 19.4 \text{min}$),术中出血量 $10 \sim 50 \text{ml}$ ($26.5 \pm 9.4 \text{ml}$),住院天数 $5 \sim 7 \text{d}$ ($5.5 \pm 0.7 \text{d}$)。术中发生 1 例硬膜囊撕裂,行胶原蛋白海绵封闭后严格卧床休息 1 周,患者未出现明显临床症状,伤口愈合良好。术前、术后 1 周、3 个月、1 年的腰痛 VAS 评分分别为 5.4 ± 0.5 分、 2.4 ± 0.6 分、 1.0 ± 0.5 分、 0.4 ± 0.5 分,腿痛 VAS 评分分别为 7.3 ± 0.5 分、 2.7 ± 0.5 分、 1.3 ± 0.5 分、 0.7 ± 0.6 分,ODI 分别为 $(78.6 \pm 2.3)\%$ 、 $(26.0 \pm 4.1)\%$ 、 $(17.4 \pm 2.2)\%$ 、 $(10.7 \pm 2.0)\%$ 。术后各时间点腰腿痛 VAS 评分、ODI 均较术前显著改善,差异具有统计学意义($P < 0.001$)。术后各时间点间两两比较差异均有统计学意义($P < 0.001$)。术后 1 年 MacNab 标准优 21 例,良 13 例,可 3 例,优良率 91.89%。**结论:**脊柱全内镜大通道下 ULBD 治疗老年单节段腰椎管狭窄症的早期临床效果较好,但远期疗效需进一步随访。

【关键词】腰椎管狭窄症;脊柱全内镜;单侧入路双侧减压;老年

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【Abstract】 Objectives: To investigate the early outcomes of unilateral laminectomy for bilateral decompression(ULBD) under full endoscopic with large portal for single-segment lumbar spinal stenosis in the elderly. **Methods:** 37 patients with single-segment lumbar spinal stenosis treated via ULBD under full endoscopic with large portal from July 2018 to July 2020 in our hospital were retrospectively analyzed. There were 17 males and 20 females, averaged 66.8 ± 4.9 (60-78) years. 7 cases were operated at L3-4, 20 cases at L4-5, and 10 cases at L5-S1. Data of patients and intraoperative complications were collected. The pain visual analog scale(VAS) was used to evaluate the low back pain and leg pain, and the Oswestry disability index(ODI) was used to evaluate the lumbar function recorded before operation, at 1 week, 3 months, and 1 year after operation. One year after operation, the clinical curative effect was evaluated by MacNab standard. **Results:** Of all the patients, the average operative time was $113.7 \pm 19.4 \text{min}$ ($75 \sim 155 \text{min}$), intraoperative blood loss was $26.5 \pm 9.4 \text{ml}$ ($10 \sim 50 \text{ml}$), and the length of hospitalization was 5.5 ± 0.7 days ($5 \sim 7$ days). 1 case of dural sac tear occurred during operation, and the patient was strictly bedridden for one week after collagen sponge closure.

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The patient did not show any obvious clinical symptoms, and the wound healed well. The preoperative, one week, three months and one year postoperative VAS scores for low back pain were 5.4 ± 0.5 , 2.4 ± 0.6 , 1.0 ± 0.5 and 0.4 ± 0.5 , respectively, and the VAS scores for leg pain were 7.3 ± 0.5 , 2.7 ± 0.5 , 1.3 ± 0.5 and 0.7 ± 0.6 , respectively, and the ODI were $(78.6 \pm 2.3)\%$, $(26.0 \pm 4.1)\%$, $(17.4 \pm 2.2)\%$, and $(10.7 \pm 2.0)\%$, respectively. The VAS score of low back pain and leg pain and ODI score at each time point after operation were significantly improved when compared with those before operation ($P < 0.001$), and the values at each time point after operation were significantly different when compared pairwise ($P < 0.001$). The clinical efficacy was evaluated 1 year after surgery using MacNab criteria, and 21 cases were classified as excellent, 13 cases as good, 3 cases as acceptable and 0 cases as poor, with an excellent rate of 91.89%. **Conclusions:** The early outcomes of ULBD under full endoscopic with large portal for single-segment lumbar spinal stenosis in the elderly are good, but further follow-up is required for long-term outcomes.

[Key words] Lumbar spinal stenosis; Full endoscopic; Unilateral approach; Bilateral decompression; Elderly

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随着全球老年人口的增加, 腰椎退行性疾病尤其是腰椎管狭窄症的发病率明显增加^[1]。老年腰椎管狭窄症通常是由于椎间盘突出、黄韧带肥厚、小关节增生等导致腰椎管狭窄, 致使硬膜囊及神经根受压, 从而引起腰腿痛和间歇性跛行^[2,3]。经过严格保守治疗无效的患者需要手术治疗^[4]。传统的全椎板切除术由于对脊柱后方结构造成损害, 术后并发症较多: 如过多地剥离椎旁肌导致的术后腰背肌综合征; 过度破坏脊柱后方的骨、韧带及肌肉导致脊柱失稳等^[5,6]。随着内镜技术的发展, 在内镜辅助下进行腰椎管狭窄双侧减压技术, 逐渐开始在临床上推广应用^[7]。本研究旨在探讨全内镜大通道下单侧入路双侧减压 (unilateral laminotomy for bilateral decompression, ULBD) 治疗老年单节段腰椎管狭窄症的早期临床效果。

1 资料与方法

1.1 纳入及排除标准

病例纳入标准: (1) 患者年龄 ≥ 60 岁; (2) 患者双侧下肢神经根症状或神经源性间歇性跛行; (3) 影像学证实单节段腰椎管狭窄; (4) 保守治疗 3 个月以上无效; (5) 采用全内镜大通道下 ULBD 治疗。排除标准: (1) 腰椎管狭窄伴有峡部滑脱或屈曲/伸展位动态不稳; (2) 伴脊柱肿瘤或感染; (3) 既往有脊柱手术史。

1.2 一般资料

2018 年 7 月~2020 年 7 月我院采用全内镜大通道下 ULBD 治疗老年单节段腰椎管狭窄症患者 37 例, 其中男 17 例, 女 20 例, 年龄 60~78 岁 (66.8 ± 4.9 岁)。手术节段: L3-4 7 例, L4-5 20

例, L5-S1 10 例。

1.3 手术方法

采取全身麻醉, 患者取俯卧位。用 C 型臂 X 线机透视确定责任椎板间隙, 穿刺点定位于上椎板下缘和同侧小关节内侧缘交汇处, 在体表投影处标记穿刺点。沿体表标记将一根 18G 腰椎穿刺针平行椎间隙刺入椎旁肌, C 型臂 X 线机透视明确穿刺针位置正确, 穿刺至责任节段的上椎板下缘和同侧小关节内侧缘交汇处。以穿刺点为中心做一个 8mm 的横行皮肤切口, 加深切口穿透筋膜层, 置入导丝后拔出穿刺针, 逐级放入导杆, 最后螺旋拧入大通道 (图 1a)。再次 C 型臂 X 线机透视确认通道位置正确。

内镜下操作: 首先, 在内镜下辨认上位椎体的椎板下缘和下位椎体的椎板上缘, 并使用内镜下动力磨钻进行同侧椎板骨性减压 (图 1b), 减压顺序为先处理上位椎体的椎板下缘后处理下位椎体的椎板上缘; 先处理内侧椎板, 后处理外侧椎板。根据实际情况决定关节突的切除范围。同侧骨性减压完成后, 用椎板咬骨钳和篮钳切除黄韧带, 用髓核钳取出切除的黄韧带和骨块。内镜下可见硬脊膜外侧缘和行走根受压完全解除 (图 1c), 完成同侧减压。将内镜大通道后退至硬脊膜背侧, 调整大通道与水平面约呈 45° , 通道尖端指向对侧关节突。用动力磨钻切除部分棘突基底, 创造出足够的空间允许大通道潜行到对侧进行减压。与同侧减压一样进行对侧的骨性减压, 必要时切除部分关节突, 在骨性减压完成前尽可能地保留黄韧带, 以防止硬脊膜损伤。切除对侧黄韧带后, 内镜下可见硬脊膜和双侧行走根受压完全解除 (图

1d、e)。最后,镜下再次检查确认受压硬脊膜和神经根减压充分,射频电凝止血,缝合切口前用吸引器吸出通道内生理盐水,根据术中情况决定是否放置引流。

1.4 术后处理

患者术前、术后各使用 1 次抗生素预防感染,术后均常规应用减轻神经水肿及营养神经药物。术后卧床 2~3d 后可腰围保护下下床活动。所有患者术后第 2 天均开始行直腿抬高训练。术后定期复查腰椎 CT、MRI。术后 1 个月内以卧床为主,床上行腰背肌锻炼,术后 3 个月内避免弯腰、负重等剧烈活动。

1.5 临床疗效评价指标

记录手术时间、术中出血量、术后住院时间、手术相关并发症发生情况。采用疼痛视觉模拟评分 (visual analogue scale, VAS) 评价腰腿痛, Oswestry 功能障碍指数 (Oswestry disability index, ODI) 评价腰部功能,术后 1 年采用 MacNab 标准对临床疗效进行评价。

1.6 统计学方法

使用 SPSS 26.0 统计软件进行分析,计量资料先做正态分布检验,符合正态分布的计量资料采用均数±标准差表示;组内各时间点间比较采用重复测量方差分析;计数资料比较采用 χ^2 检验;检验水准 $\alpha=0.05$ 。

2 结果

手术时间 75~155min (113.7±19.4min), 术中出血量 10~50ml (26.5±9.4ml), 术后住院天数 5~7d (5.5±0.7d)。患者均顺利完成手术, 术中发生 1 例硬膜囊撕裂, 余患者未出现重要血管及神经的损伤。影像学复查示椎管减压充分 (图 2)。术后各时间点腰腿痛 VAS 评分、ODI 均较术前显著改善, 差异具有统计学意义 ($P<0.001$), 术后随时间推移各指标均显著改善, 各时间点间两两比较差异均有统计学意义 ($P<0.001$, 表 1)。术后 1 年采用 MacNab 标准评价临床疗效, 获优 21 例, 良 13 例, 可 3 例, 优良率 91.89%。

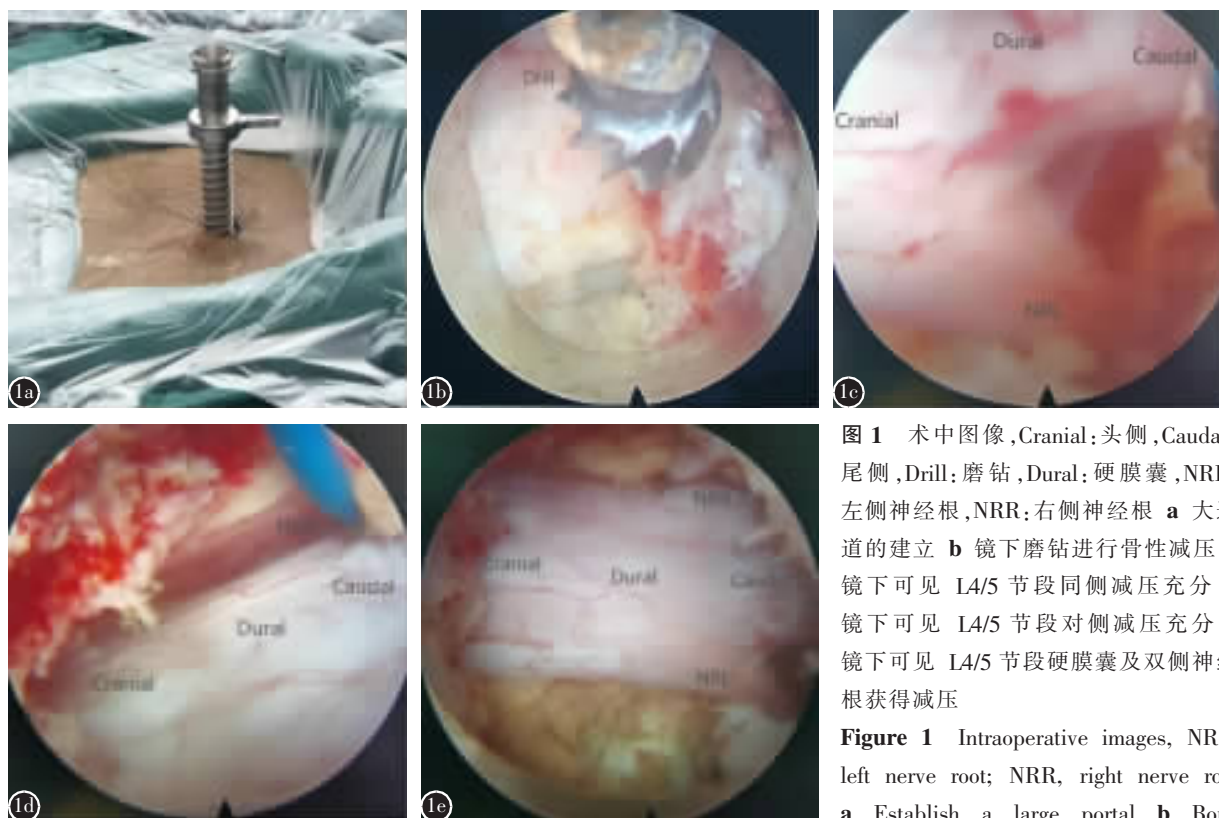


图 1 术中图像, Cranial: 头侧, Caudal: 尾侧, Drill: 磨钻, Dural: 硬膜囊, NRL: 左侧神经根, NRR: 右侧神经根 a 大通道的建立 b 镜下磨钻进行骨性减压 c 镜下可见 L4/5 节段同侧减压充分 d 镜下可见 L4/5 节段对侧减压充分 e 镜下可见 L4/5 节段硬膜囊及双侧神经根获得减压

Figure 1 Intraoperative images, NRL, left nerve root; NRR, right nerve root a Establish a large portal b Bone decompression by grinding drill under

endoscopy c Endoscopic visualization of the L4/5 segment with adequate ipsilateral decompression d Endoscopic visualization of the L4/5 segment with adequate contralateral decompression e The dural sac and bilateral nerve root of L4/5 segment were decompressed endoscopically

3 讨论

当腰椎管狭窄症患者存在双侧下肢症状时,往往需要行双侧减压。经典的全椎板切除术通过切除双侧椎板达到减压目的,但由于椎体后方结构遭到破坏,术中出血量大,容易造成术后硬膜外血肿及腰背肌综合征并发症^[5,6]。所以在充分减压的基础上,尽可能减少切除范围对于手术非常重要^[8]。单侧入路双侧减压术最早由 Joson 等于 1987 年报道^[9]。Young 等^[10]在 1988 年首次提出在显微镜辅助下实施单侧入路双侧减压术,Weiner 等^[11]在 1999 年提出显微内镜下的单侧入路双侧减压。随着显微内镜的发展,显微内镜下的单侧入路双侧减压已逐渐成为一种出血少、疼痛轻、活动早、住院时间短的常见手术方式^[12,13]。

自 Kambin 运用关节镜行椎间盘切除术以来,脊柱内镜得到迅猛的发展^[14]。Choi 等^[15]于 2006 年介绍了内镜下椎板间入路技术。Komp 等^[16]在 2015 年对 135 例腰椎中央管狭窄症的患者进行了 2 年的随访,通过比较采用椎板间入路的全内镜技术与传统显微外科技术治疗退行性腰椎中心

性狭窄的结果,发现以临床症状重或双侧症状相同时狭窄严重的同侧为手术入路的全内镜下 ULBD 相对于传统显微内镜下双侧椎板开窗减压具有手术并发症较低、术后翻修率较少及较低的后康复花费。Kim 等^[17,18]在 2017 年介绍了全内镜下单侧入路双侧腰椎管狭窄减压术,术中使用相对较大的 Delta 通道进行中央管减压,而常规较小的通道行侧隐窝和椎间孔的减压,同时术中采用临床症状重或双侧症状相同时狭窄严重的对侧入路减压,并证实该技术可获得彻底减压,早期临床效果较好,优良率 96%,围手术期并发症较少。2019 年, Ito 等^[19]介绍了全内镜下单侧入路双侧腰椎管狭窄减压,证实以临床症状重或双侧症状相同时狭窄严重的对侧为手术入路时,早期临床效果较好,优良率 85.9%;该技术可以保留椎旁肌和椎板、椎弓根、棘突、棘间韧带和小关节等椎体后部结构,作为一种实用的腰椎管狭窄减压技术,是一种相对简单、安全的方法。

2020 年, Kim 等介绍了减压顺序为“outside-in”的全内镜下单侧入路双侧腰椎管狭

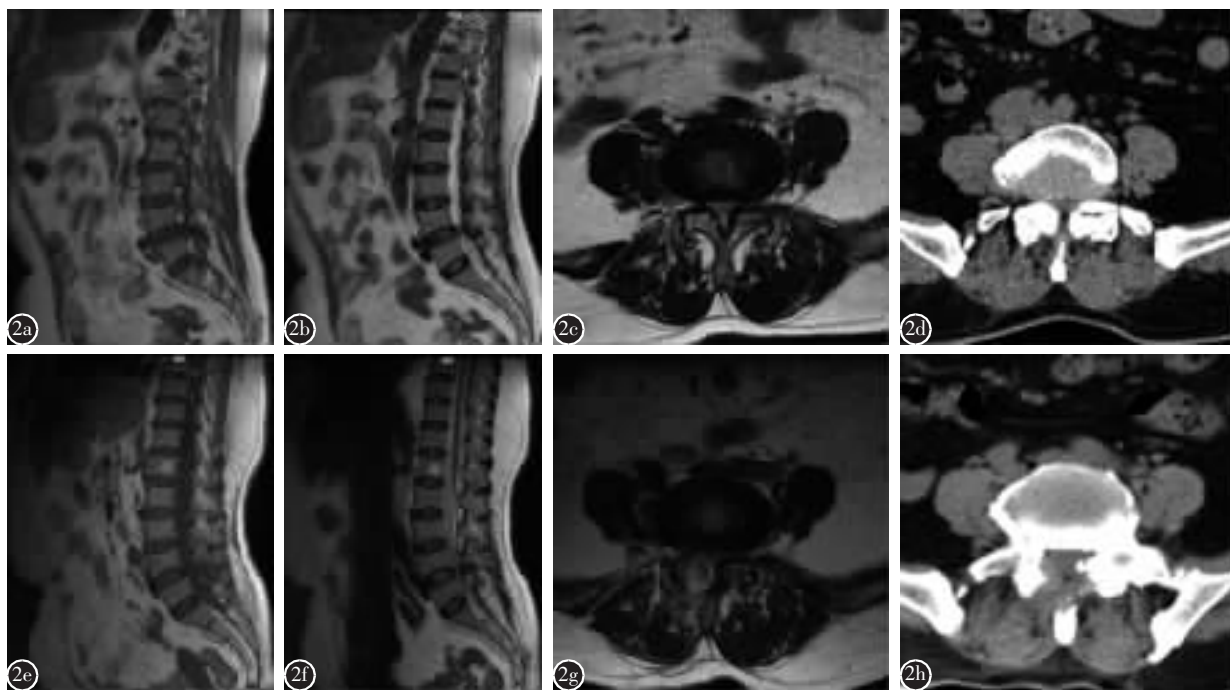


图2 患者女,60岁 a~c 术前MRI示L4-5双侧黄韧带增厚,腰椎管狭窄 d 术前CT示L4-5椎管狭窄 e~g 术后1周MRI示L4-5硬膜囊及双侧神经根压迫解除 h 术后1周CT示L4-5双侧椎板部分切除,椎管减压充分

Figure 2 A female patient, 60 years old a~c Preoperative MRI showed L4-5 bilateral thickening of ligamentum flavum and lumbar spinal stenosis d Preoperative CT showed L4-5 spinal stenosis e~g 1-week postoperatively MRI showed L4-5 dural sac and bilateral nerve root compression relieved h 1-week postoperatively CT showed L4-5 bilateral side portion laminectomy and adequate spinal channel decompression

窄减压术,对 92 例接受全内镜手术治疗的患者进行了平均 16.8 个月的随访,结果显示减压顺序为“outside-in”的全内镜下 ULBD 早期临床效果较好,优良率 97.6%,是一种安全有效的治疗椎管狭窄症的方法^[20]。Lim 等^[21]介绍了减压顺序为“inside-out”的全内镜下单侧入路双侧椎管狭窄减压术,对 127 例接受全内镜手术治疗的患者进行了 1 年的随访,早期临床结果显示减压顺序为“inside-out”的全内镜下 ULBD 是实施椎管狭窄症减压安全、有效、重复性好的方法。

显微镜下和全内镜下 ULBD 治疗腰椎管狭窄症均取得良好的临床效果。与显微镜下 ULBD 对比,全内镜下 ULBD 具有切口小、恢复快等优点,在预防术后节段不稳定和减少术后疼痛方面是一种更好的手术方式^[22,23]。

全内镜下 ULBD 治疗腰椎管狭窄症,通道上可以分为大通道和常规口径通道,减压入路上可以分为临床症状重或双侧症状相同时狭窄严重的同侧或对侧入路,减压顺序上可以分为“outside-in”和“inside-out”。本研究使用同侧入路全内镜大通道下 ULBD,减压顺序为“outside-in”的手术方式治疗 37 例老年单节段腰椎管狭窄症的患者均有双下肢症状,手术时间短,术中出血少,术后疼痛明显缓解,住院时间短,生活质量得到提高,早期临床效果优良率 91.89%,与对侧入

路的临床效果并无明显差异。

同侧入路的优势:(1)在尝试全内镜下 ULBD 之前,脊柱外科医生在进行腰椎椎板间入路减压时往往习惯以症状侧为入路。同侧入路下的全内镜下 ULBD 相对为更加熟悉的解剖路径。(2)在使用椎板咬骨钳进行椎板切除时,同侧减压操作更加方便,减压范围更大。(3)相对于对侧入路,同侧入路在侧隐窝及椎间孔狭窄的减压更具有优势。(4)合并椎间盘突出时,同侧行椎间盘摘除时,通过旋转外套管鸭舌状的尖端保护硬膜囊和神经根。与对侧入路相比,同侧入路旋转外套管时对硬膜囊及神经根的牵拉要小。(5)在暴露黄韧带深层时,尤其是黄韧带在上椎板的附着点较深,需对上椎板大量切除才能彻底暴露,同侧入路对于上椎板的切除会比对侧入路更加充分,降低了因黄韧带的残留导致减压不充分,术后复发的几率。(6)当腰椎侧隐窝和椎间孔狭窄时,对侧入路减压困难;同时由于减压时除了切除椎板还要切除部分关节突,此时对侧入路的对关节突保留的优势并未体现。

大通道的优势:(1)大通道外螺纹状结构相对于普通通道把持力更好,术中因套管滑移误伤硬膜囊及神经根的几率更小。(2)相对普通通道,大通道视野更广,操着空间更大,手术操作更加方便,手术时间也相应缩短。(3)理论上,通道越大,在对侧减压时,需要切除的棘突基底部越多,操作更加受限制,所以我们以临床症状重或双侧症状相同时狭窄严重的侧为手术入路。正因为对侧症状轻,狭窄程度不重,对减压要求不高,手术相对难度也减低,手术时间也缩短。最后,outside-in 相对于 inside-out 优势在于完成骨性减压后再进行黄韧带切除,降低了损伤硬膜囊及神经根的风险;但是 outside-in 同时存在有过度切除关节突的可能^[20]。

虽然该手术方式早期临床效果较好,但同样存在术中损伤硬膜囊及神经根的风险。本研究中出现 1 例术中硬膜囊损伤,主要因为对侧减压时解剖深层黄韧带时误伤到与黄韧带深层粘连的硬膜囊,由于术中发现硬膜囊撕裂及时,且硬膜囊破口较小,行胶原蛋白海绵封闭后患者严格卧床休息 1 周,患者未出现明显临床症状,伤口愈合良好,术后 1 个月复查未见明显异常。为了尽量减少术中并发症的发生,除了术前仔细的询问病史、查

表 1 患者各时间点腰腿痛 VAS 评分及 ODI

($n=37, \bar{x} \pm s$)

Table 1 Clinical scores of patients at different time points before and after operation

	腰痛 VAS(分) VAS for low back pain	腿痛 VAS(分) VAS for leg pain	ODI(%)
术前 Preoperatively	5.4±0.5	7.3±0.5	78.6±2.3
术后 1 周 1-week postoperatively	2.4±0.6 ^①	2.7±0.5 ^①	26.0±4.1 ^①
术后 3 个月 3-month postoperatively	1.0±0.5 ^{①②}	1.3±0.5 ^{①②}	17.4±2.2 ^{①②}
术后 1 年 1-year postoperatively	0.4±0.5 ^{①②③}	0.7±0.6 ^{①②③}	10.7±2.0 ^{①②③}

注:①与术前比较 $P<0.001$;②与术后 1 周比较 $P<0.001$;③与术后 3 个月比较 $P<0.001$

Note: ①Compared with preoperative value, $P<0.001$; ②Compared with postoperative value at 1 week, $P<0.001$; ③Compared with postoperative value at 3 months, $P<0.001$

体、影像学评估、详细的术前规划外,我们强调术中应注意:(1)椎板减压时上椎板的骨性切除应充分,Ito 等^[18]证实黄韧带的深层起点大部分附着在上椎板下缘,而黄韧带的尾端仅有少部分附着在下椎板上缘。(2)单侧关节突内侧切除超过 50% 或双侧关节突内侧切除超过 1/3 时会出现腰椎节段失稳可能;对于因病情需扩大切除范围时应当考虑增加内固定维持脊柱稳定性^[24,25]。(3)在骨性减压完成前建议保留黄韧带深层,这样可以保护黄韧带下方的硬膜囊及神经根,避免骨性减压时损伤。(4)理论上大的通道在倾斜到对侧减压时,需要更多的棘突基底及椎板切除来创建通道的空间,所以大通道在对侧减压时会受到一定限制。

本研究存在一些不足。第一,患者数量少,随访时间相对较短。第二,未设对照组,对内镜下 ULBD 的临床结果对比可能更有价值。第三,本研究仅研究单节段狭窄的患者,结果可能与多节段狭窄的结果有所差异。

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