·技术创新·

退行性脊柱侧弯椎管狭窄单侧双通道内镜减压椎间融合术△

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摘要：［**目的**］介绍单侧双通道内镜减压椎间融合术（unilateral biportal endoscopic lumbar interbody fusion, UBE-LIF）治疗退行性脊柱侧弯合并椎管狭窄症的手术技术和初步临床效果。［**方法**］对 1 例退行性脊柱侧弯合并椎管狭窄症的患者行上述治疗。根据术前临床表现和影像资料，确定手术节段，C 形臂 X 线机透视确定手术入路及解剖标志体表投影。透视下行椎弓根穿刺并置入导丝，上下两个通道分别置入内镜和手术器械，显露并去除上位椎体椎板下缘及下关节突、下位椎体上关节突尖部及内缘，切除肥厚的黄韧带，显露出口根和行走根，分离粘连组织，切除椎间盘并处理椎间隙，椎间植骨，置入融合器。同法处理其他节段。所有节段处理完毕后，沿导丝拧入椎弓根螺钉，固定连接棒。［**结果**］本例患者顺利完成手术，手术时间约 280 min，术中出血量约 180 mL。切口一期愈合。术后 3 d 下床活动。随访时间 6 个月，VAS 评分术前腰部 5 分、下肢 6 分，末次随访时均为 1 分；ODI 指数术前 51.1%，末次随访时 13.3%；JOA 评分术前 13 分，末次随访时 23 分。末次随访无症状复发。［**结论**］UBE-LIF 微创技术可以明显改善退行性脊柱侧弯合并椎管狭窄症患者的临床症状，矫正脊柱侧弯，恢复脊柱稳定性，促进术后快速恢复。

关键词：退行性脊柱侧弯，椎管狭窄，微创手术，单侧双通道内镜，减压融合术

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Abstract: [**Objective**] To introduce the surgical technique and preliminary clinical outcome of unilateral biportal endoscopic lumbar interbody fusion (UBE LIF) in the treatment of degenerative scoliosis complicated with spinal stenosis. [**Methods**] A patient received above-said surgical treatment for degenerative scoliosis complicated with spinal stenosis. According to the preoperative clinical menifestation and imaging data, the surgicall segments was determined. The surgical approach and body surface anatomical marks was identified by C-arm fluoroscopy, guide pins were placed under fluoroscopy. Working portals were made over the guide pins, and endoscope and surgical instruments were placed through the upper and lower channels, respectively, to expose and remove the lower edge of the upper vertebral lamina, the tip of upper facet and inner edge of the facet of the lower vertebra. Subsequently, the hypertrophic ligamentum flavum was removed, the outlet root and walking root were exposed, the adhesive tissue was separated, the intervertebral disc was removed. After the intervertebral space was treated, and fusion cage with bone autograft was placed into the space. The other segments were treated in the same manner. After all segments were treated, pedicle screws were inserted along the guide wire, and then fixed with the connecting rods. [**Results**] The patient successfully completed the operation with operation time of 280 min, the intraoperative blood loss of 180 mL. The patient had incision healed well, got out of bed 3 days after surgery, and followed up for 6 months. The VAS score significantly improved from 5 (low back pain) and 6 (leg pain) preoperatively to 1 at the last follow-up, additionally, the ODI improved from 51.1 to 13.3, and JOA score was from 13 to 23 correspondingly. The patient had no symptoms recurred until the last follow-up. [**Conclusion**] The UBE-LIF is a minimally invasive technique, and does significantly improve the clinical symptoms of degenerative scoliosis complicated with spinal stenosis, correct scoliosis, restore spinal stability, and promote rapid recovery after surgery.

Key words: degenerative scoliosis, spinal stenosis, minimally invasive surgery, unilateral biportal endoscopy decompression and instrumented fusion

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退行性脊柱侧弯（degenerative scoliosis, DS）是指因脊柱退行性变而导致脊柱冠状面上 Cobb 角>10°的侧弯畸形，其发病率随人口老龄化逐渐升高[1]。老年退变性脊柱侧弯常合并不同程度的腰椎管狭窄症（lumbar spinal stenosis, LS），主要表现为腰部疼痛、下肢放射痛、间歇性跛行、活动受限等临床症状，在保守治疗不能有效缓解症状时，手术治疗成为必要的选择[2,3]。目前临床上对于退行性脊柱侧弯合并椎管狭窄症的治疗以开放内固定手术为主，后路椎管减压植骨融合内固定术是经典手术方式，但其创伤大、失血量多、术后恢复缓慢等缺点不容忽视[4,5]。近年来，单侧双通道内镜技术发展迅速，单侧双通道内镜减压椎间融合术（unilateral biportal endoscopic lumbar interbody fusion, UBE-LIF）结合了开放和内镜的特点，具有视野清楚、操作灵活、创伤小、恢复快等优点，在腰椎间盘突出症、腰椎管狭窄症、退行性滑脱等多种脊柱疾病中广泛应用，取得良好的临床疗效[6,7]。但现有研究中使用 UBE-LIF 治疗退行性脊柱侧弯合并椎管狭窄症报道较少，本院应用该术式治疗 1 例退行性脊柱侧弯合并椎管狭窄症的患者，取得良好的临床疗效，现将手术技术及初步临床结果报道如下，以期为临床治疗提供参考和借鉴。

1 手术技术

1.1 术前准备

术前根据患者的症状及体征，结合 X 线片、CT 重建及 MRI，明确病变节段神经、椎体及周围软组织解剖关系并测量脊柱侧弯的角度（图 1a, 1b），确定工作通道及椎弓根螺钉的置入位置、角度，完善相关检查，排除手术及麻醉禁忌证。

1.2 麻醉与体位

行气管插管全身麻醉，麻醉成功后常规导尿，取俯卧位。C 形臂 X 线机透视定位并标记手术节段椎弓根、后正中线及椎间隙体表投影位置，于左侧椎弓根 11 点钟和右侧椎弓根 1 点钟，分别向外侧旁开 1.5~2 cm 标记切口。

1.3 手术操作

常规消毒铺巾，以切口为中心铺单呈“U”形，行横切口约 1 cm，透视下行 L_{2-5} 两侧椎弓根穿刺（图 1c），穿刺成功后插入 8 枚导丝（图 1d）。$L_{4/5}$ 节段：于 $L_{4/5}$ 椎间隙左侧（症状较重侧）切口切至深筋膜，钝性分离棘突及椎板表面的肌肉组织，建立上方观察通道和下方操作通道。观察通道置入 30°脊柱内镜，操作通道置入等离子射频刀头，以棘突与椎板交界处为中心分离软组织，克氏针透视定位确定位置（图 1d）。显露并清理 L_4 左侧椎板下缘、$L_{4/5}$ 左侧关节突关节、L_5 左侧椎板上缘，使用骨刀和椎板咬骨钳去除 L_4 左侧椎板下缘、L_4 左侧下关节突关节和 L_5 左侧上关节突尖部及内缘骨质，收集自体骨备用，探查见黄韧带肥厚、腰椎间盘突出、侧隐窝狭窄，椎板咬骨钳去除肥厚增生的黄韧带，神经剥离子松解粘连，显露神经根、硬膜囊，在出口根（L_4）和行走根（L_5）之间用尖刀切开后纵韧带及纤维环，髓核钳去除椎间髓核组织，绞刀处理椎间隙，刮除软骨终板，显露软骨下骨（图 1e），将足量自体和异体混合碎骨植入 $L_{4/5}$ 椎间隙并压实，将 1 枚预填自体碎骨的椎间融合器置入 $L_{4/5}$ 椎间隙（图 1f），透视见位置良好。$L_{3/4}$ 节段：显露方式同 $L_{4/5}$，探查见黄韧带肥厚、腰椎间盘突出、侧隐窝狭窄，处理方式同 $L_{4/5}$。$L_{2/3}$ 节段：显露方式同 $L_{4/5}$，显露后，磨钻打磨 L_2 左侧椎板下缘、$L_{2/3}$ 左侧关节突关节内缘、下位椎板上缘，将足量自体和异体混合碎骨植入 $L_{2/3}$ 椎板间。椎间隙处理完毕后，分别于 L_{2-5} 两侧沿导针行椎弓根攻丝，C 形臂 X 线机透视下拧入 8 枚经皮椎弓根螺钉，透视见椎弓根螺钉及融合器位置良好，经切口放置合适的连接棒，转棒并拧紧尾帽固定，再次透视内固定示位置满意，脊柱侧弯得到纠正（图 1g）。冲洗切口、止血、放置引流管，消毒皮肤后全层缝合切口，无菌敷料包扎覆盖。

1.4 术后处理

术后嘱患者卧床休息，轴向翻身，给予营养神经及抗感染等治疗。术后第 3 d 根据引流量拔除引流管（24 h 引注量<50 mL），腰围保护下下床活动，复查 X 线片、CT，见椎管减压彻底、融合器及钉棒位置良好、脊柱侧弯得到矫正（图 1h, 1i）。常规配戴长腰围限制腰椎活动并规律口服钙片、促进骨融合、营养神经等药物 3 个月，术后 1、3、6、12 个月规律复查。

2 病例报告

患者女性，75 岁，因“腰痛伴左下肢疼痛 2 年余，加重半年”入院。患者 2 年前无明显原因感腰部疼痛，向左下肢放射，左臀部、大腿前外侧、小腿前外侧疼痛，右下肢感觉基本正常。站立及行走时疼痛加重，平卧休息时疼痛减轻，近半年症状逐渐加重，保守治疗效果欠佳。既往高血压 10 余年。专科查体：跛行步态。腰椎生理曲度变直、侧弯，前屈、后伸、侧弯及旋转功能受限。腰椎棘突及椎旁压痛，左

下肢综合肌力Ⅳ级，右侧足背伸肌力Ⅳ级。双侧直腿抬高试验（-）。影像学检查：腰椎正侧位 X 线片示腰椎侧弯，Cobb 角 28°，腰椎过伸过屈位 X 线片显示 $L_{2/3}$、$L_{3/4}$ 节段动态不稳定（图 1a）。CT 和 MRI 检查提示 $L_{3/4}$、$L_{4/5}$ 节段腰椎间盘突出、腰椎管狭窄（图 1b）。

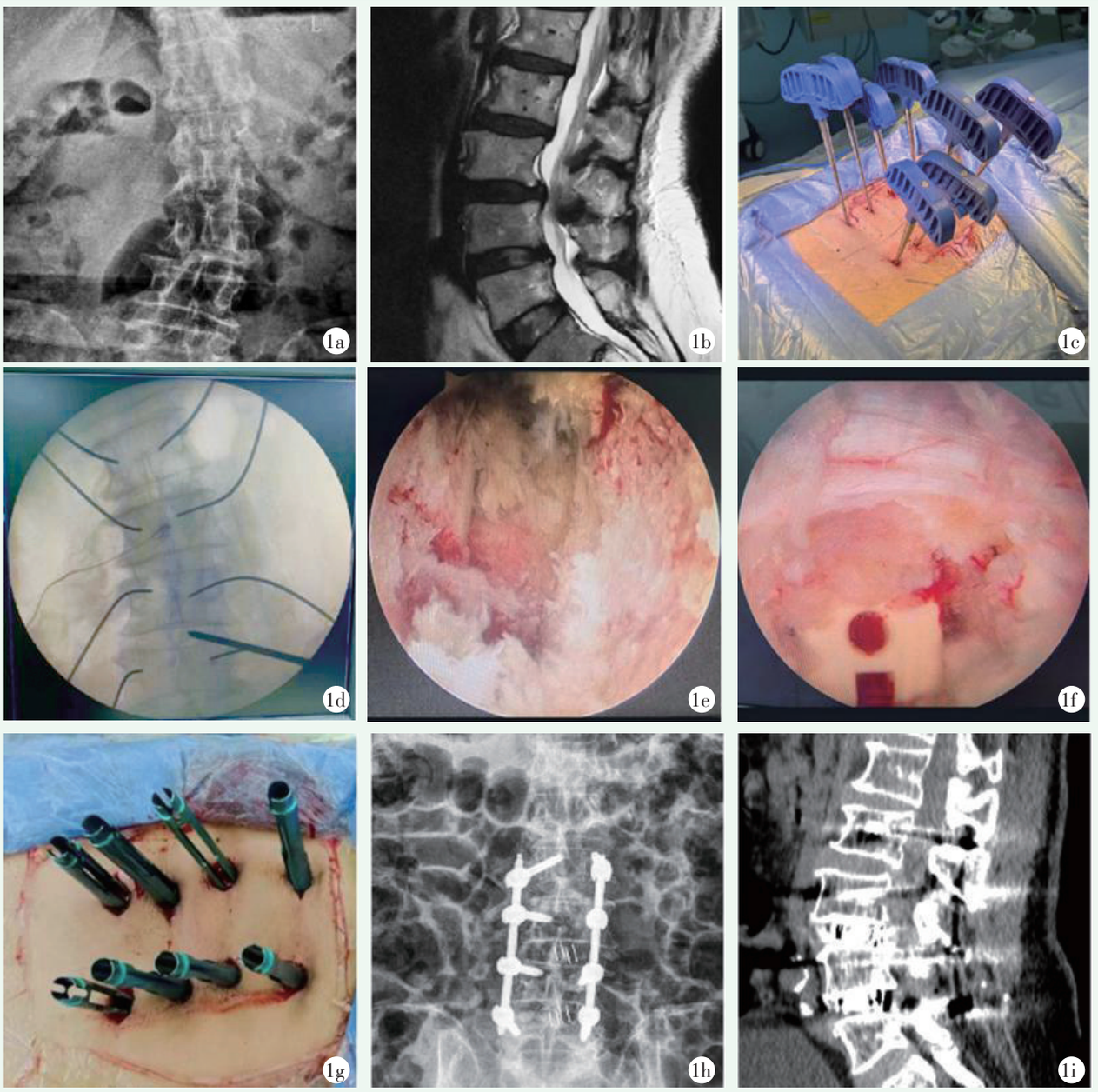

图 1.　患者女性，75 岁。1a：术前 X 线片示脊柱侧弯，Cobb 角为 28°；1b：术前 MRI 显示 $L_{3/4}$、$L_{4/5}$ 椎管狭窄；1c：透视下行 $L_{2\text{-}5}$ 椎弓根穿刺[19]；1d：经穿刺针插入 8 枚导丝，内镜下将克氏针置入上位椎板下缘并透视定位；1e：切除椎间盘，处理椎间隙，刮除软骨终板，显露软骨下骨；1f：椎间隙置入填满自体骨的椎间融合器；1g：沿导丝置入椎弓根螺钉，经切口放置连接棒，拧紧尾帽固定[19]；1h：术后 3 d X 线片示脊柱侧弯得到矫正；1i：术后 3 d CT 显示椎管减压彻底，融合器和钉棒位置良好。

Figure 1. A 75-year-old famale. 1a: Preoperative X ray shows scoliosis with a Cobb angle of 28°; 1b: Preoperative MRI shows $L_{3/4}$ and $L_{4/5}$ spinal stenosis; 1c: Puncture aimed at $L_{2\text{-}5}$ pedicles under fluoroscopy; 1d: Inserting 8 guide wires through the puncture needle, place the Kirschner wire into the lower edge of the upper vertebral plate under endoscopy, and locate it through fluoroscopy; 1e: Removing the intervertebral disc, including the cartilage endplate, and expose the subchondral bone; 1f: Placement of cage filled with bone autografts into the intervertebral space; 1g: Placing pedicle screws over the guide wires, place connecting rods through the incision, and tighten the tail cap for fixation; 1h: The X ray 3 days after surgery showed proper correction of scoliosis; 1i: CT 3 days after surgery showed complete decompression of the spinal canal, with the implants, including cage, pedicle screws and connecting rod in good position.

诊断：（1）退行性脊柱侧弯；（2）腰椎滑脱症（$L_{2/3}$、$L_{3/4}$）；（3）腰椎管狭窄症（$L_{3/4}$、$L_{4/5}$）；（4）高血压病。本研究经医院医学伦理委员会批准，患者知情同意并签署知情同意书。

患者顺利完成手术，手术时间约 280 min，术中出血量约 180 mL。切口一期愈合。术后 3 d 拔除引流管，腰围保护下下床活动。随访时间 6 个月。疼痛视觉模拟评分（visual analogue scale, VAS）：术前腰部 5 分、下肢 6 分，术后腰部 3 分、下肢评分 1 分，末次随访腰部、下肢均为 1 分；Oswestry 功能障碍指数（Oswestry disability index, ODI）：术前 51.1%、术后 28.6%、末次随访 13.3%；日本骨科协会（Japanese Orthopaedic Association, JOA）评分：术前 13 分，末次随访 23 分。术后 X 线片及 CT 显示：脊柱侧弯得到矫正，椎体稳定性得到重建，椎管彻底减压，椎间融合器及钉棒位置良好。

3 讨 论

退行性脊柱侧弯合并椎管狭窄症已成为导致老年人腰腿痛的常见疾病，手术是其有效的治疗方法[8]。但老年患者常合并基础疾病，身体耐受性差，传统开放手术对组织损伤较大，影响腰椎稳定性并导致术后疼痛加重，因此，术中减少组织损伤对术后康复十分重要[9, 10]。近年来，UBE-LIF 技术发展迅速，在多种脊柱疾病的治疗中应用并取得良好的临床疗效[11]。该技术的优势在于观察通道和工作通道相互独立，具有更清晰的手术视野和更灵活的操作空间，相较于传统开放手术，能显著减少手术创伤和术中出血量，缩短术后卧床时间，促进术后快速恢复，为退行性脊柱侧弯合并椎管狭窄症患者提供更多的治疗选择[12~14]。此外，脊柱侧弯合并椎管狭窄症主要有单纯减压、短节段融合、长节段融合矫形等治疗方式[15, 16]。单纯减压无法恢复脊柱的稳定性，随着脊柱侧弯进一步发展，可能需要二次手术；长节段融合矫形能更充分地减压、矫正弯曲，但手术时间长、失血量大，并发症的发生率和翻修率较高[17, 18]。因此，对于脊柱侧弯进展风险较低的患者，短节段融合可以在矫正侧弯的同时，减少手术创伤并保留脊柱结构及活动度，促进术后快速恢复[19, 20]。本例患者高龄且合并高血压，身体耐受性较差，为了解决这些潜在风险，采用 UBE-LIF 技术行 $L_{2\sim5}$ 经皮椎弓根螺钉内固定+$L_{3\sim5}$ 减压椎间融合+$L_{2/3}$ 后外侧融合术。

结合手术经验，笔者认为手术中应注意以下几点：（1）大量开展 UBE 和 UBE-LIF 的基础上，制定合适的手术方案，缩短手术时间，并提升疗效；（2）对非神经症状责任节段融合矫形时，可选择侧弯凹侧入路置入 Cage，有助于提升矫形效果；（3）先置入导丝再减压的手术顺序，有助于降低损伤神经的风险；（4）椎体滑脱需复位者，可先置入对侧螺钉及临时连接棒，减压后将椎间隙撑开提拉复位，再置入融合器；（5）置入导丝及内镜下减压融合时，切口不宜过大，置钉时再扩大通道，以减少术中出血，提高视野清晰度；（6）使用骨刀及咬骨钳去除骨质，收集更多的自体骨，提升融合质量；（7）切除黄韧带及椎间盘时尽量轻柔，仔细探查分离神经与周围组织，避免撕裂损伤，一旦术中发现硬膜撕裂，使用脂肪及明胶海绵压迫，及时降低水压，尽快结束手术。

本例患者术后症状明显改善，取得了良好的临床疗效，但仍需要大样本及长期随访的临床研究，以进一步证实该技术的疗效与安全性。

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