

· 技术创新 ·

开放获取

改良经椎间孔入路全镜下 L₅S₁ 减压术[△]

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摘要: [目的] 介绍改良经椎间孔入路全镜下椎间孔镜治疗 L₅S₁ 椎间孔狭窄症的手术技术和初步临床效果。[方法] 对 12 例 L₅S₁ 椎间孔狭窄症患者, 行经改良椎间孔入路全镜下椎间孔镜手术。透视下取经患侧 L₅S₁ 椎间孔水平线为穿刺路径, 水平线与髂骨嵴交点内侧作为穿刺进针点, 穿刺至 L₅ 峡部与 S₁ 上关节突交界处外侧, 置入套筒, 全可视镜外环锯切除 L₅ 部分峡部及 S₁ 上关节突尖部少部分, 去除压迫 L₅ 神经根的突出髓核、肥厚黄韧带或钙化黄韧带, 从而完成 L₅ 神经根减压。[结果] 所有患者均顺利完成手术, 其中 1 例出现神经根外膜撕裂, 另 1 例出现术后臀部疼痛, 但都无严重不良后果。随访 6 个月~5 年, 平均 (2.5±0.3) 年, 患者疼痛症状和功能均显著改善, 无复发或症状加重。术后腰椎 MRI 显示所有患者 L₅ 出口根均减压充分。[结论] 改良经椎间孔入路全镜下椎间孔镜治疗 L₅S₁ 椎间孔狭窄症具有可重复性强, 不受高髂嵴限制, 不影响脊柱稳定性等优点。

关键词: 改良经椎间孔入路, 全镜下椎间减压, 椎间孔狭窄症

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Modified transforaminal approach for full endoscopic L₅S₁ decompression // LI Jin-ge¹, LI Yue-zhong¹, XU Yuan-yuan². 1. Department of Spinal Orthopedics, People's Hospital of Weifang City, Weifang, Shandong 261041, China; 2. Department of Critical Care Medicine, The Second People's Hospital of Weifang City, Weifang, Shandong 261041, China

Abstract: [Objective] To introduce the surgical technique and preliminary clinical results of modified transforaminal approach for full endoscopic L₅S₁ decompression of foraminal stenosis. [Methods] A total of 12 patients with L₅S₁ foraminal stenosis were treated by modified foraminal approach with full endoscopic L₅S₁ decompression of foraminal stenosis. The horizontal line of the intervertebral foramina L₅S₁ on the affected side was taken as the puncture path, while the inside of the intersection of the horizontal line and the crest of the iliac crest was used as the puncture needle point. The puncture was carried out to the outside of the junction between the isthmus of L₅ and the apex of the superior articular process of S₁, and then the cannula was inserted, and the isthmus of L₅ and a small part of the apex of the superior articular process of S₁ were removed with an external circular saw under the all-visual endoscope. The protruding nucleus pulposus, hypertrophic ligamentum flavum, or calcified ligamentum flavum pressing on the L₅ nerve root were removed to complete decompression of the L₅ nerve root. [Results] All the patients had operation performed smoothly and got significant improvement in terms of symptoms and function, except 1 who had a tear of the outer nerve root membrane and another had postoperative hip pain, both of them had no serious adverse consequences. During the follow-up period lasted for 6 months to 5 years, no recurrence or worsening of symptoms was found in anyone of them. [Conclusion] Modified transforaminal approach full endoscopic decompression for the treatment of L₅S₁ foraminal stenosis has the advantages of strong repeatability, no restriction of high iliac crest, and no impact on spinal stability.

Key words: modified transforaminal approach, full-endoscopic foraminal decompression, foraminal stenosis

腰椎椎间孔狭窄症属于腰椎退变性疾病中的常见病, 发病率可达 8%~11%^[1]。由于腰椎生物力学特点与解剖因素, L₅S₁ 节段椎间孔狭窄发病率远高于其他节段, 可高达 75%^[1]。L₅S₁ 椎间孔狭窄症保守治疗很难奏效, 手术治疗往往是更好的选择^[2, 3]。以往椎间孔狭窄症多采用传统腰椎后路减压融合内固定, 术中切除大

量骨组织、黄韧带, 从而必须附加内固定, 创伤大, 出血多, 手术时间长, 花费高, 术后恢复慢^[4]。随着技术的进步, 近年来采用椎间孔镜经椎间孔入路手术直接减压开始兴起, 然而由于髂嵴遮挡或者穿刺方向限制, 很难切除 L₅S₁ 头端黄韧带附着点, 因此耗费时间长, 减压也不容易彻底, 效果不理想。作者于 2018 年

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10 月—2023 年 10 月，采用改良经椎间孔入路全镜下椎间孔镜治疗 12 例 L₅S₁ 椎间孔狭窄症患者，现将手术技术与初步临床效果介绍如下。

1 手术技术

1.1 术前准备

术前所有患者均行常规血液及大小便检验，均行心电图、胸部拍片、腰椎 DR、腰椎间盘 CT 和腰椎 MR 等检查，腰椎正侧位片明确具体的患病节段，避免腰椎骶化、骶椎腰化的干扰，保证手术节段的正确。腰椎过伸过屈位片排除腰椎不稳，选择合适病例。在腰椎 MRI 上（图 1a），通过测量与对比对侧椎间孔，明确患侧椎间孔狭窄程度。术前在腰椎轴位 MRI 上（图 1a）提前规划穿刺针外展角度及进针位置、进针深度。在腰椎间盘 CT 上明确椎间孔狭窄是骨性狭窄还是软组织导致的狭窄，提前做好切除骨质范围的预判。

1.2 麻醉与体位

所有患者均行切口局部麻醉+静脉全麻，腹部悬空俯卧于可透视手术床，双上肢可自由放置。

1.3 手术操作

患者自然放松俯卧于可透视手术床，腹部悬空，根据术前规划及阅片，触摸棘突、髂脊，初步判断 L₅S₁ 间隙，体表摆放 2 枚直径 2 mm 直克氏针，垂直交叉放置，1 枚平行于椎间隙，1 枚平行于关节突外侧缘连线，使用 C 形臂 X 线机单纯透视腰椎正位（图 1b），根据透视在体表做标记（图 1c）。常规碘酊、酒精消毒，常规铺巾，配制 0.5%利多卡因，以水平标记线与髂脊体表投影内缘交点作为穿刺进针点，局部皮肤浸润麻醉，沿穿刺点向 L₅ 峡部外缘逐步穿刺麻醉，C 形臂 X 线机透视腰椎正侧位，确认穿刺位置满意，椎间孔周围注入局麻药物 5 ml，切开皮肤，切口长约 0.7 cm，插入导丝，铅笔芯、外径 8 mm 套筒，C 形臂 X 线机透视腰椎正侧位（图 1d，1e），再次确定工作套筒位于 L₅ 峡部外缘，连接内镜系统，镜下双极射频清理 L₅ 峡部外缘周围软组织，充分显露患侧峡部、关节突关节（图 1f），充分止血，镜外环锯切除峡部外侧缘腹侧黄韧带止点、上关节突肩部部分骨质，根据需要切除骨质，充分扩大椎间孔，如神经根前方椎间盘仍有压迫需要切除部分髓核组织，直到充分游离松解 L₅ 神经根到活动度良好（图 1g），仔细询问患者患肢疼痛或麻木较术前明显改善，双极射频彻底止血，退出内镜，缝合皮肤，无

菌敷贴覆盖切口，翻身，检测生命体征，平车返回病房。

1.4 术后处理

术后不用抗生素，复查腰椎 MRI（图 1h），显示椎间孔较前明显扩大，L₅ 出口根走行通畅，术后当天鼓励患者戴腰围下地活动，并指导患者进行双下肢直腿抬高训练预防神经根粘连，术后第 2 d 进行切口换药，观察切口情况，无异常后出院，嘱院外 2~3 d 切口换药 1 次。前 3 个月分别于术后 1、2、3 个月门诊复查随访，3 个月后改为每 3 个月复查 1 次，复查时评估患者腰背部、患侧下肢疼痛情况，并行 MRI 检查，观察患者患侧椎间孔变化情况。

2 临床资料

2.1 一般资料

本组共 12 例患者，其中男 5 例，女 7 例，年龄 46~77 岁，平均（63.5±5.7）岁。临床症状主要表现为臀部疼痛并一侧下肢的疼痛、麻木，主要为钝痛或胀痛，部分患者下肢无力。术前参考腰椎片、腰椎间盘 CT、腰椎 MRI 等影像学检查，必要时行肌电图，部分患者术前行椎间孔封闭试验明确诊断，均行改良经椎间孔入路全镜下椎间孔镜手术。

2.2 初步结果

所有患者均安全度过围手术期，术中出血量 5~10 ml，其中 1 例术中出现神经根外膜撕裂，未行特殊处理，术中无不良反应，未放引流管，术后切口愈合良好，术后 3 d 内复查腰椎 MRI，均显示 L₅ 出口根减压充分。1 例出现术后臀部疼痛，给予对症治疗，术后 2 个月臀部症状完全缓解。随访 6 个月~5 年，平均（2.5±0.3）年，无复发或症状加重。

3 讨论

腰椎椎间孔狭窄是由 Putti^[5] 最早在 1927 年提出，其形成原因有腰椎小关节骨关节炎、椎间盘塌陷、关节突关节脱位或半脱位以及黄韧带的增生肥厚^[6]。L₅S₁ 是椎间孔狭窄发生率最高的节段^[7]。在解剖上腰椎间孔有圆形、椭圆形、泪滴状 3 种类型，在椎管侧方，神经根从硬膜囊发出后，行走于椎间孔后离开椎管^[8]。椎间孔有 4 个边界：上下界为相邻的上下椎弓根，前界为上位椎体后下缘、椎间盘、下位椎体后上缘，后界为黄韧带和上下关节面^[9]。椎间孔的狭窄是由高度的降低及面积的减小导致。腰椎间孔狭

窄通过腰椎间盘 CT+矢状位重建、腰椎 MRI 可以初步判定，但椎间孔狭窄不一定引起临床症状，要确定是否是椎间孔狭窄导致的症状需要结合临床，必要时需要椎间孔封闭试验确诊^[10]。腰椎椎间孔狭窄症与腰椎间盘突出引起的下肢疼痛特点不一样，腰椎

间盘突出导致的双下肢疼痛往往卧床可以有效改善，但椎间孔狭窄引起的下肢疼痛，往往与是否卧位无关。腰椎椎间孔狭窄往往引起背根神经节受压，所以下肢疼痛与麻木一般较严重^[11]。

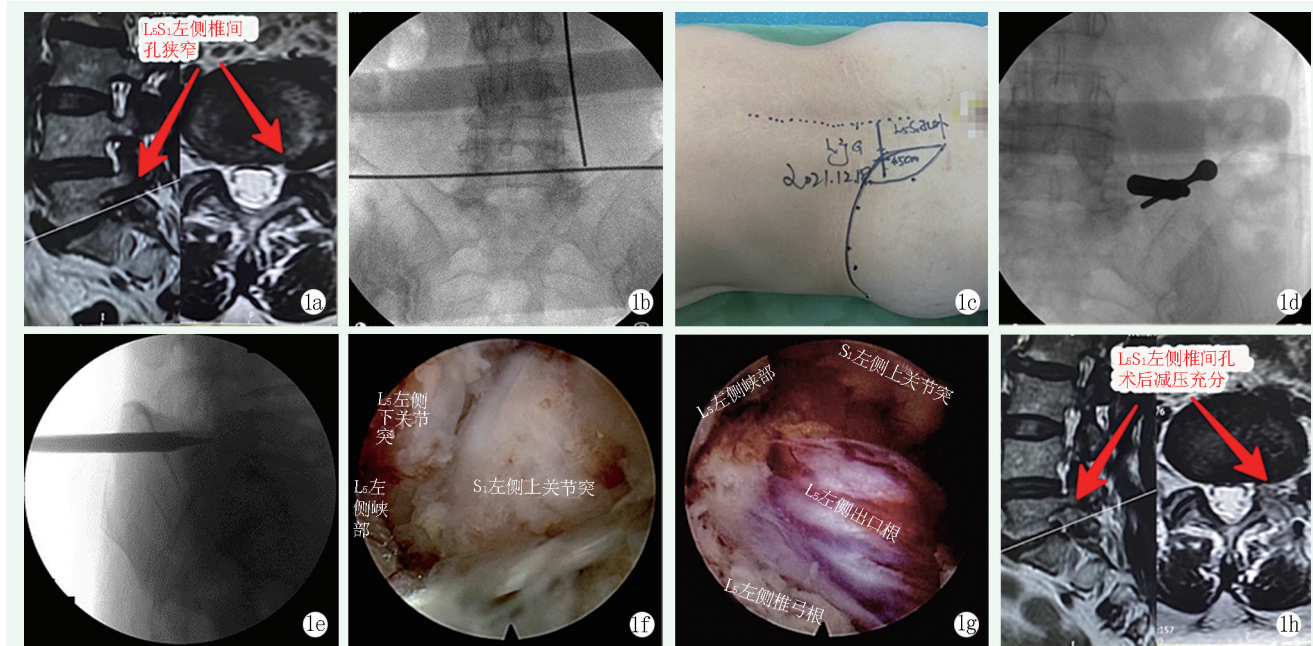


图 1. 患者女性，52 岁，因腰痛伴左下肢放射痛 10 余年入院，入院诊断“L₅S₁ 椎间孔狭窄症（左）”，择期行经改良经椎间孔入路全镜下椎间孔镜手术。1a: 术前腰椎 MRI 示 L₅S₁ 左侧椎间孔狭窄，L₅ 出口根受压严重；1b: 术中透视，确定穿刺针进针路线；1c: 体表画出穿刺针进针路线；1d: 术中正位透视显示工作通道位置合适；1e: 术中侧位透视显示工作通道位置合适；1f: 患侧峡部、关节突关节；1g: 镜下见左侧 L₅ 出口根松弛、通畅；1h: 术后 MRI，显示 L₅S₁ 左侧椎间孔通畅，L₅ 出口根松弛。

Figure 1. A 52-year-old female was admitted to hospital for low back pain with radiative pain in the left lower extremity for more than 10 years. She was diagnosed with "L₅S₁ foramen stenosis (left)" and was selected to undergo a modified transforaminal approach for full-endoscopic foraminal decompression. 1a: Preoperative lumbar MRI showed stenosis of the left foramen of L₅S₁ with severe compression of the outlet root of L₅; 1b: Intraoperative fluoroscopy to determine the puncture needle insertion route; 1c: Drawing the puncture needle route on the body surface; 1d: Intraoperative anteroposterior fluoroscopy showed that the position of the working channel was appropriate; 1e: Intraoperative lateral fluoroscopy showed that the position of the working channel was appropriate; 1f: The endoscopic view of the affected isthmus and facet joints; 1g: The left L₅ outlet root was relaxed and unobstructed under the endoscope; 1h: Postoperative MRI showed that the left intervertebral foramen of L₅S₁ was of patency and the outlet root of L₅ was relaxed.

腰椎椎间孔狭窄症手术可归纳为两大类：传统切除关节突的减压融合内固定手术和新近的保留关节突的微创单纯减压手术^[12-14]，传统开放融合内固定手术创伤大，恢复时间长^[15]，花费高，给患者带来了沉重的经济负担，近年来随着脊柱微创理念的发展及微创技术的创新，腰椎椎间孔狭窄微创手术也获得了满意的效果^[16]。1992 年，Mayer 等^[17]首次报道经皮内窥镜椎间盘切除术以来，许多学者报道了经皮内窥镜椎间盘切除术的技术和疗效^[18-20]。尤其是椎间孔镜全可视化的出现，使手术变得更为安全，高效，逐步得到了脊柱外科医生的广泛认可^[21]。但 L₅S₁ 椎间孔狭窄属于一个特例，这是由于它的解剖特点决定的，L₅S₁ 椎间孔是由 L₅、S₁ 构成，L₅S₁ 椎间孔往往更

深在，容易受到髂脊的遮挡，L₅、S₁ 横突往往更肥大，从而造成侧方入路下穿刺进入椎间孔更困难，勉强建立通道，往往套筒活动受限，不能很好地完成椎间孔成形及减压，鉴于以上种种原因，作者改良了椎间孔侧方入路，靶点放在 L₅ 峡部，水平置入管道，不受高髂嵴及肥大横突的影响，可以自由摆动套筒，随心所欲成形椎间孔，可以切除黄韧带止点，充分松解游离 L₅ 神经根，必要时可以松解 S₁ 神经根，以便达到最好的效果。

改良经椎间孔入路治疗 L₅S₁ 椎间孔狭窄症需要术者有一定的腰椎侧路镜手术经验，作者的体会有以下几点：（1）对于诊断不确切，需要行椎间孔封闭试验，进一步明确诊断；（2）术前仔细阅片，包括腰椎

片、腰椎间盘突出 CT、腰椎 MRI，明确责任节段，对穿刺路径需要仔细规划；(3) 穿刺靶点为 L₅ 峡部，而非关节突肩部；(4) 手术最好在局麻下完成，能更好地保证手术安全；(5) 手术椎间孔成形可以全程在镜下完成，镜外环锯原则上是逐片切除骨质，切勿贪大，邻近神经根时可以环锯掰断骨质，邻近神经时环锯可以往复旋转，切勿一个方向旋转，以免损伤神经根；(6) 套筒可以上下摆动，切除黄韧带止点，容易大块拿出黄韧带，便于提高效率，不宜损伤神经节；(7) 椎间盘突出不大，完全可以不切髓核组织，预防椎间盘突出复发，对效果没有影响。

综上所述，改良经椎间孔入路全镜下椎间孔镜治疗 L₅/S₁ 椎间孔狭窄症具有可重复性强，不受高髭嵴限制，不影响脊柱稳定性，病例容易复制等优点，值得临床推广。

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