

临床论著

改良椎板间隙入路经皮内镜下椎间盘切除术治疗
L5/S1 椎间盘突出症的疗效观察

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【摘要】目的:探讨改良椎板间隙入路经皮内镜下椎间盘切除术(modified percutaneous endoscopic interlaminar discectomy, MPEID)治疗 L5/S1 椎间盘突出症的临床疗效。方法:2018 年 12 月~2021 年 5 月我院对 123 例符合纳入标准的 L5/S1 椎间盘突出症患者采用 MPEID 治疗,其中男 65 例,女 58 例;年龄 16~83 岁(44.43 ± 12.67 岁)。术前、术后和末次随访时进行疼痛视觉模拟评分(visual analogue scale, VAS),术前和末次随访时进行 Oswestry 功能障碍指数(Oswestry disability index, ODI)评定,末次随访时根据改良 Macnab 标准评定疗效。结果:123 例均顺利完成手术,手术时间为 45.96 ± 21.87 min,术中出血量为 5.93 ± 3.15 ml。术后出现并发症 8 例,发生率为 6.5%。复发 3 例,复发率为 2.4%。术后随访时间为 6~35 个月(16.49 ± 7.30 个月)。术前、术后及末次随访时腰腿痛 VAS 评分分别为 5.29 ± 1.71 、 2.89 ± 0.75 和 0.59 ± 0.72 ($P < 0.05$);术前与末次随访时的 ODI 分别为 (61.14 ± 13.93)%、(7.47 ± 10.46)%,末次随访 ODI 改善明显($P < 0.05$)。末次随访改良 MacNab 标准评定:优 100 例,良 20 例,可 2 例,差 1 例,优良率 97.6%(120/123)。结论:MPEID 治疗 L5/S1 椎间盘突出症能够保留黄韧带,早期临床疗效满意。

【关键词】经皮内镜下腰椎间盘切除术;腰椎间盘突出症;改良椎板间隙入路;黄韧带;微创

doi:10.3969/j.issn.1004-406X.2022.05.08

中图分类号:R681.5, R687.3 文献标识码:A 文章编号:1004-406X(2022)-05-0434-06

The efficacy of modified percutaneous endoscopic interlaminar discectomy in the treatment of L5/S1 disc herniation/QIN Liangsheng, HUANG Heng, PAN Caicheng, et al//Chinese Journal of Spine and Spinal Cord, 2022, 32(5): 434-439

【Abstract】 Objectives: To evaluate the clinical outcome of modified percutaneous endoscopic interlaminar discectomy(MPEID) in the treatment of L5/S1 disc herniation. Methods: All 123 patients diagnosed of L5/S1 disc herniation(65 males and 58 females, age from 16 to 83 years, mean age 44.43 ± 12.67 years) were treated with MPEID in our spine surgery center. Visual analogue scale(VAS) was scored before operation, after operation and at the last follow-up. Oswestry disability index(ODI) was evaluated before operation and at the last follow-up. The clinical effect was assessed according to the modified Macnab standard at the final follow-up. Results: Operations were successfully completed in all the 123 patients. The operation time was 45.96 ± 21.87 min. The intraoperative blood loss was 5.93 ± 3.15 ml. All patients were followed up for 6-35 months (16.49 ± 7.30 months). 8 cases occurred postoperative complications, with an incidence of 6.5%. There were 3 cases of recurrence, with a recurrence rate of 2.4%. The pre-operative, post-operative and final follow-up VAS scores were 5.29 ± 1.71 , 2.89 ± 0.75 , and 0.59 ± 0.72 , respectively($P < 0.05$). The last follow-up ODI improved significantly ($P < 0.05$). According to the modified MacNab criteria, 100 cases were excellent, 20 cases were good, 2 cases were fair, and 1 case was poor. The excellent and good rate was 97.6%(120/123). Conclusions: MPEID has a satisfactory early clinical outcome in the treatment of L5/S1 disc herniation, which preserves the ligamentum flavum.

【Key words】 Percutaneous endoscopic lumbar discectomy; Lumbar disc herniation; Modified interlaminar

基金项目:广西壮族自治区卫生和计划生育委员会自筹经费科研课题(合同号:Z2016170)

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approach; Ligamentum flavum; Minimally invasive

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腰椎间盘突出症是腰腿痛最常见原因,经充分保守治疗后,疗效不佳的患者需手术治疗^[1]。经皮内镜下腰椎间盘突出切除术(percutaneous endoscopic lumbar discectomy, PELD)与传统开放手术相比,能够保证脊柱稳定性,无需剥离韧带组织和椎旁肌肉,保留关节突关节、椎板及黄韧带^[2-6]。PELD主要分为经皮内镜下椎间孔入路椎间盘切除术(percutaneous endoscopic transforaminal discectomy, PETD)和经皮内镜下椎板间隙入路椎间盘切除术(percutaneous endoscopic interlaminar discectomy, PEID)两类技术。L5/S1节段椎间盘突出的高髂嵴患者,受限于髂嵴阻挡, PETD穿刺入路困难,手术难度大^[7,8]。解剖学研究发现 L5/S1椎板间隙较宽^[9,10],为经椎板间隙入路建立手术通道创造了有利条件。2006年, Ruetten等^[11]率先采用经椎板间隙内镜技术,在内窥镜直视下采用“out-side-in”的方法切除椎间盘组织。PEID需要切除部分黄韧带,经过硬膜囊后间隙、侧方间隙才能抵达椎间盘突出位置,易对硬膜囊和神经造成挤压或牵拉损伤^[12]。我们根据传统手术经验和脊柱局部解剖特点对 PEID 进行改良,设计了改良椎板间隙入路经皮内镜下椎间盘切除术(modified percutaneous endoscopic interlaminar discectomy, MPEID),内镜工作通道经过黄韧带与椎板小关节内侧缘之间进入盘黄间隙外侧后,将黄韧带、硬膜囊和神经根一起推向中线,抵达椎间盘突出的位置,避免了对硬膜囊和神经根的直接牵拉,理论上能够减少术中神经结构损伤和术后硬膜粘连的发生率^[13]。本研究通过回顾性研究分析 2018 年 12 月~2021 年 5 月于我科采用 MPEID 治疗的 L5/S1 椎间盘突出症患者病例资料,探讨 MPEID 治疗 L5/S1 椎间盘突出症的临床疗效,报道如下。

1 资料与方法

1.1 一般资料

纳入标准:①L5/S1 节段椎间盘突出,有明显神经性疼痛,临床表现与 MRI 和 CT 结果一致;②患者经保守治疗 6 个月效果不佳;③Oswestry 功能障碍指数(Oswestry disability index, ODI)评

分 ≥ 35 分。排除标准:①手术部位皮肤感染或全身感染;②合并腰椎失稳、滑脱、椎管狭窄、腋下型巨大椎间盘突出及黄韧带肥厚;③其他严重合并症无法耐受手术;④随访数据不全。

2018 年 12 月~2021 年 5 月在我院接受 MPEID 治疗的腰椎间盘突出症患者共 173 例,符合上述纳入及排除标准共 123 例,其中男 65 例,女 58 例,年龄 16~83 岁(44.43 ± 12.67 岁)。术前均存在下肢放射痛,相应椎节呈压痛或叩痛,腰部前屈、旋转、侧向等活动受限。术前均行腰椎正侧位 X 线片、CT 和 MRI 检查明确诊断。病变节段为 L5/S1,旁外侧型 94 例,中央型 29 例;膨出型 6 例,突出型 52 例,脱出型 50 例,游离型 15 例。本研究获我院伦理委员会审批,患者对本研究知情并签署知情同意书。所有入组患者手术均由同一高年资医师实施。

1.2 手术方法

全麻成功后,俯卧位保持腰椎后凸。C 型臂 X 线透视标记棘突中线和椎间隙、椎板间隙体表投影。根据术前“靶点穿刺”设计穿刺路线(图 1a), 18G 穿刺针自后正中线斜向外侧紧贴小关节突关节内侧缘穿刺(图 1b~d),自黄韧带和小关节间隙到达盘黄间隙外侧附近,穿刺针末端离椎体后缘不低于 3~5mm 距离,取出针芯,插入导丝并沿导丝做 7mm 纵向皮肤切口。将导杆沿导丝在黄韧带与椎板、关节囊间隙插入并抵达盘黄间隙外侧椎管后壁附近,逐级扩张软组织(图 1e),松解黄韧带外侧止点。无须更换导杆,直接置入工作套管(图 1f~h),工作套管抵达盘黄间隙外侧,末端距椎管前壁 3~5mm 以避免神经损伤(必要时可进行椎板间隙扩大),放置椎间孔镜(图 1i),显示盘黄间隙,镜下操作要点:辨认外侧小关节突关节,利用神经剥离子向内拨开黄韧带及神经组织,沿神经剥离子前推工作套管达椎管前缘,旋转工作套管,松解黄韧带并向中线推开黄韧带、神经根及硬膜囊,显露突出椎间盘组织(图 1j),挤压椎间盘,取出椎管内髓核。寻找纤维环裂口(图 1k)并取出游离和松散的髓核组织。低温等离子射频消融止血,纤维环成形。360°探查椎间盘周围无遗漏髓核

组织,神经根松弛(图 1l),移除工作套管。

术后当日麻醉苏醒后腰围制动下床,术后 1d 复查 CT 和 MRI。

1.3 疗效评价指标

记录手术时间、术中出血量、术中术后并发症发生情况以及术后症状改善情况。术前、术后和末次随访时进行疼痛视觉模拟评分(visual analogue scale, VAS),术前和末次随访时进行 ODI 评定,末次随访时根据改良 Macnab 标准评定疗效。术前术后检查 X 线片、CT、MRI 等。

1.4 统计学分析

采用 SPSS 25.0 统计软件包进行统计分析,计量资料符合正态分布时,以 $\bar{x} \pm s$ 表示,计数资料以百分比进行描述。手术前后 VAS、ODI 等比较采用重复测量方差分析。检验水准 α 值取双侧 0.05。

2 结果

123 例患者均接受 MPEID 治疗,手术时间 12~160min(45.96 ± 21.87 min);术中出血量 1~20ml(5.93 ± 3.15 ml)。术中未出现神经损伤、硬膜撕裂以及马尾神经漏出等并发症发生。

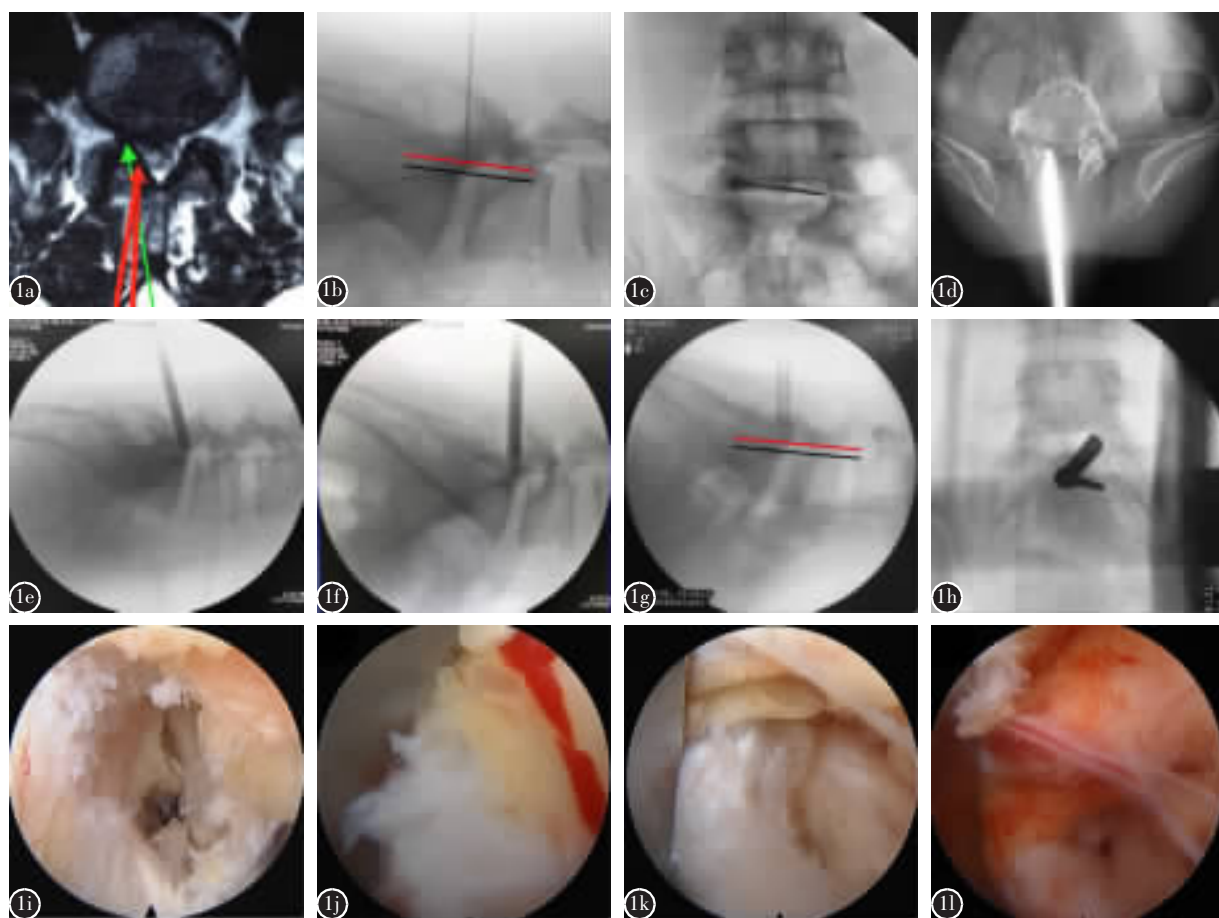


图 1 a 穿刺针方向,绿色为 MPEID 手术入路,红色为 PIED 手术入路 b 18G 穿刺针方向及其末端与椎管前壁距离(红黑线距离) c、d 穿刺角度 e 逐级扩张软组织 f 置入工作套管 g、h 工作套管方向及其末端与椎管前壁距离(红黑线距离) i 放置椎间孔镜,镜下识别组织 j 脱出髓核 k 纤维环与 S1 终板后上缘之间裂隙 l 椎间盘摘除术后神经根松弛

Figure 1 a Along needle orientation, green arrow showing surgical approach for MPEID and red arrow the PIED approach b Direction of 18G needle and distance between the end of the needle and the front wall of the spinal canal (distance between red and black lines) c, d The puncture angle e Soft tissues expanding step by step f Working cannula implanting g, h Direction of working cannula and distance between the end of cannula and the front wall of the spinal canal (distance between red and black lines) i Placing transforaminal endoscopic and tissue was identified j Nucleus pulposus herniation k A crack between the fiber ring and the posterior upper edge of S1 end plate l Nerve root was decompressed after discectomy

术后患者均获得随访,随访时间为 6~35 个月(16.49 ± 7.30 个月)。术后及末次随访时腰腿痛 VAS 评分较术前均有明显降低,差异均有统计学意义($P < 0.05$, 表 1)。末次随访时 ODI 较术前明显改善($P < 0.05$, 表 1)。末次随访时改良 MacNab 标准评定疗效:优 100 例,良 20 例,可 2 例,差 1 例,优良率 97.6% (120/123)。术后复查腰椎 MRI,髓核均已被成功切除,无残留髓核突出(图 2)。术后出现并发症 8 例,发生率为 6.5%。下肢神经炎 6 例(4.9%),术前下肢疼痛、麻木,术后下肢疼痛、麻木未减轻或加重,经营养神经药物治疗后,末次随访时患者下肢症状均明显好转。2 例(1.6%)为术后 1 个月内椎管内血肿压迫神经,予椎间盘探查术清理神经根周围血肿,术后症状好转。复发 3 例(2.4%),3 例患者均为椎间盘突出病史长,未规律治疗,术前腰椎动力位 X 线片提示脊柱稳定性欠佳,术后复查腰椎 MRI 提示 L5/S1 节段再发突出,症状较术前无明显缓解,2 例行经椎间孔腰椎椎体间融合术治疗后好转,1 例拒绝再次手术。

3 讨论

有研究^[14,15]报道 PEID 的临床疗效与 PETD 相似。PEID 穿刺入路不受骶嵴、腰椎横突以及骶髂角度的阻挡^[16,17],其手术过程类似传统手术,需要切开黄韧带,直接在硬膜囊、神经根周围操作,容易导致椎管内粘连,增加硬膜囊和神经损伤的风险^[12]。MPEID 技术不直接进入椎管,紧贴小关节突关节内侧缘刺入,自盘黄间隙外侧,松解黄韧带外侧止点,黄韧带介于工作套管和神经根、硬膜囊之间达到保护神经组织的作用,通过拨开黄韧带屏蔽硬膜囊及神经根,从椎管前壁显露突出椎间盘组织,避免切除黄韧带、过多骚扰硬膜囊及神经组织。本研究结果显示,MPEID 方法简单、安全,

手术耗时少,术后及末次随访时腰腿痛 VAS 评分较术前明显降低($P < 0.05$),末次随访 ODI 改善明显,末次随访时改良 MacNab 标准评定疗效优良率 97.6%,无神经根及硬膜囊损伤,证实 MPEID 早期临床疗效满意。

准确的穿刺定位是 MPEID 技术成功的关键。术前行 CT 三维重建,明确椎间盘突出部位与椎板间隙、椎间隙的关系,模拟穿刺路径指导临床穿刺。术中俯卧位保持 L5/S1 前后位,即保持 L5 下终板和 S1 终板成一条直线,C 型臂 X 线透视定位并标记黄韧带最外侧缘与关节突内侧缘结合处以及棘突中线的体表投影,选择最佳穿刺平面。穿刺时在 C 型臂 X 线机透视引导下,平均 1~3 次可穿刺成功,确保穿刺针紧贴小关节突关节内侧缘刺入,经过黄韧带与椎板小关节内侧缘之间进入盘黄间隙外侧。穿刺过程中可重复透视确定穿刺针位置,若位置欠佳,可适度调整。穿刺时应注意穿刺角度及深度,避免穿刺角度过小或穿刺深度过深,穿刺针提前突破黄韧带进入椎管。穿刺针末端谨记不超过椎间盘后缘,与椎间盘后缘保证 3~5mm 安全范围,避免损伤神经根和硬膜囊。

椎板间隙内,椎板由黄韧带相连。黄韧带上止于上位椎板内面 1/2 处,下方分为 2 层,分别止于下位椎板上缘的内外面,外侧止于小关节突关节囊,内侧游离^[18]。有研究认为切除黄韧带可以增加外科医生的视野^[19],但视野范围大小取决于椎间孔镜的位置以及工作通道与关节突的关系。黄韧带完整性可以保护神经根硬膜囊,通过工作套管的摆动角度,挑起黄韧带,可以探查神经根的肩胛腋下,继续向内侧推开硬膜囊,可以抵达椎管中线。对于中央型或旁中央型椎间盘突出,手术要点:(1)术中进行椎间隙上下及内侧探查;(2)充分松解关节囊及上关节上的黄韧带,用工作套管把黄韧带连同神经根推向中线,可显露中央突出的椎间盘;(3)根据术前椎间盘突出分型及 3D 定位,做到靶点穿刺,使椎间盘突出在矢状位上一致,避免残留,必要时探查肩胛、腋下及椎间隙上下。本研究中 29 例中央型椎间盘突出患者均成功手术,结果表明无需切除黄韧带即可满足手术所需的视野及操作空间。当外科医生达到满意的手术视野时,应尽量保留黄韧带,黄韧带能形成天然屏障阻挡瘢痕组织向椎管内增生,减少椎管内粘连^[20]。

表 1 123 例患者 MPEID 前后的 VAS 评分和 ODI ($\bar{x} \pm s$)

Table 1 VAS and ODI before and after MPEID in 123 patients

	VAS	ODI(%)
术前 Pre-operative	5.29±1.71	61.14±13.93
术后 Post-operative	2.89±0.75 ^①	—
末次随访时 Final follow-up	0.59±0.72 ^①	7.47±10.46 ^①

注:①与术前比较, $P < 0.05$

Note: ①Compared to pre-operative, $P < 0.05$

对于游离型椎间盘突出,根据术前靶点穿刺,找到椎间隙水平纤维环原始破口,通过破口及潜在髓核行走空间取出游离髓核,柔性抓钳取高度游离髓核。若张力大可适当扩大破口减少张力,必要时切开游离髓核表面后纵韧带。术中注意避免残留,完整取出游离髓核,可看到髓核取出后潜在腔隙,硬膜回落。注意观察神经根松弛情况。术中应注意:(1)上方游离时套筒末端尽量靠近 L5 下

终板,必要时使用磨钻、镜下椎板咬骨钳去除部分 L5 椎板扩大椎板间隙;(2)下方游离时套筒末端尽量靠近 S1 上终板,通过摆动可取出远端髓核;(3)肩上神经根下游离髓核:松解黄韧带及神经根并内侧推开取出髓核;(4)腋下髓核:从神经根表面挑起黄韧带,把套筒末端放置于腋下即可取出和探查腋下游离髓核;(5)后纵韧带完整,游离髓核局限于后纵韧带与椎体之间:找到纤维环破口,

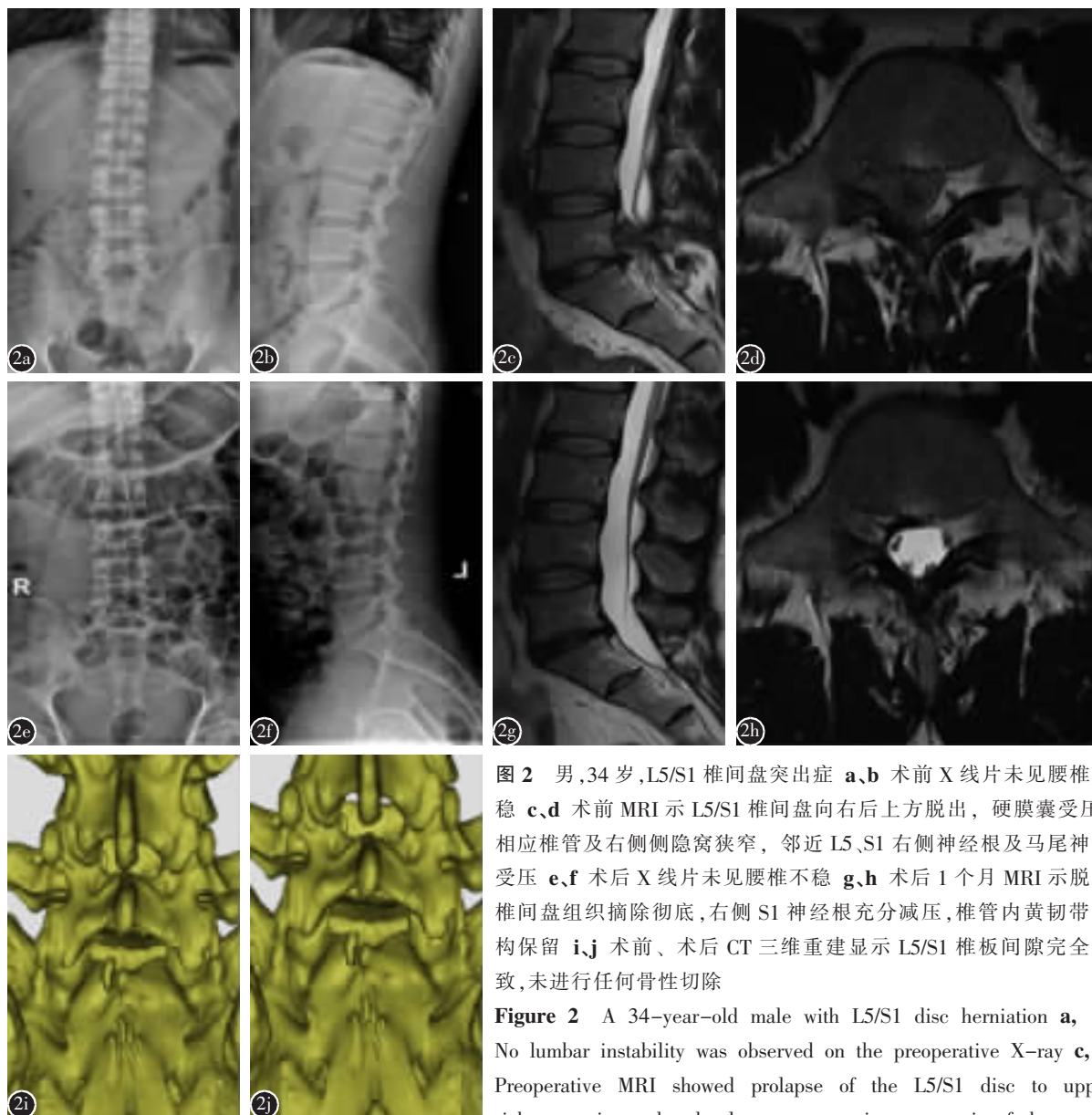


图2 男,34岁,L5/S1椎间盘突出症 a,b 术前X线片未见腰椎不稳 c,d 术前MRI示L5/S1椎间盘向右后上方脱出,硬膜囊受压,相应椎管及右侧侧隐窝狭窄,邻近L5/S1右侧神经根及马尾神经受压 e,f 术后X线片未见腰椎不稳 g,h 术后1个月MRI示脱出椎间盘组织摘除彻底,右侧S1神经根充分减压,椎管内黄韧带结构保留 i,j 术前、术后CT三维重建显示L5/S1椎板间隙完全一致,未进行任何骨性切除

Figure 2 A 34-year-old male with L5/S1 disc herniation a, b No lumbar instability was observed on the preoperative X-ray c, d Preoperative MRI showed prolapse of the L5/S1 disc to upper right posterior end, dural sac compression, stenosis of the corre-

sponding spinal canal and right lateral crypts, and compression of the right nerve root and cauda equina nerve adjacent to L5 and S1 e, f No lumbar instability was observed on the postoperative X-ray g, h One month after surgery, MRI showed that the herniated disc tissue was completely removed, the right S1 nerve root was fully decompressed, and the structure of ligamentum flavum was preserved in the spinal canal i, j Preoperative and postoperative 3D reconstruction of CT showed the L5/S1 lumbar laminae interval space was completely consistent without any bony resection

通过破口及潜在髓核行走空间取出游离髓核;(6)后纵韧带破裂,游离髓核位于椎管内;找到破口,先取出后纵韧带与椎体间游离髓核,根据术前分析游离髓核具体位置,仔细探查肩上、腋下及椎间隙上下。

本研究不足之处:病例数量较少,随访时间较短。同时缺乏随机对照研究,还需要系统性研究以及中、长期随访进一步验证 MPEID 技术治疗腰椎间盘突出症的疗效。

总之,本研究结果显示,MPEID 治疗 L5/S1 椎间盘突出症早期临床疗效满意。手术方法简单、安全,耗时少,能够保留黄韧带,不破坏椎板及小关节,减少了手术对硬膜囊的牵拉和神经根的牵拉,对脊柱稳定性影响小。结合术前 CT 三维重建,明确 L5/S1 结构特点,制定手术计划,有利于更精准、安全地进行手术。

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(收稿日期:2021-12-27 末次修回日期:2022-04-25)

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