

临床论著

腰椎后路峡部植骨钉棒系统固定治疗青年
腰椎双侧峡部裂疗效分析蓝 云^{1,2}, 张建政², 孙天胜²

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【摘要】目的:探讨腰椎后路峡部植骨钉棒系统固定治疗青年双侧腰椎峡部裂的疗效。**方法:**回顾性分析 2015 年 10 月~2017 年 10 月我院收治的 17 例青年双侧腰椎峡部裂患者资料, 男性 13 例, 女性 4 例, 年龄 18~39 (25.1±6.1) 岁, 病程 12.7±8.8 个月。其中 L3 节段 1 例, L5 节段 16 例, 致伤原因均为长期体育或军事等训练所致。所有患者均为单纯峡部裂, 均采取双侧峡部髂骨植骨、椎弓根螺钉固定术治疗。术后随访 12~18 个月, 平均 15.4±2.0 个月。通过腰椎 CT 评价峡部骨折愈合情况, 通过腰部视觉模拟评分法 (visual analogue score, VAS) 和 Oswestry 功能障碍指数 (Oswestry disability index, ODI) 评价临床疗效。随访期间腰椎 CT 证实峡部骨性愈合后行内固定取出。记录本组患者性别、年龄、病程、责任节段、致伤原因、合并伤、手术切口长度、手术时间、术中出血量、术中和末次随访时的腰椎 CT 责任节段峡部表现以及腰部 VAS 评分、脊柱 ODI 评分, 并进行统计学分析。**结果:**手术切口长度 9.1±2.1cm, 手术时间 168.5±46.4min, 术中出血量 108.8±61.8ml。所有患者手术切口无感染, 均获得甲级愈合。17 例患者末次随访时腰椎 CT 均可见腰椎滑脱恢复, 峡部骨性愈合, 均行内固定取出。术前、末次随访时, 腰部 VAS 分别为 5.8±1.1 分和 1.2±0.7 分, 脊柱 ODI 分别为 (35.8±9.1)% 和 (7.1±2.0)%, 差异有统计学意义 ($P<0.01$)。末次随访时有 2 例患者剧烈活动时偶有腰部疼痛, 不影响正常生活。随访期内均无断钉、内固定松动和邻近节段退变等不良并发症。**结论:**腰椎后路峡部植骨钉棒系统固定治疗青年双侧腰椎峡部裂是一种安全且有效的方法。

【关键词】 双侧腰椎峡部裂; 长期训练; 钉棒系统; 手术

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Therapeutic effect analysis of posterior lumbar isthmus bone grafting and screw-rod system fixation for bilateral lumbar spondylolysis in youths/LAN Yun, ZHANG Jianzheng, SUN Tiansheng/Chinese Journal of Spine and Spinal Cord, 2019, 29(8): 712-716

【Abstract】 Objectives: To investigate the effects of posterior lumbar isthmus screw-rod system fixation and local bone grafting in the treatment of bilateral lumbar spondylolysis in youths. **Methods:** Data of 17 patients with bilateral lumbar spondylolysis admitted to our hospital from October 2015 to October 2017 were retrospectively analyzed, including 13 males and 4 females, aged 18-39 (25.1±6.1) years, with an average course of 12.7±8.8 months. Among them, 1 case with L3 spondylolysis, and the other 16 cases with L5 spondylolysis, and all were caused by long-term sports or military training. All patients were simple spondylolysis. All patients were treated with iliac bone grafting and pedicle screw fixation. The follow-up period ranged from 12 to 18 months, with an average of 15.4±2.0 months. The fusion status of isthmus was evaluated by lumbar CT scan, and the clinical outcome was evaluated by visual analogue score (VAS) and spinal Oswestry disability index (ODI). During the follow-up period, implant was removed after CT scan confirming the isthmus fusion. Gender, age, disease course, fixed level, cause of injury, combined injuries, incision length, operation time, intra-operative bleeding volume, the CT manifestation of isthmus before operation and at final follow-up, VAS of lumbar spine and ODI of spinal column were collected and analyzed. **Results:** The average age of 17 pa-

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tients was 25.1 ± 6.1 years, there were 13 males and 4 females, 16 L5 segments and 1 L3 segments. All patients were followed up for an average of 15.4 ± 2.0 months. The course of disease was 12.7 ± 8.8 months. All of them are simple isthmus fissures. The injuries were caused by long-term sports or military training. The incision was 9.1 ± 2.1 cm, the operation time was 168.5 ± 46.4 min, intra-operative bleeding volume was 108.8 ± 61.8 ml. No infection was found in the incision of all the patients, and grade A healing was achieved. At final follow-up, lumbar spondylolisthesis recovered and isthmus bone healed in all 17 patients, with implant removed during the follow-up. The preoperative and final follow-up VAS scores were 5.8 ± 1.1 and 1.2 ± 0.7 respectively, and the ODI scores were $(35.8 \pm 9.1)\%$ and $(7.1 \pm 2.0)\%$, respectively ($P < 0.01$). At final follow-up, 2 patients had occasional low back pain during intense activities, which did not influence their normal life. No implant breakage, implant loosening and adjacent segments degeneration were found during the follow-up.

Conclusions: Posterior lumbar isthmus bone grafting and screw-rod system fixation is an effective and safe method in the treatment of bilateral lumbar spondylolysis in youths.

[Key words] Bilateral spondylolysis; Long-term training; Screw-rod system; Surgery

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腰椎峡部裂可分为单侧或双侧,多为双侧,好发于青少年,一般人群中发病率高达 3%~10%,是脊柱外科常见的疾病,临床上以长期军事或体育等训练患者多见^[1,2]。目前,国内外腰椎峡部裂相关研究较多,临床上主要采取保守治疗和手术治疗,手术方式包括单纯峡部修复术、椎体间融合术等。笔者回顾性分析 2015 年 10 月~2017 年 9 月我院收治的 17 例青年双侧腰椎峡部裂患者资料,旨在探讨采取腰椎后路峡部植骨钉棒系统固定治疗青年双侧腰椎峡部裂的临床疗效。

1 资料与方法

1.1 一般资料

病例纳入标准:(1)腰椎 X 线及 CT 检查明确双侧腰椎峡部裂的青年患者;(2)持续腰痛症状影响正常生活且保守治疗无效者;(3)无局部及全身感染以及明显神经、血管损伤。病例排除标准:(1)同节段椎间盘退变 Pfirrmann MRI 分级(T2WI) ≥ 3 级;(2)合并椎体骨折或腰椎滑脱;(3)脊柱侧凸;(4)单侧峡部裂保守治疗者;(5)患者年龄 ≥ 40 岁。

2015 年 10 月~2017 年 10 月我院收治了 33 例腰椎峡部裂患者,根据纳入排除标准,排除了 16 例(其中同节段椎间盘退变 Pfirrmann MRI 分级 ≥ 3 级 3 例、滑脱 8 例、单侧峡部裂保守治疗 5 例),最后纳入 17 例双侧腰椎峡部裂患者,年龄为 18~39 岁,平均 25.1 ± 6.1 岁,男 13 例,女 4 例。其中 16 例均为 L5 峡部裂,1 例为 L3 峡部裂。致伤诱因:长期体育或军事等训练所致,患者均为单纯峡部裂。17 例患者均采用椎弓根钉棒系统技术,

经腰椎后路行双侧峡部取髂骨植骨及椎弓根螺钉内固定术。

1.2 治疗方法

在全身麻醉下,患者取俯卧位。术中透视定位明确责任节段。取腰椎后正中纵向切口,长约 10 cm,逐层切开皮肤、皮下组织、腰背筋膜及棘上韧带,沿骨膜下剥离棘突椎板旁的椎旁肌肉,以保护血管,防止不必要的组织损伤。显露术野,定位缺损,去除缺损部位的关节软骨组织,注意避免破坏双侧关节囊。磨钻磨除缺损部位的硬化骨,制备植骨床。取关节突外缘与横突中点连线的交点作为椎弓根螺钉的进钉点,椎弓根螺钉方向与椎板垂直,神经根探针明确椎弓根四壁均为骨质,于病损及下一节椎体双侧置入适当尺寸的椎弓根螺钉,C 型臂 X 线机透视下证实内固定位置好,深度适宜。在原切口下端沿一侧髂骨分离皮下软组织及肌肉,显露髂嵴,空心环锯取髂骨,并抽取骨髓备用,修理合适大小骨块作为植骨备用。依次填塞骨诱导、移植骨块于双侧峡部清理后的间隙,适当打压植骨块至其进入间隙内,冲洗后往原缺损处注入备用骨髓。选择合适长度的连接杆,适当预弯后,与尾钉连接,旋紧所有固定螺帽,以维持节段生理性弯曲。再次透视见内固定及植骨块位置佳,仔细止血,放置负压引流管后,逐层关闭手术切口。

1.3 术后处理及疗效评估

术后对患者静脉应用抗生素治疗 3 d,术后常规穿抗血栓弹性袜 3 d。一般术后第 3 天允许患者使用单腿伸展的腰骶矫形器坐下和走动。矫形支架保护下进行活动 6 周。在痊愈后 4~6 个月,患

者可正常运动。

术后 1、3、6、12 和 15 个月定期拍摄腰椎正侧位 X 线片及 CT 对术后愈合情况进行评价。所有患者接受门诊或电话随访至少 12 个月。骨性愈合标准:随访期间腰椎 CT 证实峡部骨性愈合,即腰椎 CT 显示有骨小梁横贯通过峡部裂两端。确定骨性愈合后行内固定取出,内固定取出时间即为末次随访时间。

记录本组患者病程、手术切口长度、手术时间、术中出血量、术中和末次随访时的腰椎 CT 责任节段峡部表现以及腰部视觉模拟评分法 (visual analogue score, VAS)、脊柱 Oswestry 功能障碍指数 (Oswestry disability index, ODI), 并进行统计学分析。

疗效评价:采用腰部 VAS 评分和脊柱 ODI 评分评价术后恢复情况。功能判断 (ODI): 0~20%: 轻度功能障碍; 21%~40%: 中度功能障碍; 41%~60%: 重度功能障碍; 61%~80%: 严重的腰背痛; 81%~100%: 这些患者需要卧床休息或者他们的症状非常严重)。

2 结果

本组患者均经腰椎后路行双侧峡部植骨及椎弓根螺钉内固定术。17 例患者病程为 12.7 ± 8.8 个月, 手术切口长 9.1 ± 2.1 cm, 手术所用时间为 168.5 ± 46.4 min, 术中出血量为 108.8 ± 61.8 ml。所有患者手术切口无感染, 均获得一期愈合。

所有患者均获得随访, 平均随访 15.4 ± 2.0 个月。末次随访时, 4 例腰椎滑脱患者腰椎正侧位 X 线均显示已复位, 17 例患者腰椎 CT 均可见腰椎责任节段峡部骨性愈合, 即腰椎 CT 显示有骨小梁横贯通过峡部裂两端。所有符合骨性愈合标准的患者均行内固定取出 (图 1)。

17 例患者术前、末次随访腰部 VAS 评分分别为: 5.8 ± 1.1 分和 1.2 ± 0.7 分, 脊柱 ODI 分别为 $(35.8 \pm 9.1)\%$ 和 $(7.1 \pm 2.0)\%$, 差异有统计学意义 ($P < 0.01$)。内固定取出后有 2 例患者偶有下腰部疼痛, 不影响正常生活。所有患者均能回归正常的工作和生活。随访期内均无断钉、内固定松动、邻近节段退变等不良并发症。

3 讨论

腰椎峡部裂指的是峡部缺损或断裂, 或伴发

腰椎滑脱, 是腰背痛的一个已知原因^[2]。其病因复杂, 最可能的机制是椎弓峡部裂是一种反复的微损伤造成了关节间的缺损, 随之导致椎弓峡部发生应力性骨折。先天性发育不良所致的峡部缺损也是常见原因^[3,4]。本研究中所有的患者致伤原因均为长期军事或者体育锻炼。人体运动系统包括骨、关节和骨骼肌, 不同个体之间存在着明显差异。长期非科学、非个性化的训练容易引起机体反复出现微损伤, 峡部发生应力性骨折, 这可能与青年群体腰椎峡部裂高发生率存在相关性^[4]。

腰椎生物力学研究发现, 日常生活中, 正常节段的 L1~5 应力逐渐增加, 应力都集中在 L5 节段上^[5], 因此腰椎峡部裂常好发于下腰椎, 其中 90% 以上的患者发生在 L5 节段^[6]。本研究患者均为双侧腰椎峡部裂, 其中 L5 节段占 94%, 这与既往研究结果一致^[6]。

腰椎峡部裂患者一般在保守治疗有较好的恢复, 一线治疗包括 PT 和胸腰段和骶骨矫形器支撑的组合。有研究报道, 不少患者采取上述措施进行保守治疗之后都获得了好转, 甚至有部分儿童自发愈合^[7-9]。Karatas 等^[10]认为顽固性慢性腰痛患者保守治疗无效后可选择手术治疗。

腰椎峡部裂的手术方式有多种, 总体上分为前路、后路两类, 前路主要用于严重滑脱患者, 而后路主要有峡部直接修复术、后外侧融合术以及后路椎间植骨融合内固定术^[11]。20 世纪 50 年代, 后路腰椎椎体间融合术 (posterior lumbar interbody fusion, PLIF) 和经椎间孔椎体间融合术 (transforaminal lumbar interbody fusion, TLIF) 引入, 后逐渐向微创技术, 腰椎峡部裂治疗取得了很大进展。作为传统术式, 后路融合时峡部直接修补术不适合峡部缺损 2~3 mm 的患者, 完全达到骨性融合的概率会很低。尽管手术治疗可以减轻患者疼痛, 获得较好的短期疗效, 但是该术式以牺牲相邻节段机动性为代价^[10]。有力学研究结果表明, 传统的脊柱融合手术往往会增加相邻节段的应力, 长期的应力刺激下, 相邻节段比同年龄段的退行性改变更为严重, 后期可能需要进行额外手术治疗^[10,12-16]。Cecchinato 等^[17]力学研究发现, 80% 的重量通过前脊椎支撑的, 脊柱后柱仅支撑小于 20% 体重。相对于后路椎体间融合, 后外侧融合术 (posterolateral fusion, PLF) 可允许行坚固的椎体间小关节融合^[11]。Paul 等^[18]对 71 例采用无器械后

外侧融合术的腰椎峡部裂病例进行分析,共有 54 例患者达到稳固融合。Paul 据此认为,后外侧融合术是无内固定器械治疗峡部裂的一种有效的方式。Tsirikos 等^[19]对 34 例轻度峡部裂型腰椎滑脱的青少年患者行后外侧植骨融合的同时行峡部修补融合术,但 50.0%(17 例)的患者双侧峡部仍未融合,23.5%(8 例)的患者仅单侧峡部融合。张新亮等^[20]认为峡部融合率如此之低可能与未使用内固定有关。Kimura 等^[21]提出可直接修复峡部缺损,但直接修复术不适合峡部缺损超过 2~3mm 的患者。后续有学者采用钢丝捆扎或拉力螺钉固定,但是峡部融合率仍很低^[22~24]。本研究所有患者治疗上均采取的椎弓根钉棒系统短期刚性固定椎

体,以有效减少其微动性,为峡部后期骨性融合提供基本条件,椎体峡部的融合率高。峡部骨性愈合取出内固定后可完整保留腰椎的活动性,显著减少相邻节段退变的风险,这对于腰部活动度以及活动范围需求高的青年高发群体是一个福音。

双侧腰椎峡部裂,可合并腰椎滑脱不稳,通常以顽固性腰痛为主诉就诊,好发于青少年^[1]。腰椎椎弓根钉棒系统为刚性的固定物,牢固固定责任节段后可以短时间获得疼痛症状的缓解,并且能防止腰椎滑脱加剧、椎管狭窄等严重并发症,对于改善预后效果显著。本研究中 17 例青年患者均采用后路椎弓根钉棒系统治疗双侧腰椎峡部裂的方法,滑脱椎体牢固复位,术后切口愈合好,无神经

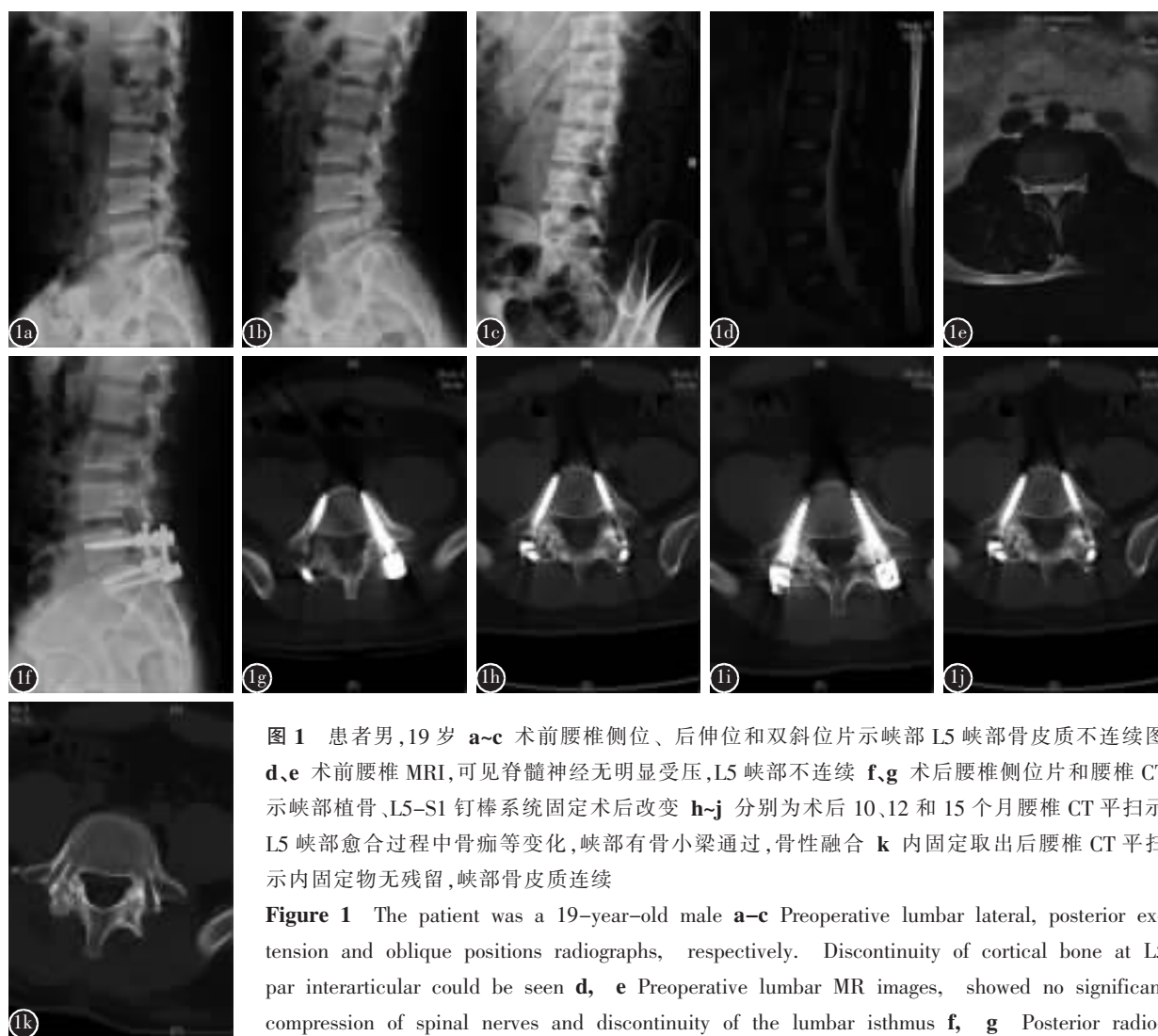


图 1 患者男,19 岁 a~c 术前腰椎侧位、后伸位和双斜位片示峡部 L5 峡部骨皮质不连续图 d、e 术前腰椎 MRI,可见脊髓神经无明显受压,L5 峡部不连续 f、g 术后腰椎侧位片和腰椎 CT 示峡部植骨、L5-S1 钉棒系统固定术后改变 h~j 分别为术后 10、12 和 15 个月腰椎 CT 平扫示 L5 峡部愈合过程中骨痂等变化,峡部有骨小梁通过,骨性融合 k 内固定取出后腰椎 CT 平扫示内固定物无残留,峡部骨皮质连续

Figure 1 The patient was a 19-year-old male a~c Preoperative lumbar lateral, posterior extension and oblique positions radiographs, respectively. Discontinuity of cortical bone at L5 par interarticular could be seen d, e Preoperative lumbar MR images, showed no significant compression of spinal nerves and discontinuity of the lumbar isthmus f, g Posterior radiographs and CT scans respectively. The changes in isthmus bone grafting and L5-S1 screw-rod system fixation were observed h~j CT scans of the lumbar spine at 10, 12 and 15 months after operation, showed changes in callus with bone trabecula passing through the isthmus and bone healing at L5 par k CT scans of the lumbar spine taken after removal of the hardware showed continuous isthmus cortex

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损伤、切口感染等并发症。末次随访复查腰椎 CT 提示峡部全部骨性愈合,椎弓根内固定取出术后腰部活动度恢复至伤前,患者对疗效满意度高达 90%以上。随访期内邻近节段均无退化现象,末次随访患者较术前疼痛减轻,甚至消失,脊柱功能得到恢复。

鉴于本研究为回顾性分析,入选病例较少,且未采取对照研究,证据级别较低。但已有的临床结果证实,腰椎后路峡部植骨及钉棒系统固定治疗青年腰椎峡部裂是一个安全且有效的方法。至于是否有其他并发症,尚需要累积更多的临床病例来进一步随访观察。下一步希望设计前瞻性研究,以完善椎弓根钉棒系统治疗腰椎峡部裂的入路及固定技术。

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