

全椎板减压侧块螺钉固定与单开门椎管成形治疗无骨折脱位型颈髓损伤的病例对照研究

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【摘要】 目的: 比较全椎板减压侧块螺钉固定与单开门椎管成形治疗无骨折脱位型颈髓损伤的临床疗效。方法: 对 2014 年 12 月至 2020 年 4 月收治的 75 例无骨折脱位型颈髓损伤患者进行回顾性分析, 其中男 65 例, 女 10 例, 年龄 33~83 (60.1±11.4) 岁。按手术方式分为观察组 (36 例) 与对照组 (39 例)。观察组采用 C₃-C₆ 单开门椎管减压成形术治疗。对照组采用“揭盖”的方式掀开 C₃-C₆ 全椎板, 侧块螺钉植骨固定融合治疗。记录两组患者的一般情况 (手术时间、术中出血量、住院时间) 和并发症 (轴性疼痛、脑脊液漏、术后 C₅ 神经麻痹); 采用疼痛视觉模拟评分 (visual analogue scale, VAS), Nurick 疼痛量表, 日本骨科协会 (Japanese Orthopaedic Association scores, JOA) 评分, 美国脊髓损伤协会 (American Spinal Injury Association, ASIA) 损伤量表评估两组患者术后 12 个月临床症状的改善及相关功能恢复情况。**结果:** 两组患者在手术时间、术中出血量、住院时间方面差异无统计学意义 ($P>0.05$); 术后 12 个月所有患者的 JOA 评分、VAS、ASIA、Nurick 评分与术前比较差异有统计学意义 ($P<0.05$), 组间比较差异无统计学意义; 两组患者术后并发症在 C₅ 神经根麻痹、轴性疼痛发生率方面差异有统计学意义 ($P<0.05$), 在脑脊液漏并发症上两组差异无统计学意义 ($P>0.05$)。**结论:** 颈椎后路手术全椎板减压侧块螺钉固定术与单开门椎管减压成形术治疗无骨折脱位型颈髓损伤, 在恢复神经功能、缓解疼痛、改善日常行为能力等方面均能获得满意的疗效, 但单开门椎管成形术具有创伤小、并发症发生率低的优势。

【关键词】 无骨折脱位型颈髓损伤; 脊髓损伤; 减压; 病例对照研究

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A case-control study: the clinical efficacy of total laminectomy with lateral mass screw fixation and single open-door laminoplasty for cervical spinal cord injury without fracture and dislocation LI Qiu-wei, WANG Lin, and WANG Hong.

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ABSTRACT Objective: To compare the clinical effects of total laminectomy with lateral mass screw fixation and single open-door laminoplasty in the treatment of cervical spinal cord injury without fracture and dislocation. **Methods:** The clinical data of 75 patients with cervical spinal cord injury without fracture and dislocation treated from December 2014 to April 2020 were retrospectively analyzed, including 65 males and 10 females, aged from 33 to 83 years old with an average of (60.1±11.4) years. According to surgical method, the patients were divided into observation group (36 cases) and control group (39 cases). The observation group was treated with C₃-C₆ single open-door laminoplasty. In the control group, the C₃-C₆ whole lamina was opened by "uncovering", and the lateral mass screw was fixed and fused. The general conditions including operation time, intraoperative blood loss, hospital stay and complications such as axial pain, cerebrospinal fluid leakage, postoperative C₅ nerve palsy were recorded. Visual analogue scale (VAS), Nurick pain scale, Japanese Orthopaedic Association (JOA) scores and American Spinal Injury Association (ASIA) injury scale were used to evaluate the improvement of clinical symptoms and related functional recovery 12 months after operation. **Results:** There were no statistically significant differences in operation time, intraoperative blood loss and hospital stay between two groups ($P>0.05$). There were statistically significant differences in JOA, VAS, ASIA and Nurick scores of the all patients between 12 months after surgery and before surgery ($P<0.05$), and there was no significant difference between groups. There was significant difference in the incidence of C₅ nerve root palsy and axial pain between two groups ($P<0.05$), but there was no significant difference in the complications of cerebrospinal fluid leakage between two groups ($P>0.05$). **Conclusion:** Total laminectomy with lateral mass screw fixation and single open-door laminoplasty in treating cervical spinal cord injury without fracture and dislocation can obtain satisfactory results in restoring nerve function, alleviating pain and improving daily behavior, but single open-door laminoplasty has the advantages of less trauma and low in-

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vidence of complications.

KEYWORDS Cervical spinal cord injury without fracture and dislocation; Spinal cord injuries; Decompression; Case-control studies

无骨折脱位型颈髓损伤(acute cervical spinal cord injury without fracture and dislocation, ACSCI-WOFD)是指外力导致患者具有临床症状和体征但无影像学异常的颈部脊髓损伤,可引起四肢麻木无力、大小便功能障碍等,影响患者的正常生活。因此,一旦确诊明确,大多数患者需手术治疗。根据脊髓损伤节段的不同,可采取颈椎前路和后路手术。对于多节段的颈髓损伤,一般采取颈椎后路的手术方式。目前临床上应用最多的颈椎后路术式分为全椎板切除减压术和单开门椎管减压成形术,本文对 2014 年 12 月至 2020 年 4 月采用颈椎后路治疗的 75 例无骨折脱位型颈髓损伤患者进行回顾性分析。

1 资料与方法

1.1 病例选择

纳入标准:症状、体征、影像学资料均符合无骨折脱位型颈髓损伤;手术方式均为颈椎后路;无颈椎后凸畸形;随访时间>12 个月,手术前后影像学资料完整;心、肺、脑等重要器官功能均尚可,血糖、血压术前均趋于正常范围;患者或家属知情同意。排除标准:合并胸、腰椎脊髓损伤;合并肿瘤、结核、感染、凝血功能及先天性的发育异常;明显颈椎后凸畸形。

1.2 临床资料

本组 75 例患者,根据手术方式的不同分为观察组和对照组。其中观察组 36 例,男 30 例,女 6 例;年龄 29~79(58.8±11.4)岁;行单开门椎板减压成形术。对照组 39 例,男 35 例,女 4 例;年龄 33~83(60.7±10.6)岁;行全椎板切除减压术。两组患者术前一般资料差异无统计学意义($P>0.05$),见表 1。所有患者影像学检查未发现明显脱位、骨折等情况,但其中 43 例有明显的椎体后缘骨质增生,38 例有不同程度的颈部椎管狭窄,包括 9 例发育性狭窄。伤后早期颈椎 MRI 检查:52 例患者在 T1W1 呈现低信号,T2W1 呈现高信号,表现为脊髓水肿;12 例在 T1W1 和 T2W1 中均呈现出低信号,表现为脊髓出血。

1.3 治疗方法

所有患者全身麻醉,麻醉成功后取仰卧位,头部俯卧于头架上,腹部悬空,双眼避免受压,胶带固定头部,常规术野消毒,铺单,取后正中切口。

观察组单开门由 C₂ 棘突下缘至 C₇ 棘突上缘,切口约 8 cm,依次切开皮肤、皮下及筋膜层。沿棘突剥离双侧椎旁肌肉,电凝止血,显露双侧 C₃-C₇ 椎板至关节突关节内侧。经 C 形臂 X 线透视见减压节段正确后,先咬除 C₃-C₇ 棘突骨以备术中植骨,以左侧

表 1 两组无骨折脱位型颈髓损伤患者术前一般资料比较
Tab.1 Comparison of preoperative general data of patients with cervical spinal cord injury without fracture and dislocation between two groups

组别	例数	性别(例)		年龄($\bar{x}\pm s$,岁)
		男	女	
观察组	36	30	6	58.8±11.4
对照组	39	35	4	60.7±10.6
检验值		$\chi^2=0.667$		$t=-1.838$
P 值		0.415		0.07

为门轴侧,右侧为椎管扩大成形侧。左侧于 C₃-C₇ 关节突关节内侧缘开槽,磨钻小心磨除外层皮质骨,保留内层薄层皮质骨,在神经剥离分子分离下,以薄层枪钳咬除左侧内层椎板,并清除周围韧带连接。神经钩小心钩起 C₃-C₇ 椎板向左侧掀开,形成开门,开门角度至 45°左右,清除椎管内韧带等致压软组织,开门后见硬膜囊完整,搏动良好。于开门间隙量取合适大小,分别于 C₃、C₅、C₇ 水平安放 12 mm 规格钢板各 1 枚,螺钉固定。术中透视见内固定位置良好。大量生理盐水冲洗伤口,确切止血,见无活动性出血后,将咬除之棘突骨修成条状,植于门轴侧,见图 1。

对照组全椎板切除减压采用沿 C₃-C₇ 棘突做长约 10 cm 纵行切口,切开皮肤、皮下及颈后筋膜,逐层剥离椎旁肌肉组织,电凝止血,充分显露 C₃-C₆ 双侧椎板及侧块。透视见螺钉位置良好。取长度合适的连接棒,按生理曲度预弯后置于螺钉尾部,颈部后伸以恢复颈椎生理前凸,顶丝固定。冲洗、止血,行 C₃-C₆ 全椎板切除减压。术中以神经剥离器仔细分离,磨钻逐步打磨 C₃-C₆ 双侧椎板边缘至骨质断裂,小号枪钳小心咬除椎板打磨处残留相连骨组织及黄韧带组织,随后以“揭盖”方式掀开 C₃-C₆ 全椎板。术中见 C₃-C₆ 局部椎管狭窄,椎管内部分粘连,水肿严重。术中彻底去除致压因素,探查见硬膜完整,明显膨出,搏动一般。锁紧顶丝,透视见“颈椎生理曲度较术前改善,内固定位置满意”。充分打磨 C₃-C₆ 双侧侧块,将取下的椎板骨组织制备成 2~3 mm 大小的颗粒状骨,行侧块间植骨融合,见图 2。

术后均予以止痛、抗炎、补液、营养神经等药物治疗。当 24 h 切口引流量<50 ml 时拔出引流管。在颈围的保护下下床活动,颈围固定 1 个月左右。

1.4 观察项目与方法

(1)记录两组患者的手术时间、术中出血量、住

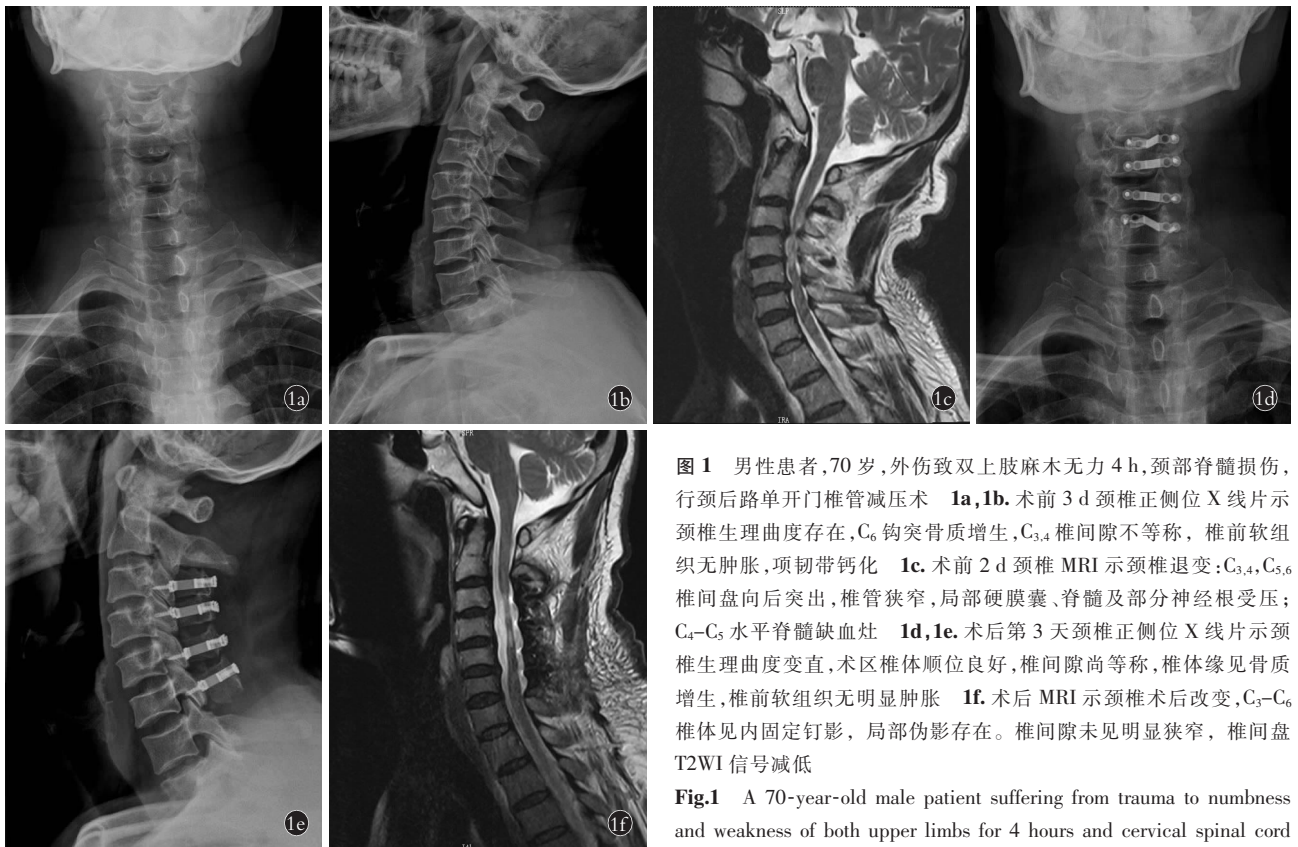


图 1 男性患者,70 岁,外伤致双上肢麻木无力 4 h,颈部脊髓损伤,行颈后路单开门椎管减压术 1a,1b。术前 3 d 颈椎正侧位 X 线片示颈椎生理曲度存在,C₆ 钩突骨质增生,C_{3,4} 椎间隙不等称,椎前软组织无肿胀,项韧带钙化 1c。术前 2 d 颈椎 MRI 示颈椎退变:C_{3,4},C_{5,6} 椎间盘向后突出,椎管狭窄,局部硬膜囊、脊髓及部分神经根受压;C₄-C₅ 水平脊髓缺血灶 1d,1e。术后第 3 天颈椎正侧位 X 线片示颈椎生理曲度变直,术区椎体顺位良好,椎间隙尚等称,椎体缘见骨质增生,椎前软组织无明显肿胀 1f。术后 MRI 示颈椎术后改变,C₃-C₆ 椎体见内固定钉影,局部伪影存在。椎间隙未见明显狭窄,椎间盘 T2WI 信号减低

Fig.1 A 70-year-old male patient suffering from trauma to numbness and weakness of both upper limbs for 4 hours and cervical spinal cord injury underwent posterior single open-door spinal canal decompression

1a,1b. Three days before operation, the anterior and lateral X-ray films of cervical spine showed the existence of cervical physiological curvature, hyperosteo-genesis of C₆ uncinate process, unequal size of C_{3,4} intervertebral spaces, no swelling of prevertebral soft tissue and calcification of nuchal ligament 1c. Two days before operation, cervical MRI showed cervical degeneration: C_{3,4}, C_{5,6} intervertebral discs protruded backward, spinal canal stenosis; local dural sac, spinal cord and partial nerve roots were compressed; spinal cord ischemic focus at C₄-C₅ level 1d,1e. On the 3rd day after operation, AP and lateral X-rays showed that the physiological curvature of the cervical spine became straight, the vertebral body in the operation area was in good alignment, the intervertebral space was still equal, the bone hyperplasia was seen at the edge of the vertebral body, and there was no obvious swelling of the prevertebral soft tissue 1f. Postoperative MRI showed postoperative changes of cervical spine, internal fixation nail shadows and local artifacts were observed in C₃-C₆ vertebrae. No obvious stenosis was found in intervertebral space, and T2WI signal of intervertebral disc decreased

院时间。(2)术前及术后 12 个月采用日本骨科协会 (Japanese Orthopaedic Association, JOA) 评分评估神经功能的恢复情况^[1];采用视觉模拟评分 (visual analogue scale, VAS) 评估疼痛程度^[2];采用 Nurick 疼痛量表评价日常行为恢复情况^[3];采用美国脊髓损伤协会 (American Spinal Injury Association, ASIA) 损伤量表 评估脊髓损伤程度^[4]。(3)统计术后出现轴性疼痛、脑脊液漏、C₅ 神经根麻痹等并发症的发生情况。

1.5 统计学处理

采用 SPSS 22.0 软件进行统计分析。定量资料采用均数±标准差 ($\bar{x}\pm s$) 表示,符合正态分布的定量资料采用成组设计样本 *t* 检验;两组间定性资料比较采用 χ^2 检验。以 $P<0.05$ 为差异有统计学意义。

2 结果

(1)两组手术时间、术中出血量、住院时间比较差异无统计意义 ($P>0.05$)。见表 2。(2)两组患者术后

12 个月的 VAS, JOA 评分均较术前明显改善;术前及术后 12 个月的 VAS, JOA 评分组间比较,差异均无统计学意义 (表 3)。说明两组患者术后神经功能和疼痛缓解均较术前有较大的改善,但两组手术之间在神经功能和疼痛缓解上并无明显差异。(3)两组患者手术前后的 Nurick 和 ASIA 评分差异均有统计学意义 (表 4),说明两组患者日常行为能力和脊髓损伤术后均有所改善,组间比较差异均无统计学意义 ($P>0.05$)。(4)对照组在轴性疼痛、C₅ 神经根麻痹并发症总发生率高于观察组 ($P<0.05$),在脑脊液漏并发症上两组差异无统计学意义 ($P>0.05$)。见表 5。

3 讨论

3.1 损伤机制及治疗策略

无骨折脱位型颈髓损伤多由高速事故引起的节段性半脱位对脊髓造成严重损伤,之后会自行减轻。在这种突然过度弯曲期间,脊髓的压缩发生在前部后纵韧带和轻度突出的椎间盘,以及后部的椎板和

表 2 两组无骨折脱位型颈髓损伤患者手术时间、术中出血量、住院时间比较($\bar{x}\pm s$)

Tab.2 Comparison of operation time, intraoperative blood loss and length of hospital stay of patients with cervical spinal cord injury without fracture and dislocation between two groups($\bar{x}\pm s$)

组别	例数	手术时间(h)	术中出血量(ml)	住院时间(d)
观察组	36	1.75±0.63	220.35±75.47	13.23±3.05
对照组	39	1.82±0.55	224.67±80.26	14.67±4.29
t 值		2.763	1.604	1.458
P 值		0.085	0.061	0.085

黄韧带。因此，椎管狭窄和椎间盘疾病是成人 AC-SCIWOFD 发展的重要条件,在男性中老年群体中更为常见^[5]。目前主要的治疗方式为保守治疗和早期手术干预。Jin 等^[6]在对 17 例无骨折脱位型颈脊髓

损伤的患者治疗后发现，保守治疗 6 周后 8 例出现不同程度的神经功能的恶化复发。目前认为,对于无骨折脱位型颈部脊髓损伤的治疗，早期的手术干预有助于改善损伤部位和远端脊髓运动神经元的功能障碍,减少继发性运动神经元的丢失。Wang 等^[7]对无骨折脱位型颈脊髓损伤的患者治疗中长期随访发现,在所有患者中 JOA 评分在前后路治疗之间没有明显差异。但根据 Frankel 分类,手术治疗和保守治疗的患者之间存在明显差异。早期的手术治疗减压能直接缓解脊髓的压迫，减少神经症状和一些并发症的出现。临床上有多种手术方式可以用于 AC-SCIWOFD 的治疗,主要包括前路、后路、前后路联合 3 种入路。颈椎前路减压融合术(anterior cervical discectomy and fusion, ACDF) 主要通过直接探查颈椎间盘,去除压迫脊髓受压组织,重建颈椎的生理结构,从而恢复脊髓功能和颈椎的稳定性。ACDF 主要



图 2 男性患者,72 岁,外伤致颈部不适伴双手麻木无力 4 h,颈部脊髓损伤,行颈后路全椎板减压侧块螺钉固定术 2a,2b。术前 3 d 颈椎正侧位 X 线片示颈椎退变,C₅ 椎体棘突不连 2c。术前 2 d 颈椎 MRI 示颈椎生理曲度存在,顺位尚可;椎体边缘骨质增生,椎体骨质信号不均匀。颈段各椎间隙未见明显变窄,颈椎间盘 T2WI 信号强度减低,C_{3,4} 及 C_{4,5} 椎间盘向后膨出,C_{5,6} 椎间盘向后方膨出,相应硬膜囊、脊髓受压。C_{3,4} 水平颈段脊髓见斑片样长 T2 信号。颈椎前及颈背部局部软组织肿胀、渗出 2d,2e。术后 3 d 颈椎正侧位 X 线片示 C₃-C₆ 椎体内固定术后,相应部位见金属固定影,术区顺位可 2f。术后 MRI 示颈椎术后改变,相应部位见金属固定影

screw fixation 2a,2b. Three days before operation, AP and lateral X-rays showed cervical degeneration and nonunion between the spinous process and the C₅ vertebral body 2c. Two days before operation, MRI showed that the physiological curvature of cervical spine existed and the alignment was fair; Bone hyperplasia at the edge of vertebral body, and the bone signal of vertebral body was uneven. No obvious narrowing was observed in the cervical intervertebral space, the T2WI signal intensity of cervical intervertebral disc was decreased, The C_{3,4} and C_{4,5} intervertebral discs were dilated backward, and the C_{5,6} intervertebral disc were bulged posteriorly, and the corresponding dural sac and spinal cord were compressed. Patchy long T2 signal can be seen in cervical spinal cord at C_{3,4} level. Local soft tissue swelling and exudation in front and back of cervical spine 2d,2e. Three days after operation, AP and lateral X-rays showed that postoperative C₃-C₆ vertebral body, metal fixation shadow can be seen at the corresponding position, and the location of the operative area was acceptable 2f. Postoperative MRI showed postoperative changes of cervical spine, and metal fixation shadow was observed in corresponding parts

表 3 两组无骨折脱位型颈髓损伤患者手术前后 VAS 和 JOA 评分比较($\bar{x}\pm s$, 分)

Tab.3 Comparison of pre- and post-operative VAS and JOA of patients with cervical spinal cord injury without fracture and dislocation between two groups($\bar{x}\pm s$, score)

组别	例数	JOA 评分				VAS 评分			
		术前	术后 12 个月	t 值	P 值	术前	术后 12 个月	t 值	P 值
观察组	36	7.70±0.75	13.30±0.47	15.774	0.000	7.22±0.57	2.56±0.24	19.374	0.000
对照组	39	8.00±0.65	13.43±0.57	15.439	0.000	7.67±0.33	2.00±0.00	20.069	0.000
t 值		0.425	0.653			0.784	0.987		
P 值		0.642	0.584			0.487	0.056		

表 4 两组无骨折脱位型颈髓损伤患者手术前后 Nurick 和 ASIA 评分比较($\bar{x}\pm s$, 分)

Tab.4 Comparison of pre- and post-operative Nurick and ASIA of patients with cervical spinal cord injury without fracture and dislocation between two groups($\bar{x}\pm s$, score)

组别	例数	Nurick 评分				ASIA 评分			
		术前	术后 12 个月	t 值	P 值	术前	术后 12 个月	t 值	P 值
观察组	36	2.70±0.30	1.60±0.22	14.835	0.000	69.78±2.99	50.56±0.80	11.56	0.015
对照组	39	2.33±0.21	1.17±0.17	17.659	0.000	78.33±4.55	49.50±1.59	13.43	0.024
t 值		0.749	0.834			0.945	0.479		
P 值		0.586	0.627			0.663	0.875		

表 5 两组无骨折脱位型颈髓损伤患者患者术后并发症情况比较($\bar{x}\pm s$, 例)

表 5 Comparison of postoperative complications of patients with cervical spinal cord injury without fracture and dislocation between two groups($\bar{x}\pm s$, case)

组别	例数	轴性症状		C ₅ 神经根麻痹		脑脊液漏
		可	差	可	差	
观察组	36	2	1	0	2	2
对照组	39	9	2	7	3	2
χ^2 值		4.869		5.619		0.007
P 值		0.038		0.026		1.000

运用于 3 个节段以下的颈部脊髓损伤,而对于多阶段的 ACSCIWOFD 一般选用颈后路入路方式。后路手术较前路手术能够提供更稳定的固定,而且能够更加方便的去病变节段椎板^[8]。目前,临床上常用的颈后路包括全椎板减压融合术和单开门、双开门椎管成形术。

3.2 两种术式特点及其适应证

单开门椎管成形术是通过向后打开轴下椎管的方式使脊髓的背侧移位达到充分的脊髓减压。在传统的开门椎板成形术中,颈部肌肉在两侧被解剖。在开口侧行单侧椎板切开术后,在铰链侧行单皮质切开术以削弱椎板。“开门”的稳定通过一个迷你板,单侧入路在保留一侧肌肉韧带复合体的情况下实现了相同的开口。与传统技术相比,对侧椎板在不破坏骨

性结构的情况下断裂。这是通过打孔和拇指对棘突同时施加的力使椎板升高来完成的。通常,从 C₆ 到 C₃ 进行开口,以使脊髓有足够的移位。如有必要,单开门椎板成形术可结合单侧 LM 螺钉固定,采用相同的微创入路^[9]。相比较于全椎板减压融合术,其优点在于能够降低术后脊柱后凸和颈部疼痛的风险,并且能够保留对侧的肌肉韧带复合体。主要适用于多节段的颈椎管狭窄伴脊髓病;脊柱明显前凸或者中性矢状面;颈部疼痛和中性矢状面需要额外的单侧稳定。禁忌证为:下颈椎后凸排列;椎间孔狭窄导致的双侧神经根病;节段明显不稳^[9-10]。

全椎板减压融合术是目前一种广泛应用的颈椎后路手术,主要是能够对脊髓进行广泛的减压。目前全椎板减压常常与侧块螺钉固定或者融合术一起进行,因为单纯的全椎板切除往往会导致术后颈椎结构不稳,全椎板减压联合侧块螺钉固定或者融合能够使后凸畸形、术后节段不稳定、神经功能恶化的概率降低^[11]。主要适应证为:颈椎管狭窄症;急性创伤性中央管脊髓综合征;黄韧带过度肥大或者有颈椎后纵韧带骨化症。禁忌证为:严重后凸畸形;椎管缩小>50%;颈椎节段明显不稳^[12]。

本研究中所纳入的 75 例研究对象颈椎正侧位片、CT 扫描均未发现明显的骨折或脱位,但绝大多数患者有不同程度的颈椎退变及骨赘生成,近一半患者 CT 扫描后发现椎管狭窄。颈椎 MRI 检查发现所有患者在创伤后出现不同程度的脊髓水肿或者

出血,并且所有接受手术的患者观察到了 T2 成像的高信号变化,这和 Bao 等^[13]在对 16 例 ACSCIWOFD 的患者研究中观察到的结果一致。MRI 作为 ACSCIWOFD 的重要诊断工具,在 MRI 扫描中可以观察到颈脊髓中的高强度信号变化、椎间盘突出和破裂、椎管狭窄和颈椎前积液,而在 CT 上经常被遗漏。

3.3 两种术式疗效及其术后并发症

两种颈后路手术方式均能够有效改善患者的临床神经症状,减轻疼痛,取得满意的临床疗效。两组患者术后 Nurick 评分较术前均有较大程度的下降,说明两组患者术后步态改善或者恢复较为明显,日常行为能力得到恢复。并且术后 12 个月两组患者 ASIA 评分均较术前明显好转($P<0.05$)。在术后并发症方面,12 例出现轴性症状、C₅ 神经根麻痹、脑脊液漏症状,其中全椎板减压组在轴性症状、C₅ 神经根麻痹并发症上发生率更高。C₅ 神经根麻痹在临床上好发于男性,通常表现为三角肌和肱二头肌的无力,可能在术后几天内出现,但由于其症状的短暂性,一般采取保守治疗为主^[14]。目前关于轴性症状的发生具体因素尚不明确,颈曲角度、术前脊髓压迫率和术后脊髓移位被认为是轴性疼痛的相关影响因素,术后脊髓移位是轴性症状的高危因素。神经牵引引起脊髓后移,术后硬膜膨出引起脊髓牵拉更大,颈脊髓过度变形引起自主神经损伤或支配血管的坏死可能是轴性疼痛的发病机制^[15]。但根据临床随访数据,笔者认为颈后路手术 C₅ 神经根麻痹和轴性症状的发生不会影响神经功能的恢复,当然这一观点需要更多的临床试验来验证。而在脑脊液漏的发生率上,全椎板减压和单开门椎管成形术未见明显差异。

3.4 结论

无骨折脱位型颈髓损伤的治疗关键在于利用 MRI 做到早期检查,从而能够尽早选择合适的治疗手段减轻患者的疼痛。目前临床上常用的两种治疗 ACSCIWOF 的颈后路手术方式在术后神经功能恢复、日常行为能力恢复、疼痛缓解等方面都具有很好的效果。但全椎板减压在术后并发症 C₅ 神经根麻痹、轴性疼痛发生率高于单开门椎管成形术,单开门椎管成形术具有创伤小、并发症发生率低的优势。综上所述,两种手术方式在治疗 ACSCIWOF 都能在恢复神经功能上达到满意的疗效,但由于每一种术式都在不断更新和变化,因此脊柱外科医生必须充分认识每种手术的适应证和禁忌证,根据每位患者不同的情况选取合适的手术方式变得尤为重要。

参考文献

[1] Kobayashi K, Imagama S, Ito Z, et al. Prevention of spinal cord injury using brain-evoked muscle-action potential (Br (E)-MSEP) moni-

toring in cervical spinal screw fixation[J]. *Euro Spine J*, 2017, 26(4): 1154-1161.

- [2] 李玉伟,王海蛟,王义生,等. 不同脊髓前方致压因素对后路手术治疗脊髓型颈椎病疗效的影响[J]. *中国修复重建外科杂志*, 2015, 29(9): 1099-1103.
- LI YW, WANG HJ, WANG YS, et al. Influence of anterior spinal cord compression factors on the curative effect of posterior approach surgery for cervical spondylotic myelopathy[J]. *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi*, 2015, 29(9): 1099-1103. Chinese.
- [3] Gu J, Guan F, Zhu L, et al. Predictors of surgical outcome in acute spinal cord injury patients with cervical ossification of the posterior longitudinal ligament[J]. *World Neurosurgery*, 2016, 90: 364-371.
- [4] Ter Wengel PV, Post MWM, Martin E, et al. Neurological recovery after traumatic spinal cord injury: what is meaningful? A patients' and physicians' perspective[J]. *Spinal Cord*, 2020, 58(8): 865-872.
- [5] Wyndaele JJ, Sciwora[J]. *Spinal Cord*, 2016, 54(10): 755.
- [6] Jin W, Sun X, Shen K, et al. Recurrent neurological deterioration after conservative treatment for acute traumatic central cord syndrome without bony injury: seventeen operative case reports[J]. *J Neurotrauma*, 2017, 34(21): 3051-3057.
- [7] Wang J, Li J, Cai L. Effects of treatment of cervical spinal cord injury without fracture and dislocation in a medium-to long-term follow-up study[J]. *World Neurosurg*, 2018, 113: E515-F520.
- [8] Zheng C, Yu Q, Shan X, et al. Early surgical decompression ameliorates dysfunction of spinal motor neuron in patients with acute traumatic central cord syndrome: an ambispective cohort analysis[J]. *Spine (Phila Pa 1976)*, 2020, 45(14): E829-E838.
- [9] Kothe R, Schmeiser G, Papavero L. Open-door laminoplasty: what can the unilateral approach offer[J]. *Oper Orthop Traumatol*, 2018, 30(1): 3-12.
- [10] Lee YS, Lee S, Kom J, et al. Preservation of deep cervical extensor muscle volume: comparison between conventional open-door and muscle preserving laminoplasty approaches in the same patients[J]. *World Neurosurg*, 2020, 141: E514-E523.
- [11] Phan K, Scherman DB, Xu J, et al. Laminectomy and fusion vs laminoplasty for multi-level cervical myelopathy: a systematic review and meta-analysis[J]. *Eur Spine J*, 2017, 26(1): 94-103.
- [12] Lawrence BD, Brodke DS. Posterior surgery for cervical myelopathy: indications, techniques, and outcomes[J]. *Orthop Clin North Am*, 2012, 43(1): 29-40.
- [13] Bao Y, Zhong X, Zhu W, et al. Feasibility and safety of cervical kinematic magnetic resonance imaging in patients with cervical spinal cord injury without fracture and dislocation[J]. *Orthop Surg*, 2020, 12(2): 570-581.
- [14] Joaquim AF, Makhni MC, Riew KD. Postoperative nerve injuries after cervical spine surgery[J]. *Int Orthop*, 2019, 43(4): 791-795.
- [15] 朱小龙,徐卫星,丁伟国,等. 颈椎单开门椎板成形术后轴性症状的影响因素分析[J]. *中国骨伤*, 2018, 31(11): 1022-1026.
- ZHU XL, XU WX, DING WG, et al. Analysis of factors influencing axial symptoms after open-door laminoplasty of cervical spine[J]. *Zhongguo Gu Shang/China J Orthop Trauma*, 2018, 31(11): 1022-1026. Chinese with abstract in English.

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