

· 临床研究 ·

选择性椎板成形术和传统椎板成形术治疗脊髓型颈椎病的中期疗效

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【摘要】目的 对比选择性椎板成形术和传统椎板成形术治疗脊髓型颈椎病的中期疗效。**方法** 回顾性分析2010年9月—2015年12月收治的130例脊髓型颈椎病(CSM)患者临床资料, 其中67例采用选择性椎板成形术治疗(试验组), 63例采用传统椎板成形术治疗(对照组)。记录并比较2组手术时间、术中出血量、并发症发生情况, 以及手术前后双手10 s握拳次数、双手握力、日本骨科学会(JOA)评分、C₂₋₇ Cobb角、C₂₋₅ Cobb角、C₅₋₇ Cobb角、C₇倾斜角、T₁倾斜角、C₂₋₇矢状位平衡(SVA)和K线角。**结果** 试验组手术时间、术中出血量均少于对照组, 差异有统计学意义($P < 0.05$)。2组患者末次随访时双手10 s握拳次数、双手握力及JOA评分均较术前改善, 差异有统计学意义($P < 0.05$)。末次随访时, 对照组C₂₋₇ Cobb角较术前减小、C₂₋₇ SVA较术前增大, 而试验组无显著改变, 2组相比差异有统计学意义($P < 0.05$)。末次随访时, 试验组7例(7/67, 10.4%)发生轴性症状, 对照组20例(20/63, 31.7%)发生轴性症状, 试验组轴性症状发生率显著低于对照组, 差异有统计学意义($P < 0.05$)。**结论** 2种术式治疗CSM中期临床疗效满意。选择性椎板成形术在保证手术疗效的前提下, 可缩短手术节段, 减少对颈后部肌肉韧带的损伤, 降低术后轴性症状的发生率。

【关键词】 颈椎; 颈椎病; 减压术, 外科**【中图分类号】** R 681.531.1 **【文献标志码】** A **【文章编号】** 1672-2957(2019)05-0308-06**【DOI】** 10.3969/j.issn.1672-2957.2019.05.003

Mid-term efficacy of selective laminoplasty and traditional laminoplasty for cervical spondylotic myelopathy

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【Abstract】Objective To observe and compare the medium-term efficacy between selective laminoplasty and traditional laminoplasty for the treatment of cervical spondylotic myelopathy (CSM). **Methods** The clinical data of 130 CSM patients recruited from September 2010 to December 2015 were retrospectively analyzed, of whom 67 were treated with selective laminoplasty (experiment group) and 63 were treated with traditional laminoplasty (control group). The operation time, intraoperative blood loss, complications, as well as number of finger grip and release test in 10 s, grip strength, Japanese Orthopaedic Association (JOA) score, C₂₋₇ Cobb's angle, C₂₋₅ Cobb's angle, C₅₋₇ Cobb's angle, C₇ slope, T₁ slope, C₂₋₇ sagittal vertical axis (SVA) and K-line tilt at pre- and post-operative were recorded and compared between the 2 groups. **Results** The operation time and intraoperative blood loss of the experiment group were less than those of the control group, and the differences were statistically significant ($P < 0.05$). At the final follow-up, the number of finger grip and release test in 10 s, the grip strength and JOA score of both groups were improved compared with those at pre-operation, and the differences were statistically significant ($P < 0.05$). At the final follow-up, the C₂₋₇ Cobb's angle decreased and C₂₋₇ SVA increased compared with pre-operation in the control group, but there was no significant change in the experiment group; there were significant differences between the 2 groups ($P < 0.05$). At the final follow-up, 7 patients (7/67, 10.4%) had axial symptoms in the experiment group, while 20 (20/63, 31.7%) in the control group. The incidence of axial symptoms was significantly lower in the experiment group than in the control group, and the difference was statistically significant ($P < 0.05$). **Conclusion** The mid-term clinical effect of 2 surgical methods for CSM is satisfactory. Selective laminoplasty can shorten the operative segment, reduce the injury to the posterior cervical muscles and ligaments, and reduce the incidence of axial symptoms.

【Key Words】 Cervical vertebrae; Cervical spondylosis; Decompression, surgical

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后路颈椎椎板成形术是治疗多节段脊髓型颈椎病(CSM)的主要术式^[1]。对于颈椎生理曲度尚存的颈椎病患者,椎板成形术可以使脊髓向后方充分漂移,解除脊髓前后方压迫^[2-3]。传统椎板成形术选择C₃₋₇为手术节段,手术效果良好,但对颈椎后部肌肉、韧带造成不同程度的破坏,导致术后出现颈椎活动度(ROM)降低、矢状位平衡(SVA)改变、C₅神经根麻痹和轴性症状等并发症^[4-7]。传统椎板成形术通常切开分离在C₂棘突上附着的颈半棘肌和在C₇棘突上附着的颈背部肌肉。有研究表明,虽然在关闭切口时对分离的肌肉进行缝合重建,但18%的患者术后存在颈半棘肌重建不良,导致颈半棘肌及颈背部肌肉萎缩及功能不全;剥离肌肉C₇止点及项韧带导致轴性疼痛及颈椎SVA改变^[8]。为减少术后并发症的发生,有学者提出选择性椎板成形术,在保证减压效果的前提下减少开门节段,减少对颈椎后部肌肉、韧带的损伤,尤其是对C₂及C₇棘突肌肉、韧带的保护,取得良好疗效^[9]。本研究回顾性分析2010年9月—2015年12月采用选择性椎板成形术和传统椎板成形术治疗的CSM患者的临

床资料,并对临床效果进行对比分析,现总结报告如下。

1 资料与方法

1.1 一般资料

纳入标准:①非手术治疗>3个月无效;②CT或MRI检查确认 ≥ 2 个节段颈椎椎管狭窄、脊髓受压且有相应症状;③术前颈椎动力位X线片未发现颈椎明显不稳。排除标准:①术前侧位X线片示颈椎后凸畸形(C₂₋₇ Cobb角 $\leq -12^\circ$);②前方巨大椎间盘突出或骨赘致脊髓严重受压(椎管占位率 $\geq 50\%$);③类风湿关节炎、肿瘤、外伤、感染、脊柱手术史、伴胸腰段脊柱疾病;④失访或影像学资料不全。

根据以上标准共纳入患者130例,其中67例采用选择性后路颈椎椎板成形术治疗(试验组),63例采用传统后路颈椎椎板成形术治疗(对照组)。试验组中20例为后纵韧带骨化所致;对照组中17例为后纵韧带骨化所致。2组一般资料差异无统计学意义,具有可比性($P>0.05$,表1)。

表1 一般资料

Tab. 1 General data

组别 Group	n	年龄 / 岁 Age/year	性别 Gender		病程 / 月 Course of disease/ month	病变节段 Lesion segment					住院时 间/d Hospital stay/d	随访时间 / 月 Follow up time/month	合并症 Complication		
			男 Male	女 Female		C ₂₋₇	C ₃₋₇	C ₃₋₆	C ₃₋₅	C ₄₋₇			高血压 Hypertension	2型糖尿病 Type 2 diabetes mellitus	冠心病 Coronary diseas
对照 Control	63	56.5 ± 9.8	43	20	29.1 ± 32.9	17	13	22	6	5	11.3 ± 2.9	38.5 ± 17.6	19	4	3
试验 Experiment	67	57.9 ± 9.3	49	18	31.2 ± 45.1	19	11	27	5	5	10.4 ± 4.3	40.1 ± 18.9	18	6	3

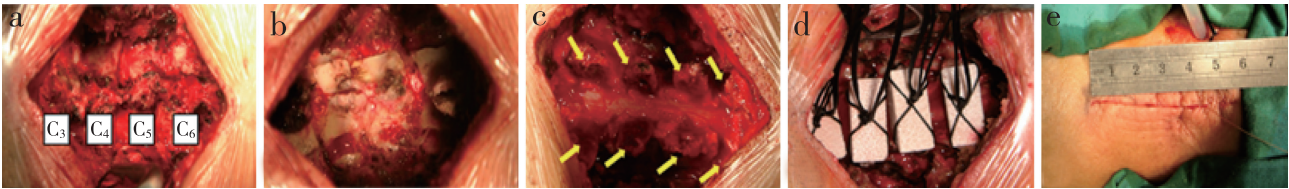
1.2 手术方法

对照组患者全身麻醉后取俯卧位,常规消毒铺巾,做颈后正中切口长约10 cm,依次显露C₃至C₇棘突分叉,于棘突分叉基底部剪断分叉,剥离双侧椎旁肌显露C₃₋₇棘突及椎板。用直径为2 mm的高速磨钻正中劈开C₃₋₇棘突,之后改用直径为5 mm的磨钻于C₃₋₇两侧椎板侧块交界处开槽至内板,用棘突间撑开器向两侧撑开,行双侧开门并在被劈开的棘突上打孔。取合适型号(24或26号)的梯形珊瑚羟基磷灰石人工骨(意华健,北京),用双10号丝线穿过人工骨及棘突打孔处后,将人工骨交叉固定于棘突上。将被劈开的棘突分叉缝合固定后逐层关闭切口。

试验组手术方法以C₃₋₇病变,行C₃₋₆开门为例(图1)进行介绍。患者全身麻醉后取俯卧位,常规消毒铺巾,做颈后正中切口长约5 cm,剥离双侧椎旁肌显露C₃₋₆棘突及椎板(注意不要剥离颈椎半棘肌及项韧带在C₂及C₇棘突上起止点)。其他步骤同对照组。椎板成形范围选择:①病变节段头端为C₂,行C₂椎板潜行减压并C₃至尾端下位椎板(C₆以上节段)开门。如病变节段为C₂₋₅,行C₂潜行减压并C₃₋₅开门;②病变节段头端为C₃,行C₃至尾端下位椎板(C₆以上节段)开门;③病变节段为C₇,则开门至C₆并C₇椎板潜行减压。

1.3 评价指标

记录并比较2组手术时间、术中出血量、并发



a: 显露C₃₋₆ 棘突、椎板 b: 双侧开槽、劈开棘突 c: 双侧开门, 箭头示劈开的棘突 d: 安放羟基磷灰石人工骨并用丝线固定 e: 切口长度
a: Exposing C₃₋₆ spinous processes and laminae b: Bilateral grooving and splitting of spinous processes c: Double door. Arrow indicates splitting of spinous processes d: Hydroxyapatite artificial bone is placed and fixed with silk thread e: Length of incision

图1 选择性椎板成形术切口
Fig. 1 Selective laminoplasty incision

症发生情况, 以及术前、末次随访时双手 10 s 握拳次数、双手握力及日本骨科学会(JOA)^[10]评分。颈后或肩胛上区域疼痛或僵硬诊断为轴性症状。JOA 评分改善率(%)=(术后JOA 评分-术前JOA 评分)/(17-术前JOA 评分)×100%。

采用 Surgimap Spine(Nemaris Inc, USA) 软件, 在术前及末次随访侧位 X 线片上测量并比较 2 组 C₂₋₇ Cobb 角、C₂₋₅ Cobb 角、C₅₋₇ Cobb 角、C₇ 倾斜角、T₁ 倾斜角、C₂₋₇ SVA 和 K 线角。①Cobb 角为相应节段上位椎体上终板与下位椎体下终板延长线间的夹角。②SVA 为 C₂ 中心垂线与 C₇ 椎体后上缘的距离。③C₇ 或 T₁ 倾斜角是 C₇ 或 T₁ 上终板延长线和水平线间的夹角。④K 线为 C₂ 与 C₇ 椎管中点的连线, 骨化的后纵韧带未超过 K 线为(+), 超过 K 线为(-)。K 线角为 K 线与铅垂线间的夹角。

1.4 统计学处理

采用 SPSS 22.0 软件对数据进行统计学分析, 数据采用 $\bar{x} \pm s$ 表示, 术前及末次随访比较采用配对样本 *t* 检验, 2 组之间比较采用独立样本 *t* 检验; 以 *P* < 0.05 为差异有统计意义。

2 结 果

试验组 19 例潜行切除 C₂ 椎板下缘, 2 例潜行切

除 C₆ 椎板上缘, 35 例潜行切除 C₇ 椎板上缘。试验组手术时间、术中出血量均少于对照组, 差异有统计学意义(*P* < 0.05, 表 2)。2 组患者末次随访时双手 10 s 握拳次数、双手握力及 JOA 评分均较术前改善, 差异有统计学意义(*P* < 0.05, 表 2); 组间比较差异均无统计学意义(*P* > 0.05, 表 2)。2 组患者末次随访时 C₂₋₅ Cobb 角、C₅₋₇ Cobb 角、C₇ 倾斜角、T₁ 倾斜角及 K 线角与术前相比差异均无统计学意义(*P* > 0.05, 表 2); 组间比较差异也无统计学意义(*P* > 0.05, 表 2)。末次随访时, 对照组 C₂₋₇ Cobb 角较术前减小, C₂₋₇ SVA 较术前增大, 差异均有统计学意义(*P* < 0.05, 表 2); 末次随访时, 试验组 C₂₋₇ Cobb 角和 C₂₋₇ SVA 与术前相比差异均无统计学意义(*P* > 0.05, 表 2); 末次随访时, 试验组 C₂₋₇ Cobb 角和 C₂₋₇ SVA 与对照组相比, 差异均有统计学意义(*P* < 0.05, 表 2)。

试验组术后 1 例因切口愈合不良行清创术, 术后伤口愈合良好。对照组 2 例发生 C₅ 神经根麻痹, 给予营养神经药物治疗后 1 个月好转; 发生脑脊液漏 1 例, 伤口感染 2 例, 均经换药、清创等治疗后痊愈。末次随访时, 试验组 7 例(7/67, 10.4%) 发生轴性症状, 对照组 20 例(20/63, 31.7%) 发生轴性症状, 试验组轴性症状发生率显著低于对照组, 差异有统计学意义(*P* < 0.05)。2 组典型病例影像学资料见图 2, 3。

表 2 统计数据
Tab. 2 Statistical data

组别 Group	<i>n</i>	手术时间/ min Operation time/min	出血量/mL Blood loss/ mL	左手 10 s 握拳次数		右手 10 s 握拳次数		左手握力/kg	
				Number of left finger grip in 10 s		Number of right finger grip in 10 s		Grip strength of left hand/kg	
				术前 Pre-operation	末次随访 Final follow-up	术前 Pre-operation	末次随访 Final follow-up	术前 Pre-operation	末次随访 Final follow-up
对照 Control	63	161 ± 57	231 ± 111	11.5 ± 2.3	18.2 ± 3.7*	10.7 ± 1.5	17.8 ± 2.8*	18.7 ± 2.8	34.3 ± 1.8*
试验 Experiment	67	139 ± 53 [△]	131 ± 83 [△]	11.3 ± 3.2	18.6 ± 2.5*	10.9 ± 2.1	18.1 ± 1.6*	17.8 ± 6.5	33.4 ± 5.2*

续表 2

组别 Group	右手握力/kg		C ₂₋₇ Cobb角/(°)		C ₂₋₅ Cobb角/(°)		C ₅₋₇ Cobb角/(°)		C ₇ 倾斜角/(°)	
	Grip strength of right hand/kg		C ₂₋₇ Cobb's angle/(°)		C ₂₋₅ Cobb's angle/(°)		C ₅₋₇ Cobb's angle/(°)		C ₇ slope/(°)	
	术前	末次随访	术前	末次随访	术前	末次随访	术前	末次随访	术前	末次随访
	Pre-operation	Final follow-up	Pre-operation	Final follow-up	Pre-operation	Final follow-up	Pre-operation	Final follow-up	Pre-operation	Final follow-up
对照 Control	18.1 ± 6.2	33.7 ± 4.2 [*]	17.2 ± 6.6	13.6 ± 5.9 [*]	8.0 ± 5.8	6.3 ± 5.6	10.6 ± 4.1	8.1 ± 5.7	25.5 ± 6.1	24.6 ± 5.9
试验 Experiment	18.4 ± 3.8	34.1 ± 2.7 [*]	17.4 ± 7.5	15.9 ± 6.3 [△]	8.2 ± 5.8	7.4 ± 6.9	9.9 ± 4.7	8.8 ± 6.0	25.4 ± 5.7	24.7 ± 6.2

组别 Group	T ₁ 倾斜角/(°)		K线角/(°)		C ₂₋₇ SVA/mm		JOA 评分		
	T ₁ slope/(°)		K-line tilt/(°)				JOA scores		
	术前	末次随访	术前	末次随访	术前	末次随访	术前	末次随访	改善率(%)
	Pre-operation	Final follow-up	Pre-operation	Final follow-up	Pre-operation	Final follow-up	Pre-operation	Final follow-up	Improvement rate(%)
对照 Control	28.5 ± 7.2	28.3 ± 6.4	9.7 ± 5.9	10.8 ± 7.1	20.8 ± 8.5	24.2 ± 6.0 [*]	10.3 ± 1.4	13.9 ± 2.3 [*]	55.9 ± 15.4
试验 Experiment	28.7 ± 7.4	28.2 ± 6.8	9.8 ± 6.7	10.5 ± 7.1	20.9 ± 6.5	22.1 ± 7.9 [△]	9.7 ± 1.5	14.0 ± 1.3 [*]	58.6 ± 14.4

注: *与术前相比, $P < 0.05$; Δ 与对照组相比, $P < 0.05$
Note: * $P < 0.05$, compared with pre-operation; Δ $P < 0.05$, compared with control group

女, 71岁, 四肢麻木>4个月, 行C₃₋₆椎板成形术 a~c: 术前影像学资料 d, e: 术后2年影像学资料示减压充分, 颈椎矢状位序列良好
Female, 71 years old, limbs numb for >4 months, treated with C₃₋₆ laminoplasty a~c: Preoperative imaging data d, e: Imaging data at postoperative 2 years show that decompression is sufficient and sagittal sequence of cervical spine is good

图2 对照组典型病例影像学资料

Fig. 2 Imaging data of a typical case in control group

男, 47岁, 右上肢无力>2年, 加重0.5年, 行C₃₋₅椎板成形术, C_{2,6}椎板潜行减压 a~c: 术前影像学资料 d, e: 术后3年影像学资料示减压充分, 颈椎矢状位序列良好
Male, 47 years old, right upper limb weakness for >2 years, aggravated by 0.5 years, treated with C₃₋₅ laminoplasty and C_{2,6} lamina decompression a~c: Preoperative imaging data d, e: Imaging data at postoperative 3 years show that decompression is sufficient and sagittal sequence of cervical spine is good

图3 试验组典型病例影像学资料

Fig. 3 Imaging data of a typical case in experiment group

3 讨论

3.1 椎板成形术后并发症

3.1.1 颈椎生理曲度丢失

颈椎生理曲度丢失或后凸畸形是椎板成形术后的主要并发症,颈椎生理曲度丢失使脊髓向后方漂移受限,间接导致减压效果下降,脊髓还会重新遭受前方致压物压迫,使已恢复的神经功能重新恶化^[11]。Maeda等^[12]认为术后颈椎曲度的维持不是通过椎间软组织挛缩或骨性融合来实现的,而是通过动力性因素(如肌肉和韧带的功能)来实现的。Sakaura等^[13]在椎板成形术中保留C_{6,7}项韧带,术后发生后凸畸形的患者明显减少,说明保留C_{6,7}项韧带对整个颈椎序列的维持至关重要。本研究中对对照组术后C₂₋₅ Cobb角、C₅₋₇ Cobb角与术前相比差异无统计学意义,但术后下颈椎曲度C₂₋₇ Cobb角较术前减小,差异有统计学意义,说明椎板成形术后颈椎曲度的丢失是整个下颈椎曲度的丢失;试验组对颈椎后部整体肌肉、韧带的剥离少、破坏小,很好地维持了颈椎序列的生理曲度。本研究还发现对照组术后C₂₋₇ SVA较术前增加,而试验组无明显改变,分析其原因可能为传统椎板成形术对颈椎后部肌肉韧带等组织破坏相对较重,导致颈椎后部伸肌力量减弱,头部中心前移,SVA增加。

Fujiyoshi等^[14]认为对于前方致压物超过K线的患者,后路减压后脊髓不能获得足够的漂移程度,不能获得足够的神经功能恢复。因此,术前制订手术计划时要综合测量考虑各矢状位参数,进行合理全面的影像学评估。本研究中3例患者(试验组1例、对照组2例)术前骨化的后纵韧带均超过K线,术后神经功能均恢复良好。Kim等^[15]研究发现K线角与C₂₋₇ SVA强烈相关,是颈椎重要的矢状位参数,可为制订手术计划及术后评价临床疗效提供依据。本研究中2组患者术后K线角有增大趋势,但差异无统计学意义,将来仍需积累大样本数据,对K线角术后变化及其对临床疗效的影响作进一步研究。

3.1.2 轴性症状

轴性症状是颈椎后路椎板成形术后最常见的并发症^[16],严重影响患者生活质量。其发生的具体机制仍不清楚,有研究表明其与颈椎后部肌肉韧带的破坏,特别是C₂与C₇棘突肌肉止点、韧带的剥离有关^[4,8,17]。颈半棘肌作为颈部动力稳定系统^[18-19],大部分止于C₂棘突,在颈部伸展中起重要作用。传

统椎板成形术通常切开、分离颈半棘肌在C₂棘突上的附着,即使在关闭切口时进行缝合重建,仍有患者术后颈半棘肌重建不良,导致颈半棘肌及颈背部肌肉萎缩及功能不全,引起轴性症状^[8]。Fielding等^[17]的研究表明,项韧带与C₇棘突剥离可能会影响背部肌肉的收缩。颈部项韧带正常状态下一直保持紧张状态,支持背部肌肉系统,协助保持头部向前注视位置,且项韧带本身存在本体感受器,能够控制头部位置;因此,减少对项韧带的剥离,保持项韧带的紧张状态及C₇棘突的完整性可减少轴性症状的发生。Takeuchi等^[4]也证实,保留C₇棘突及项韧带可以降低椎板成形术后轴性症状发生率。本研究中试验组不剥离颈半棘肌在C₂棘突上的附着及在C₇棘突上的止点,不剥离止于C₇棘突上的肌肉和项韧带,C₇棘突完整保留,颈部轴性症状发生率低于对照组。

3.1.3 C₅神经根麻痹

研究报道,椎板成形术后C₅神经根麻痹发生率为5%~8%^[20],其具体发生机制尚未明确,普遍认为与脊髓过度后移导致的神经根牵拉作用有关。本研究中对照组2例发生C₅神经根麻痹,试验组减少开门节段,在保证减压效果的前提下一定程度上减少了脊髓的后移,未发生C₅神经根麻痹。

3.1.4 发生“再关门”

单开门椎板成形术后易出现“再关门”现象,有研究表明其发生率为10%^[21],可造成已扩大椎管的再狭窄,产生粘连及脊髓压迫。锚钉及微型钛板等内固定技术的应用,大大降低了“再关门”的发生率,但一定程度上加重了患者的经济负担^[22]。本研究2组患者术中均采用羟基磷灰石人工骨,其多为海绵状结构,有利于骨长入,生物相容性好,强度大,无机体免疫排斥反应,其弧形结构适配脊髓圆柱状结构,极大减少了粘连及内置物引起的压迫;与自体髂骨相比,羟基磷灰石人工骨形态规则,不会引起供骨区疼痛及相关并发症,减少手术时间及出血量。本研究2组患者随访中均未出现“再关门”现象或人工骨移位、脱落。

3.2 选择性椎板成形术的优势

本研究结果显示,2组在JOA评分改善率、双手握力、10 s握拳次数试验等神经功能评价上没有差异,选择性椎板成形术后复查CT或MRI显示减压充分。选择性椎板成形术的优势:①在保证减压效果(减压 $\geq$ 3个节段)的前提下,减少开门节段,减少对肌肉、韧带的剥离,保留C₂和C₇棘突及其附

着的肌肉、韧带组织,减少创伤,缩短手术时间,减少出血量。②有利于维持颈椎生理曲度和C₂₋₇ SVA,防止后凸畸形。③降低轴性症状发生率。

综上所述,2种术式治疗CSM中期临床疗效满意。选择性椎板成形术在保证减压效果的前提下,减少开门节段,减少对颈椎后部肌肉韧带的破坏,保护C₂和C₇棘突及其附着的肌肉、韧带,术后神经功能恢复满意,颈椎矢状位序列维持良好,手术时间短、出血量少,显著降低术后轴性症状的发生率,疗效满意,但仍需进行远期随访。

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