

· 技术创新 ·

## 脊髓型颈椎病前路“V”形截骨“Y”形减压融合<sup>△</sup>

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**摘要:** [目的] 介绍脊髓型颈椎病前路“V”形截骨“Y”形减压融合术(anterior cervical V-osteotomy, Y-decompression and fusion, ACVYF)的手术技术和初步临床结果。[方法] 充分显露术椎并处理上下椎间隙, 在术椎两侧使用超声骨刀沿颈长肌内侧缘外倾30°~40°对术椎进行截骨(截骨深度以椎体矢状径1/2为宜), 完整取出“V”形骨块保存。在截骨基底开槽, 深度达后侧皮质后, 使用刮匙和椎板钳向椎体两侧潜行扩大减压范围, 呈“Y”形。自椎间隙向上或下切除后纵韧带及致压物进行彻底减压。将“V”形的截骨块原位回植于截骨的“V”形骨槽内, 选择合适大小的笼架置入上下间隙, 打压至嵌合牢固, 带锁钢板固定并锁定。[结果] 所有患者顺利完成手术, 术中及术后无严重并发症发生; 术后颈椎CT及MRI显示致压物切除干净, 神经减压彻底。随访时间平均(16.4±3.1)个月, 与术前相比, 术后12个月, 患者颈椎JOA评分[(8.3±1.4) vs (14.8±1.1),  $P<0.001$ ]、C<sub>2-7</sub> Cobb角[(15.7±2.5)° vs (19.9±1.9)°,  $P<0.001$ ]均显著增加。所有患者均植骨融合良好, 未出现骨块移位、置入物松动、断裂等情况。[结论] ACVYF治疗后纵韧带骨化、椎体后缘骨赘增生以及椎间盘钙化严重、椎间隙明显狭窄等脊髓型颈椎病安全可行。

**关键词:** 脊髓型颈椎病, 颈椎前路V形截骨, “Y”形减压, 骨块回植

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**Anterior "V"-shaped osteotomy, "Y"-shaped decompression and fusion for cervical spondylotic myelopathy // Li Lin<sup>1,2</sup>, ZHOU Ying-jie<sup>2</sup>, SONG Ren-qian<sup>2</sup>, WANG Yan-jin<sup>1,2</sup>, XU Cheng-han<sup>2</sup>. 1. Postgraduate School, Henan University of Chinese Medicine, Zhengzhou, Henan 450046, China; 2. Department of Spinal Surgery, Luoyang Orthopaedic Hospital of Henan Province, Luoyang, Henan 471002, China**

**Abstract: [Objective]** To introduce the surgical techniques and preliminary clinical results of the anterior "V"-shaped osteotomy, "Y"-shape decompression and fusion (ACVYF) for cervical spondylotic myelopathy. **[Methods]** As the affected segments were fully exposed and the upper and lower intervertebral spaces were treated, a "V"-shaped osteotomy was conducted with ultrasonic osteotome on the vertebral body at 30°~40° along the medial margin of the cervical longus muscle, to the depth of 1/2 of the sagittal diameter of the vertebrae, and the "V"-shaped bone blocks were completely removed and preserved. After grooving at the base of the osteotomy to reach the posterior cortex, curette and laminar forceps were used to sneak to both sides of the vertebral body to expand the decompression area in a "Y" shape. The posterior longitudinal ligaments and compressors are removed from the intervertebral space up or down for complete decompression. The "V"-shaped bone block was re-implanted back into the "V"-shaped bone groove of the osteotomy in situ, and cage frames in appropriate size was placed into the upper and lower intervertebral space. Finally, the segments were fixed with a locking plate. **[Results]** All patients had operation performed successfully without serious complications during and after the operation. Postoperative CT and MRI of the cervical spine showed that the compressors were removed completely, in other word, the nerve was decompressed completely. Compared with those preoperatively, JOA score [(8.3±1.4), (14.8±1.1),  $P<0.001$ ], C<sub>2-7</sub> Cobb angle [(15.7±2.5), (19.9±1.9),  $P<0.001$ ] were significantly improved at the latest follow-up lasted (16.4±3.1) months on an average. At the last interview, all patients had good bony fusion without bone graft displacement, implant loosening or fracture. **[Conclusion]** ACVYF is safe and feasible in the treatment of cervical spondylotic myelopathy, including ossification of posterior longitudinal ligament, osteophytic hyperplasia of posterior margin of vertebral body, severe disc calcification, and obvious stenosis of vertebral canal.

**Key words:** cervical spondylotic myelopathy, anterior cervical "V"-shaped osteotomy, "Y"-shaped decompression, bone block re-implantation

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随着电子产品的普及以及人口老龄化程度的不断加剧,脊髓型颈椎病(cervical spondylotic myelopathy, CSM)的发病率不断升高,严重影响人们的生活质量<sup>[1, 2]</sup>。对于保守治疗无效且致压物来自于椎管前方的CSM,临床多需行颈椎前路手术,如椎间盘切除融合术(anterior cervical discectomy and fusion, ACDF)和椎体次全切融合术(anterior cervical corpectomy and fusion, ACCF)等,以解除脊髓压迫<sup>[3, 4]</sup>。ACDF具有手术时间短、术中创伤小、术后稳定性高、植骨融合快以及矢状位平衡保持好等优点<sup>[5]</sup>,但ACDF只能在椎间隙进行操作,手术视野及操作空间相对狭小,对于椎间隙明显狭窄、后纵韧带骨化、椎体后缘骨赘增生严重以及髓核脱垂或游离等严重脊髓型颈椎病患者存在操作难度大、减压不充分等问题<sup>[6, 7]</sup>。此时,临床往往不得不采用创伤较大的ACCF。ACCF与ACDF相比能够通过次全切椎体获得良好手术视野及操作空间,可完全解除脊髓压迫并保证手术的安全性,但ACCF又存在椎间高度和颈椎Cobb角丢失严重以及椎骨融合缓慢甚至不融合等情况<sup>[8, 9]</sup>。为了将两者优点充分结合同时避开其缺点,本课题组提出一种新的术式,根据手术的特点将其命名为颈椎前路椎体“V”形截骨、“Y”形减压、骨块回植术(anterior cervical V-osteotomy, Y-decompression and fusion, ACVYF)。本研究回顾性分析2017年7月—2021年10月本院采用ACVYF治疗的脊髓型颈椎病患者的临床资料,初步评估ACVYF的安全性及有效性,总结该技术的操作要点与注意事项。报道如下。

## 1 手术技术

### 1.1 术前准备

详细采集患者病史并仔细查体,完善相关检查,明确诊断及手术适应证,排除手术禁忌证后与患者及家属沟通手术方案。术前备好钛笼,防止骨块碎裂导致回植失败。

### 1.2 麻醉与体位

采用静吸复合全身麻醉,患者取仰卧位,肩部垫高,后伸颈部以更好地打开椎间隙。

### 1.3 手术操作

所有手术均由同一组医生完成,以C<sub>5</sub>椎体为例。(1)切开椎间盘前部纤维环,切除部分髓核后,Caspar撑开器撑开上位病变椎间隙,去除髓核、终板,显露至后纵韧带;Caspar撑开器撑开下位病变椎

间隙,去除髓核、终板,显露至后纵韧带;(2)充分显露上下病变间隙间椎体,使用超声骨刀沿颈长肌内侧缘外倾30°~40°。两侧形成“V”形截骨(截骨深度以椎体矢状径1/2为宜),完整取出“V”形骨块保存(图1a);(3)在截骨基底部开槽,深度达后侧皮质后,使用刮匙和椎板钳向椎体两侧潜行扩大减压范围,呈“Y”形(图1b);(4)自椎间隙向上或下切除后纵韧带及致压物,进行彻底减压;(5)将V形截骨块原位回植于截骨的“V”形骨槽内(图1c);(6)选择合适大小Cage置入上下间隙,打压至嵌合牢固,带锁钢板固定并锁定(图1d)。

### 1.4 术后处理

术后应用药物镇痛、抗感染治疗,切口定期换药,术后24h拔除引流管并指导患者带颈托下床活动,颈托固定时间为2~3个月。

## 2 临床资料

### 2.1 一般资料

2017年7月—2021年10月行ACVYF治疗的脊髓型颈椎病患者21例纳入本研究,其中男12例,女9例;年龄47~67岁,平均(61.1±6.3)岁;病程12~72个月,平均(38.8±17.8)个月;手术节段:C<sub>3</sub>1例,C<sub>4</sub>4例,C<sub>5</sub>10例,C<sub>6</sub>6例。本研究通过本院伦理委员会批准(编号:KY2021-022-01),所有患者均知情同意。

### 2.2 初步结果

所有患者术中均未发生脑脊液渗漏及神经损伤等严重并发症,手术时间60~125min,平均(87.1±17.7)min,术中出血量80~180ml,平均(132.4±21.9)ml。术后3例患者发生吞咽困难,1~2周后自行缓解,随访期间无其他并发症发生。随访时间12~26个月,平均(16.4±3.1)个月,患者颈椎日本骨科协会(Japanese Orthopaedic Association, JOA)评分由术前的(8.3±1.4)分显著增加至术后12个月的(14.8±1.1)分( $P<0.001$ ),末次随访颈椎JOA评分改善率为(76.1±9.5)%。颈椎C<sub>2-7</sub>Cobb角由术前的(15.7±2.5)°显著增加至术后12个月的(19.9±1.9)°( $P<0.001$ )。术后12个月融合区高度与术后1周相比,5例沉降超过2mm,沉降率为23.8%。术后3个月植骨融合14例,融合率为66.7%,术后6个月植骨融合19例,融合率为90.5%,末次随访时,21患者均骨性融合,内固定及回植骨块在位,无螺钉松动及钢板下沉。典型病例见图2。

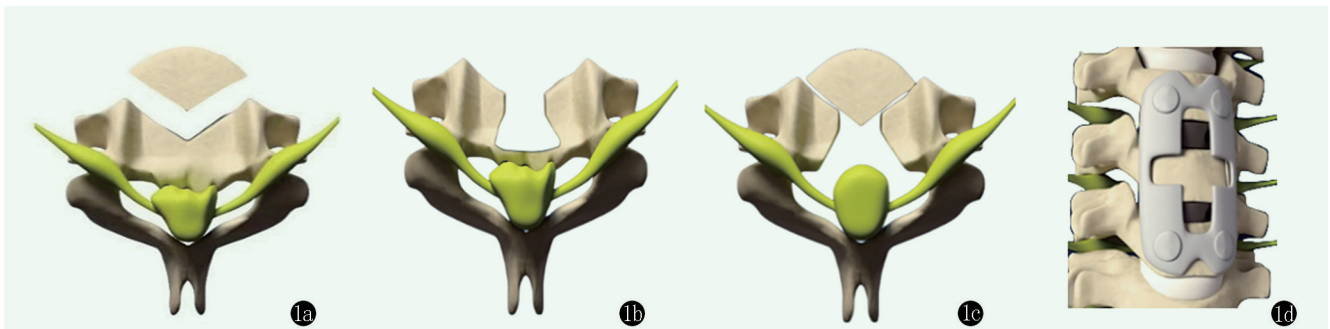


图 1. 前路“V”形截骨“Y”形减压融合术 (anterior cervical V-osteotomy, Y-decompression and fusion, ACVYF) 示意图。1a: 使用超声骨刀在需处理椎体的前方行“V”形截骨; 1b: 在截骨基底部开槽并使用刮匙和椎板钳小心向椎体两侧潜行扩大, 充分暴露致压物并切除, 减压区呈“Y”形; 1c: 将“V”形截骨块回植于截骨的骨槽内; 1d: 选择合适大小笼架置入间隙, 打压至嵌合牢固, 锁定钢板固定。

Figure 1. Schematic diagram of the anterior "V"-shaped osteotomy, Y-decompression and fusion (ACVYF). 1a: A "V"-shaped osteotomy in front of the vertebral body was made by ultrasonic osteotome; 1b: Curettage was done at the base of the osteotomy groove to expand towards both sides of the vertebral body for full decompression in "Y" shape; 1c: Re-implant the "V"-shaped bone block removed previously back into the "bone groove"; 1d: Cage frame in proper size was press fit in the space, locking plate was placed for fixation.

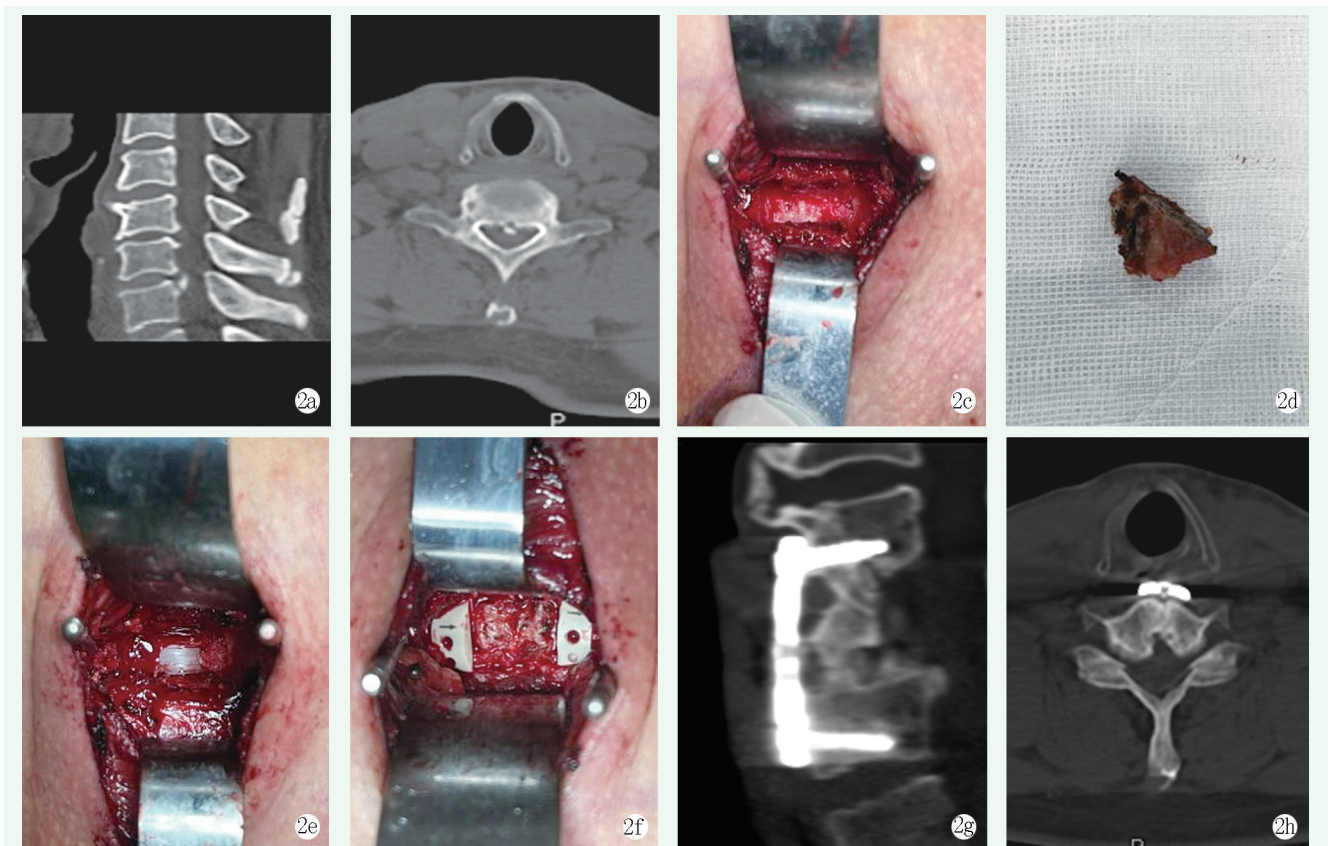


图 2. 患者男性, 56 岁。2a, 2b: 术前 CT 显示 C<sub>5/6</sub> 节段周围脊髓受压, 骨赘增生严重, ACDF 减压困难; 2c: 处理上下椎间隙后行“V”形截骨; 2d: 截出的“V”形骨块; 2e: “Y”形减压暴露硬膜; 2f: 彻底减压后“V”形骨块回植并 Cage 置入; 2g, 2h: 术后 12 个月 CT 显示植骨融合牢靠, 融合区高度、颈椎生理曲度维持良好。

Figure 2. A 56-year-old male, 2a, 2b: Preoperative CT showed C<sub>5/6</sub> spinal cord compression by severe osteophytic proliferation, which was difficult for ACDF decompression; 2c: "V"-shaped osteotomy after treatment of upper and lower vertebral space; 2d: "V" shaped bone block removed; 2e: "Y" shaped decompression to expose the dural; 2f: After decompression, the "V" shaped bone block was re-implanted with cage; 2g, 2h: CT 12 months after surgery showed sound fusion, with proper height cervical physiological curvature.

### 3 讨论

ACDF 对于后纵韧带骨化、椎体后缘骨赘增生以

及椎间盘钙化严重、椎间隙明显狭窄等脊髓型颈椎病难以有效治疗<sup>[7, 10]</sup>, 临床多采用 ACCF, ACCF 能够在确保手术安全性的同时彻底解除脊髓压迫, 临床疗



效显著<sup>[11]</sup>。但 ACCF 切除范围较大，破坏了椎体前、中柱，即使术中使用了钛网重建，稳定性也相对较差，术后易出现置入物松动移位、钢板及螺钉断裂、植骨融合缓慢、钛网沉降、颈椎生理弧度减小甚至反弓等情况，影响手术的远期疗效<sup>[12, 13]</sup>。对此，作者设计出一种新的术式 ACVYF，将单个椎体的 ACCF 转化为双节段 ACDF 能够有效避免 ACCF 所存在的弊端。

ACVYF 将椎体前部“V”形截骨取出，在截骨槽内运用刮匙和椎板钳小心向椎体两侧潜行扩大，可充分显露致压物，创造出类似于 ACCF 术式的减压空间及手术视野，能够有效确保手术的安全性及术后疗效。此次研究术中未发生脑脊液渗漏及神经损伤，仅3例患者术后发生吞咽困难，1~2周后自行缓解，随访期无其他并发症发生，证实了其安全性。术后颈椎 CT 及 MRI 显示增生骨赘切除干净，神经减压彻底；颈椎 JOA 评分较术前显著提高，末次随访颈椎 JOA 改善率为 $(76.1 \pm 9.5)\%$ ，这与 Wei 等<sup>[14]</sup>所报道的 ACCF 神经功能改善率相似，证实了 ACVYF 的确切疗效。

ACVYF 术在减压完成后将“V”形骨块回植于截骨槽内，行类似于 ACDF 的椎间融合及固定，骨块回植可减少植骨融合的爬行绝对高度，“V”形骨块两侧均为松质骨，能够为新生骨提供良好的爬行和生长通道，可有效缩短融合所需时间，提高植骨融合率。以自身骨块替代 ACCF 术中的钛网，能够有效避免应力遮挡效应，减少邻近椎体的骨组织流失，降低骨折与内置物松动沉降的风险<sup>[15]</sup>，同时，较快的植骨融合速度也一定程度上降低了置入物松动与下沉发生的概率。这使得本技术的置入物沉降率显著低于传统的 ACCF 置入物沉降率<sup>[16, 17]</sup>。

研究表明，融合区高度丢失与颈椎曲度改变存在正相关关系<sup>[15, 18]</sup>，本研究对颈椎 C<sub>2-7</sub> Cobb 角进行测量发现，术后1周颈椎 C<sub>2-7</sub> Cobb 角较术前显著增加 $(P < 0.05)$ ；随着时间推移，术后各时间点 C<sub>2-7</sub> Cobb 角缓慢下降，但与术后1周相比差异无统计学意义 $(P > 0.05)$ ，由此可得结论，ACVYF 能够有效恢复颈椎曲度并使之保持相对稳定。曹胜<sup>[19]</sup>与钟远鸣<sup>[20]</sup>研究报道，融合区高度的丢失以及颈椎生理曲度改变易引起颈部诸多不适甚至再次发生神经功能障碍，而本研究采用的 ACVYF 能够通过降低置入物沉降、恢复并保持颈椎曲度，来确保手术的远期疗效。

综上所述，ACVYF 能够充分解除脊髓压迫、恢复神经功能，显著改善 ACCF 术后植骨融合缓慢、钛

网下沉、颈椎 C<sub>2-7</sub> Cobb 角丢失等缺点，并减少相关并发症的发生，具有良好的有效性和安全性，值得临床推广应用。

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