

· 临床研究 ·

双小切口前路颈椎椎间盘切除融合术治疗连续4节段脊髓型颈椎病

沈宝良¹, 沈洪兴^{1, 2*}, 陈 智², 劳立峰², 李 全², 殷 勇¹

1. 上海健康医学院附属嘉定区中心医院骨科, 上海 201800

2. 上海交通大学附属仁济医院骨科, 上海 200001

【摘要】目的 比较单/双小切口前路颈椎椎间盘切除融合术(ACDF)治疗连续4节段脊髓型颈椎病(CSM)的疗效及术后并发症发生情况。**方法** 回顾性分析2014年10月—2017年9月上海交通大学附属仁济医院骨科采用ACDF治疗的64例连续4节段CSM患者临床资料,根据手术切口分为单切口组($n=31$, SI)和双小切口组($n=33$, DI)。比较2组手术切口、颈肩疼痛视觉模拟量表(VAS)评分,日本骨科学会(JOA)评分和改善率;记录并比较术后并发症发生情况(切口感染、吞咽困难、声音嘶哑、C₅神经根麻痹和脑脊液漏)。**结果** 所有手术均顺利完成。所有患者随访时间>12个月,最长2.5年。2组患者术后72 h切口疼痛均明显缓解,术后3个月切口疼痛基本消失。末次随访时,2组患者VAS评分和JOA评分均较术前显著改善,差异有统计学意义($P<0.05$),组间比较差异无统计学意义($P>0.05$)。SI组16例发生手术并发症,其中切口感染1例,吞咽困难11例,声音嘶哑2例,C₅神经根麻痹1例,脑脊液漏1例;DI组5例发生手术并发症,吞咽困难3例,声音嘶哑1例,C₅神经根麻痹1例。**结论** 对于以前方脊髓压迫为主的连续4节段CSM,采用单/双小切口ACDF治疗,均能有效改善患者的神经功能,缓解颈肩疼痛,但双小切口可有效降低术后吞咽困难发生率。

【关键词】 颈椎; 颈椎病; 椎间盘切除术; 脊柱融合术; 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(2020)01-0019-05

【DOI】 10.3969/j.issn.1672-2957.2020.01.005

Anterior cervical discectomy and fusion with double mini-incisions for 4-segment cervical spondylotic myelopathy

SHEN Bao-liang¹, SHEN Hong-xing^{1, 2*}, CHEN Zhi², LAO Li-feng², LI Quan², YIN Yong¹

1. Department of Orthopaedics, Central Hospital of Jiading District, Shanghai University of Medicine and Health Sciences, Shanghai 201800, China

2. Department of Orthopaedics, Renji Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai 200001, China

【Abstract】Objective To compare the efficacy and complications of anterior cervical discectomy and fusion(ACDF) with single/double mini-incisions in the treatment of 4-segment cervical spondylotic myelopathy(CSM). **Methods** The clinical data of 64 patients with 4-segment CSM treated with ACDF in Renji Hospital Affiliated to Shanghai Jiao Tong University School of Medicine from October 2014 to September 2017 were analyzed retrospectively. They were divided into single incision group($n=31$, SI) and double mini-incision group($n=33$, DI) according to the surgical incision. The surgical incision, neck and shoulder pain visual analogue scale(VAS) scores, Japanese Orthopaedic Association(JOA) score and improvement rate were compared between the 2 groups. Postoperative complications(incision infection, dysphagia, hoarseness, C₅ nerve root paralysis and cerebrospinal fluid leakage) in the 2 groups were recorded and compared. **Results** All the operations were successfully completed. All the patients were followed up >12 months, with a maximum period of 2.5 years. The incision pain was relieved in both groups at postoperative 72 h, and almost disappeared at postoperative 3 months. At the final follow-up, the VAS and JOA scores of the 2 groups were significantly improved compared with those of the pre-operation, with statistical significances($P<0.05$), and there was no significant difference between the 2 groups($P>0.05$). In SI group, 16 patients suffered surgical complications, including incision infection in 1, dysphagia in 11, hoarseness in 2, C₅ nerve root paralysis in 1 and cerebrospinal fluid leakage in 1. In DI group, 5 patients suffered surgical complications, including dysphagia in 3, hoarseness in 1 and C₅ nerve root paralysis in 1. **Conclusion** For 4-segment CSM with anterior spinal cord compression, ACDF with single/

作者简介: 沈宝良(1980—), 硕士, 主治医师; 13918788372@163.com

*通信作者: 沈洪兴 shenhxgk@126.com

double mini-incision can effectively improve neurological function and relieve neck and shoulder pain, but double mini-incision can effectively reduce the incidence of dysphagia.

【Key Words】Cervical vertebrae; Cervical spondylosis; Discectomy; Spinal fusion; Decompression, surgical

J Spinal Surg, 2020, 18(1): 19-23

前路颈椎间盘切除融合术(ACDF)是目前治疗脊髓型颈椎病(CSM)的常用术式,疗效确切^[1]。多数学者认为1~3节段CSM主要采用前路手术治疗^[2-3],4节段CSM治疗的手术方式选择争议较大,有学者认为,后路手术相对较安全,术后疗效较满意,但后路手术属于间接减压,往往减压不够彻底,无法恢复颈椎生理曲度;前路手术可直接去除来自脊髓前方的致压物,同时可恢复颈椎的生理曲度,但手术风险相对较大,且并发症也相对较多^[4-5]。近年来,本研究组对部分连续4节段CSM患者采用ACDF治疗,疗效满意,但也发现单切口ACDF术后吞咽困难发生率较高,考虑可能与术中为获得更好视野过度牵拉有关,因此,本研究组尝试采用双小切口ACDF治疗连续4节段CSM,术后吞咽困难发生率降低,现报告如下。

1 资料与方法

1.1 一般资料

纳入标准:①根据临床表现和影像学结果明确诊断为CSM;②主要病理改变在C₃/C₄/C₅/C₆/C₇,脊髓前方受压为主;③非手术治疗时间>6个月且症状无明显缓解;④手术节段为C₃/C₄/C₅/C₆/C₇;⑤采用ACDF治疗(融合器植骨并钢板内固定)。排除标准:①有严重后纵韧带骨化症、骨质疏松症或黄韧带增生肥厚;②有颈椎手术史;③有颈椎肿瘤史;④先天性颈椎畸形;⑤合并感染性疾病。根据以上标准,回顾性分析2014年10月—2017年9月病例资料,共纳入患者64例,男44例、女20例,年龄53~75(64.04±10.36)岁;根据手术切口分为单切口组(SI组)和双小切口组(DI组)。SI组患者31例,男22例、女9例,年龄(64.80±10.01)岁;DI组33例,男22例、女11例,年龄(63.31±10.71)岁。2组患者术前一般资料差异无统计学意义($P>0.05$),具有可比性。

1.2 手术方法

所有患者全身麻醉下采用Smith-Robinson入路,DI组在右侧上下做2个横行小切口,每个切口长度约3 cm,切口间距为3~4 cm,根据体表标志,上切口位于C₄椎体水平(平甲状软骨),下切口位于C₆

椎体水平(颈动脉结节水平),切开皮肤和颈阔肌,纵向分离颈深筋膜,确定胸锁乳突肌和肩胛舌骨肌,在C₃/C₄和C₄/C₅水平从肩胛舌骨肌外侧边缘平面进入椎前,在C₅/C₆和C₆/C₇水平从肩胛舌骨肌内侧边缘进入椎前,C形臂X线机透视定位病变椎间隙,刮除椎间盘至终板软骨,彻底减压,取合适大小融合器(自体碎骨填充)置入椎间隙,选择合适长度钛板固定,再次透视确认无误后充分止血,逐层缝合伤口。SI组在颈前右侧C₅椎体水平做1个纵切口,长约8 cm,术中均离断肩胛舌骨肌以获得更为广泛的暴露,其余手术步骤同DI组。手术均由同一组医师完成。术后第1天指导患者进行床上四肢功能锻炼,术后24~48 h拔除切口负压球引流管,并可佩戴颈托下床活动。术后颈托制动保护3个月,复查X线片示钢板螺钉无松动,可去除颈托固定;若发现螺钉松动,则需适当延长颈托保护时间,2个月后内置物无新发移位即可去除颈托固定。

1.3 评价指标

术后第1周、第3、6及12个月门诊随访,超过1年的患者每年通过电话随访。术后24 h、72 h、1周及3个月采用疼痛视觉模拟量表(VAS)评分^[6]评估手术切口疼痛情况;术前,术后1周、3个月、6个月及12个月采用VAS评分评估颈肩疼痛情况。术前,术后1周、3个月、6个月及12个月采用日本骨科学会(JOA)评分^[7]及改善率^[8]评估神经功能改善情况。记录并比较术后并发症发生情况(切口感染、吞咽困难、声音嘶哑、C₅神经根麻痹和脑脊液漏)。术后吞咽困难评估采用Skeppholm等^[9]的吞咽功能障碍简明量表(DSQ)进行评估。本研究患者信息采集、量表评分等均由同一组医师完成。

1.4 统计学处理

采用SPSS 20.0软件对数据进行统计学分析。计量资料以 $\bar{x} \pm s$ 表示,用 t 检验比较;分类变量用 χ^2 检验;以 $P<0.05$ 为差异有统计学意义。

2 结果

所有手术均顺利完成。所有患者随访时间>12个月,最长2.5年。2组患者切口长度(DI组为2个切口长度之和)、手术时间、术中出血量及随访时间

差异无统计学意义($P>0.05$, 表1)。2组患者术后72 h及1周切口疼痛较术后24 h均明显缓解, 术后3个月切口疼痛基本消失, 差异有统计学意义($P<0.05$, 表1)。2组患者术后各时间点颈肩疼痛

VAS评分和JOA评分均较术前显著改善, 差异有统计学意义($P<0.05$, 表2), 组间比较差异无统计学意义($P>0.05$, 表2)。末次随访时2组JOA评分改善率差异无统计学意义($P>0.05$, 表2)。

表1 切口长度、手术时间、术中出血量及随访时间

Tab. 1 Incision length, operation time, blood loss and follow-up time

组别 Group	<i>n</i>	切口长度/cm Incision length/cm	手术时间/min Operation time/min	术中出血量/mL Intraoperative blood loss/mL	随访时间/月 Follow-up time/month
SI	31	7.32 ± 0.51	125.28 ± 30.81	108.61 ± 86.70	10.25 ± 2.54
DI	33	8.11 ± 0.62	132.12 ± 34.51	120.10 ± 62.21	10.12 ± 2.31

表2 手术前后VAS评分和JOA评分

Tab. 2 Pre- and post-operative VAS and JOA scores

组别 Group	<i>n</i>	切口疼痛 VAS 评分 VAS score of incision pain			
		术后 24 h Postoperative 24 h	术后 72 h Postoperative 72 h	术后 1 周 Postoperative 1 week	术后 3 个月 Postoperative 3 months
		SI	31	5.3 ± 1.4	3.6 ± 1.2 [*]
DI	33	5.4 ± 1.1	3.5 ± 1.3 [*]	2.2 ± 1.0 [*]	0.6 ± 0.2 [*]

组别 Group	颈肩疼痛 VAS 评分 VAS score of neck and shoulder pain				
	术前 Pre-operation	术后 1 周 Postoperative 1 week	术后 3 个月 Postoperative 3 months	术后 6 个月 Postoperative 6 months	术后 12 个月 Postoperative 12 months
	SI	7.5 ± 1.2	5.2 ± 1.8 [△]	4.1 ± 0.9 [△]	3.6 ± 1.1 [△]
DI	7.4 ± 1.3	5.0 ± 1.6 [△]	4.1 ± 0.7 [△]	3.5 ± 0.9 [△]	2.3 ± 0.6 [△]

组别 Group	JOA 评分 JOA score					
	术前 Pre-operation	术后 1 周 Postoperative 1 week	术后 3 个月 Postoperative 3 months	术后 6 个月 Postoperative 6 months	术后 12 个月 Postoperative 12 months	改善率(%) Improvement rate(%)
	SI	8.22 ± 1.61	9.41 ± 2.21 [△]	12.82 ± 3.14 [△]	13.27 ± 3.14 [△]	14.87 ± 1.15 [△]
DI	8.33 ± 1.41	9.51 ± 2.19 [△]	12.93 ± 2.96 [△]	13.39 ± 3.41 [△]	14.93 ± 1.01 [△]	76.12 ± 19.62

注: *与术后24 h相比, $P<0.05$; Δ 与术前相比, $P<0.05$ 。

Note: * $P<0.05$, compared with postoperative 24 h; Δ $P<0.05$, compared with pre-operation.

SI组16例发生手术并发症, 切口感染1例, 吞咽困难11例, 声音嘶哑2例, C₅神经根麻痹1例, 脑脊液漏1例; DI组5例发生手术并发症, 吞咽困难3例, 声音嘶哑1例, C₅神经根麻痹1例。吞咽困难和声音嘶哑患者术后给予消肿补液, 糖皮质激素雾化吸入等治疗, 术后3个月患者症状均明显缓解。脑脊液漏患者通过平卧、正压引流等治疗后恢复。C₅神经根麻痹患者予口服甲钴胺片、塞来昔布胶囊等, 术后3个月症状明显改善。切口感染患者30年重度吸烟史(900支/年), 予万古霉素抗感染、伤口酒精湿敷换药等治疗, 术后3周切口愈合满意。典型病例影像学资料见图1。

3 讨论

CSM是中老年人的常见病和多发病, 手术仍是目前重要的治疗方式。对于1~3个节段的CSM, ACDF是目前被普遍认可的手术方式^[10], 但是对于连续4节段CSM, 手术方式选择意见不一。Tamai等^[11]对180例老年CSM患者采用ACDF和后路椎板成形术治疗, 发现前者手术效果更好。相较于后路手术, 颈椎前路手术可直接去除来自脊髓前方的压迫, 如发生退行性变的椎间盘组织、椎体后缘增生的骨赘、钩椎关节的增生组织、后纵韧带骨化物等, 可有效恢复椎间隙高度, 维持颈椎稳定性, 符

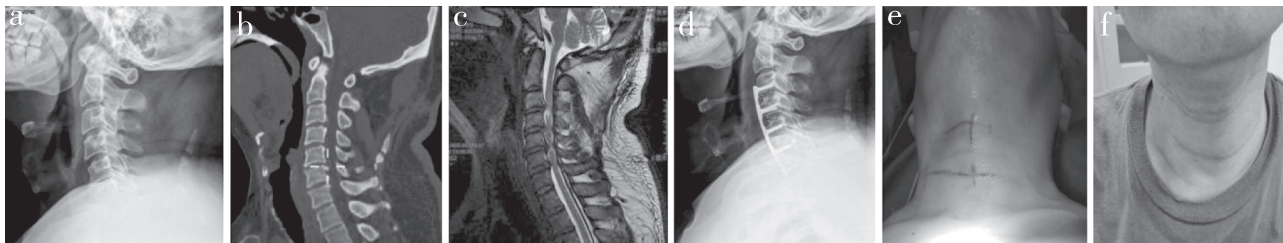


图1 典型病例影像学资料

Fig. 1 Imaging data of a typical case

男, 63岁, C₃/C₄/C₅/C₆/C₇ CSM a: 术前侧位X线片示C₃/C₄/C₅/C₆/C₇椎间隙狭窄, 项韧带骨化 b: 术前CT示C₃₋₅椎体后方骨赘增生, C_{3,4}后纵韧带骨化 c: 术前MRI示C₃/C₄/C₅/C₆/C₇椎间盘突出, 硬膜囊明显受压, C₃/C₄水平脊髓高信号 d: 术后2 d颈椎侧位X线片示内固定位置良好 e: 术前颈椎前路双切口标记 f: 术后3个月切口愈合良好

Male, 63 years old, C₃/C₄/C₅/C₆/C₇ CSM a: Preoperative lateral roentgenograph shows C₃/C₄/C₅/C₆/C₇ intervertebral space stenosis and ligament ossification b: Preoperative CT shows C₃₋₅ posterior osteophyte hyperplasia and C_{3,4} ossification of posterior longitudinal ligament c: Preoperative MRI shows that C₃/C₄/C₅/C₆/C₇ intervertebral disc herniation, significant compression of dural sac and high signal of spinal cord at C₃/C₄ level d: Roentgenograph at postoperative 2 d shows good position of internal fixator e: Preoperative double incision mark of cervical spine f: Incisions heal well at postoperative 3 months

合颈椎病的病理特点^[12-13]。侯铁胜等^[14]对4节段CSM患者采用不同颈椎前路手术方式治疗, 也取得了满意的临床疗效。因此, 颈椎前路手术是治疗4节段CSM的有效方式。

颈椎前路手术主要有ACDF, 颈前路椎体次全切除减压融合术(ACCF)以及基于两者的改良“混合”术式^[15]。祁敏等^[16]对327例多节段CSM患者采用3种不同颈椎前路术式治疗, 对术后并发症发生情况进行分析比较发现, ACDF并发症发生率最低, ACCF较高。Fountas等^[17]对1 015例采用ACDF治疗的患者临床资料进行回顾性分析发现, 术后吞咽困难的发生率较高, 主要原因是术中对切口周围软组织牵拉过大、持续时间过久, 术后局部血肿压迫及置入钢板体积过大等, 且手术节段越多并发症发生率也越高。因此, 如何减少颈椎前路手术的术后并发症一直是研究的热点。在无法选择内固定材料的情况下, 如何选择更为合适的手术切口和入路, 减少软组织牵拉, 降低术后并发症发生率, 是目前研究的主要方向。Chin等^[18]报道2例颈椎术后发生邻近节段退行性变患者, 采用颈椎前路双横行切口进行翻修, 为本研究提供了参考。

颈椎前路手术后吞咽困难的发生与多种因素有关, 包括性别^[19]、年龄^[20-22]、吸烟史^[23-25]、肥胖^[19, 22]、慢性阻塞性肺疾病(COPD)^[23]、手术入路^[20, 22]、手术时间^[26]、术中切口牵拉时间和牵拉器类型^[27]、内固定类型^[28]、高位手术节段^[29]、多节段手术^[20, 23]等相关, 然而其具体的病理生理机制尚未完全阐明。在颈椎前路单切口治疗4节段CSM的手术中需要暴露最上方的C₃椎体和最下方的C₇椎

体, 尤其是在对上位椎体进行暴露时, 容易造成术后椎前软组织肿胀, 这可能也是多节段颈前路手术后吞咽困难发生率比较高的原因之一^[30-31]。本研究采用双小切口ACDF治疗4节段CSM, 单个切口长度2~3 cm, 切口间距3~4(3.58±0.51)cm, 术后未发生切口感染或皮肤坏死情况, 虽然手术时间及术中出血量比单切口手术有所增加, 但差异并无统计学意义, 且双小切口手术后吞咽困难发生率明显低于单切口手术。

双小切口ACDF的优势: ①切口暴露更加充分, 切口软组织牵拉少。双切口对C₃/C₄和C₆/C₇的显露比较充分, 术中可有效减少对切口上下重要神经血管等软组织的牵拉, 更有助于椎间隙的彻底减压, 有助于神经功能的改善。②可降低术后吞咽困难的发生率。由于高位颈椎(C₃以上)对应咽部和下咽部, 后方潜在的咽后空间相对较大, 容易发生软组织肿胀, 术后吞咽困难发生率高^[30-31]。单切口手术为了顾及C₃₋₇长范围的显露, 对切口最上方及最下方的软组织牵拉必然会加大; 而双切口手术对切口的牵拉较小, 对高位颈椎周围软组织的保护优于单切口手术, 术后椎前软组织肿胀小, 吞咽困难发生率低。③完整保留肩胛舌骨肌。虽然以往的研究表明是否离断肩胛舌骨肌并不会影响术后吞咽困难等并发症的发生率^[32], 但是多节段颈椎手术中一般均离断肩胛舌骨肌以获得更大范围的手术视野。离断肩胛舌骨肌是否真的对颈椎术后并发症的发生率没有影响, 目前尚不清楚, 但是术中尽可能多的保护正常组织结构是每一位医师的责任和追求。本研究根据Fengbin等^[22]的前瞻性研究结果, 在处理

C₃/C₄/C₅椎间隙时于肩胛舌骨肌外侧边缘进入椎前, 在C₅/C₆/C₇椎间隙于肩胛舌骨肌内侧缘进入椎前, 以完整保留肩胛舌骨肌, 同时对切口牵拉影响最小。

本研究为回顾性分析, 缺少前瞻性设计, 而且样本量不足, 同时本研究中手术均由同一医师完成, 所得结论还需扩大样本量进行随机对照或多中心研究来进一步验证。综上, 双小切口ACDF治疗连续4节段CSM术野暴露更加充分, 可降低术后早期吞咽困难的发生率, 且可完整保留肩胛舌骨肌, 为临床多节段颈椎病手术治疗提供参考。

参考文献

- [1] Liow MHL, Lee M, Goh GS, *et al.* Poorer fusion outcomes in diabetic cervical spondylotic myelopathy patients undergoing single-level anterior cervical discectomy and fusion does not compromise functional outcomes and quality of life[J]. Spine(Phila Pa 1976), 2018, 43(7): 477-483.
- [2] Xiong Y, Xu L, Yu X, *et al.* Comparison of 6-year follow-up of result hybrid surgery and anterior cervical discectomy and fusion for the treatment of contiguous two segment cervical degenerative disc diseases[J]. Spine (Phila Pa 1976), 2018, 43(20): 1418-1425.
- [3] 陈朦村, 杨述华, 杨操, 等. 可吸收固定板在脊髓型颈椎病前路减压融合术中的应用[J]. 中华骨科杂志, 2015, 35(6): 602-609.
- [4] Lian XF, Xu JG, Zeng BF, *et al.* Noncontiguous anterior decompression and fusion for multilevel cervical spondylotic myelopathy: a prospective randomized control clinical study[J]. Eur Spine J, 2010, 19(5): 713-719.
- [5] Koller H, Hempling A, Ferraris L, *et al.* 4- and 5-level anterior fusions of the cervical spine: review of literature and clinical results[J]. Eur Spine J, 2007, 16(12): 2055-2071.
- [6] Huskisson EC. Measurement of pain[J]. Lancet, 1974, 2(7889): 1127-1131.
- [7] Yonenobu K, Abumi K, Nagata K, *et al.* Interobserver and intraobserver reliability of the Japanese Orthopaedic Association scoring system for evaluation of cervical compression myelopathy[J]. Spine(Phila Pa 1976), 2001, 26(17): 1890-1895.
- [8] Hirabayashi K, Miyakawa J, Satomi K, *et al.* Operative results and postoperative progression of ossification among patients with ossification of cervical posterior longitudinal ligament[J]. Spine(Phila Pa 1976), 1981, 6(4): 354-364.
- [9] Skeppholm M, Ingebro C, Engström T, *et al.* The dysphagia short questionnaire: an instrument for evaluation of dysphagia a validation study with 12 months' follow-up after anterior cervical spine surgery[J]. Spine(Phila Pa 1976), 2012, 37(11): 996-1002.
- [10] He S, Feng H, Lan Z, *et al.* A randomized trial comparing clinical outcomes between zero-profile and traditional multilevel anterior cervical discectomy and fusion surgery for cervical myelopathy[J]. Spine(Phila Pa 1976), 2018, 43(5): E259-E266.
- [11] Tamai K, Terai H, Suzuki A, *et al.* Anterior cervical discectomy and fusion provides better surgical outcomes than posterior laminoplasty in elderly patients with C₃₋₄ level myelopathy[J]. Spine(Phila Pa 1976), 2017, 42(8): 548-555.
- [12] Wang SJ, Ma B, Huang YF, *et al.* Four-level anterior cervical discectomy and fusion for cervical spondylotic myelopathy[J]. Orthop Surg, 2016, 24(3): 338-343.
- [13] 陈文恒, 郭团茂, 刘强. 双节段ACDF和单节段ACCF手术治疗脊髓型颈椎病疗效比较[J]. 实用骨科杂志, 2017, 23(2): 100-104.
- [14] 侯铁胜, 严宁, 虞舜志, 等. 前路手术治疗4节段脊髓型颈椎病的疗效分析[J]. 中华骨科杂志, 2015, 35(11): 1129-1135.
- [15] Li Z, Wang H, Tang J, *et al.* Comparison of three reconstructive techniques in the surgical management of patients with four-level cervical spondylotic myelopathy[J]. Spine(Phila Pa 1976), 2017, 42(10): E575-E583.
- [16] 祁敏, 王新伟, 刘洋, 等. 三种颈前路减压术式治疗多节段脊髓型颈椎病的并发症比较[J]. 中国脊柱脊髓杂志, 2012, 22(11): 963-968.
- [17] Fountas KN, Kapsalaki EZ, Nikolakakos LG, *et al.* Anterior cervical discectomy and fusion associated complications[J]. Spine(Phila Pa 1976), 2007, 32(21): 2301-2317.
- [18] Chin KR, Ricchetti ET, Yu WD, *et al.* Less exposure surgery for multilevel anterior cervical fusion using 2 transverse incisions[J]. J Neurosurg Spine, 2012, 17(3): 194-198.
- [19] Bazaz R, Lee MJ, Yoo JU. Incidence of dysphagia after anterior cervical spine surgery: a prospective study[J]. Spine(Phila Pa 1976), 2002, 27(22): 2453-2458.
- [20] Kalb S, Reis MT, Cowperthwaite MC, *et al.* Dysphagia after anterior cervical spine surgery: incidence and risk factors[J]. World Neurosurg, 2012, 77(1): 183-187.

(下转第57页)

- pedicle screw and cortical screw in posterior lumbar interbody fusion: a prospective randomized noninferiority trial[J]. Spine J, 2015, 15(7): 1519-1526.
- [14] 夏天, 董双海, 田纪伟, 等. 皮质骨轨迹螺钉在腰椎融合术中的初步应用[J]. 脊柱外科杂志, 2017, 15(6): 369-373.
- [15] 郑武, 林院, 黄少辉, 等. 皮质骨轨迹螺钉固定技术在腰椎手术中的应用[J]. 中国医学创新, 2018, 15(31): 129-133.
- [16] Mitchell SM, Wellington HK. Lumbar pedicle cortical bone trajectory screw: indications and surgical technique[J]. Contemporary Spine Surgery, 2016, 17(1): 6.
- [17] 席焱海, 王洋, 余将明, 等. 应用皮质骨轨迹螺钉联合椎弓根螺钉技术治疗老年骨质疏松腰椎退变性疾病临床疗效[J]. 第二军医大学学报, 2016, 37(7): 879-883.
- [18] Ashayeri K, Nasser R, Nakhla J, *et al.* The use of a pedicle screw-cortical screw hybrid system for the surgical treatment of a patient with congenital multilevel spinal non-segmentation defect and spinal column deformity: a technical note[J]. Eur Spine J, 2016, 25(11): 3760-3764.
- (收稿日期: 2019-01-05)
(本文编辑: 张建芬)

(上接第23页)

- [21] Puvanesarajah V, Jain A, Shimer AL, *et al.* Complications and mortality following one to two-level anterior cervical fusion for cervical spondylosis in patients above 80 years of age[J]. Spine (Phila Pa 1976), 2017, 42(9): E509-E514.
- [22] Fengbin Y, Xinwei W, Haisong Y, *et al.* Dysphagia after anterior cervical discectomy and fusion: a prospective study comparing two anterior surgical approaches[J]. Eur Spine J, 2013, 22(5): 1147-1151.
- [23] Siska PA, Ponnappan RK, Hohl JB, *et al.* Dysphagia after anterior cervical spine surgery: a prospective study using the swallowing-quality of life questionnaire and analysis of patient comorbidities[J]. Spine (Phila Pa 1976), 2011, 36(17): 1387-1391.
- [24] Olsson EC, Jobson M, Lim MR. Risk factors for persistent dysphagia after anterior cervical spine surgery[J]. Orthopedics, 2015, 38(4): e319-e323.
- [25] Shi S, Li XF, Zhao QT, *et al.* Risk factors for dysphagia after single-level anterior cervical decompression with arthroplasty or fusion: a prospective study comparing 2 zero-profile implants[J]. World Neurosurg, 2016, 95: 148-155.
- [26] Cho SK, Lu Y, Lee DH. Dysphagia following anterior cervical spinal surgery: a systematic review[J]. Bone Joint J, 2013, 95-B(7): 868-873.
- [27] Mendoza-Lattes S, Clifford K, Bartelt R, *et al.* Dysphagia following anterior cervical arthrodesis is associated with continuous, strong retraction of the esophagus[J]. J Bone Joint Surg Am, 2008, 90(2): 256-263.
- [28] 张宗余, 姜为民, 李雪峰, 等. 桥形椎间锁定融合器(ROI-C)在颈椎病前路减压融合术中应用的临床研究[J]. 中国脊柱脊髓杂志, 2014, 24(6): 510-516.
- [29] 马骏雄, 项良碧, 于海龙, 等. 低位和高位颈椎前路减压融合术后椎前软组织肿胀及吞咽困难发生率的比较分析[J]. 中国矫形外科杂志, 2014, 22(21): 1921-1925.
- [30] 马骏雄, 陈语, 项良碧, 等. 单节段和双/多节段颈椎前路减压融合术后椎前软组织肿胀及吞咽困难发生率的比较[J]. 脊柱外科杂志, 2015, 13(1): 41-44.
- [31] Chen Z, Wei X, Li F, *et al.* Tracheal traction exercise reduces the occurrence of postoperative dysphagia after anterior cervical spine surgery[J]. Spine (Phila Pa 1976), 2012, 7(15): 1292-1296.
- [32] 袁鹏, 刘宏建, 皮国富, 等. 脊髓型颈椎病颈前路是否离断肩胛舌骨肌两种手术入路的比较[J]. 中国实用医刊, 2012, 39(19): 97-98.
- (收稿日期: 2018-09-10)
(本文编辑: 于倩)