·脊柱脊髓疾病·

颈椎前路椎间盘切除椎间融合术:零切迹自锁式椎间融合系统与传统融合器联合钛板内固定对比分析

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【摘要】 **目的** 对比分析零切迹自锁式椎间融合系统(ROI-C)与传统融合器联合钛板内固定技术在颈椎前路椎间盘切除椎间融合术中的有效性和安全性。**方法** 纳入2017年3月至2019年3月在天津市人民医院行颈椎前路椎间盘切除椎间融合术的116例颈椎退行性病变患者,术中辅助应用ROI-C(ROI-C组,60例)或传统融合器联合钛板内固定(钛板组,56例),根据颈椎X线和CT扫描、日本骨科协会评分(JOA)、颈椎功能障碍指数(NDI)和Bazaz吞咽困难分级,对比分析手术前后颈椎生理曲度和椎间隙高度,评价术后1、3、6和12个月时神经功能和日常生活质量恢复程度、吞咽困难发生率,术后12个月行影像学检查观察融合器沉降、假关节形成等融合失败现象和相邻椎体节段退行性变,以及呼吸道、食管损伤或食管瘘,脑脊液漏,内固定排异,伤口感染或术后血肿等并发症。**结果** 与钛板组相比,ROI-C组无论单节段或双节段病变患者手术时间缩短($t=5.619$,$P=0.001$;$t=3.110$,$P=0.002$)、术中出血量减少($t=7.448$,$P=0.001$;$t=5.946$,$P=0.001$),术后颈椎生理曲度增大($F=82.424$,$P=0.024$)、椎间隙高度增高($F=43.427$,$P=0.021$),JOA评分增加($F=16.024$,$P=0.016$)、NDI指数降低($F=21.439$,$P=0.024$);两组患者手术前后颈椎生理曲度($F=70.247$,$P=0.000$)和椎间隙高度($F=35.312$,$P=0.000$)、JOA评分($F=13.420$,$P=0.000$)和NDI指数($F=19.523$,$P=0.000$)差异亦有统计学意义,术后1、3、6和12个月随访时颈椎生理曲度(均$P=0.001$)和椎间隙高度(均$P=0.001$)测量数据均高于术前,JOA评分高于术前(均$P=0.001$),而NDI指数低于术前(均$P=0.001$)。两组患者术后1周吞咽困难发生率差异无统计学意义[48.21%(27/56)对33.33%(20/60);$\chi^2=2.661$,$P=0.103$],术后12个月钛板组吞咽困难发生率高于ROI-C组[16.07%(9/56)对0(0/60);$\chi^2=6.779$,$P=0.009$]。两组患者植骨融合良好,无融合器沉降、假关节形成等融合失败现象,以及呼吸道、食管损伤或食管瘘,内固定排异,切口感染等手术相关并发症;ROI-C组有1例单节段手术患者术中发生脑脊液漏,两组各有1例双节段手术患者术后发生血肿和上位相邻椎体节段退行性变。**结论** 采用ROI-C行颈椎前路椎间盘切除椎间融合术疗效良好且安全可靠,适用于单节段或连续双节段病变的颈椎退行性病变的治疗。

【关键词】 颈椎; 椎间盘切除术; 脊柱融合术; 手术后并发症

Comparison of ROI-C and traditional cage combined with titanium plate internal fixation for anterior cervical discectomy and fusion

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【**Abstract**】 **Objective** Comparative analysis of the efficacy and safety of zero-notch self-locking interbody fusion system (ROI-C) and traditional cage combined with titanium plate internal fixation technology in the anterior cervical discectomy and fusion (ACDF). **Methods** A total of 116 patients with cervical degenerative diseases who underwent ACDF in Tianjin Union Medical Center from January 2014 to December 2016 were included, of which 60 patients underwent the ROI-C (ROI-C group) and 56 patients underwent traditional cage combined with titanium plate internal fixation (titanium plate group). According

doi:10.3969/j.issn.1672-6731.2022.08.007
基金项目:天津市医学重点学科(专科)建设项目(项目编号:TJYXZDXK-064B)
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to cervical vertebral X-ray and CT, Japanese Orthopaedic Association Scores (JOA), Neck Disability Index (NDI) and Bazaz dysphagia classification, the physiological curvature and intervertebral space height of cervical vertebal before and after surgery were compared and analyzed, and the degree of neurology function and quality of daily life recovery, and incidence of dysphagia at 1, 3, 6, and 12 months after surgery were evaluated. The imaging examination were set at 12 months after surgery to evaluate the fusion failure phenomenon such as cage subsidence, pseudoarthrosis, and the degeneration of adjacent vertebral segments, as well as respiratory, esophageal injury or esophageal fistula, cerebrospinal fluid (CBF) leakage, internal fixation rejection, wound infection and postoperative hematoma. **Results** Compared with titanium plate group, patients with single-segment or double-segment lesions in ROI-C group showed shorter operation time (t = 5.619, P = 0.001; t = 3.110, P = 0.002), and decreased intraoperative blood loss (t = 7.448, P = 0.001; t = 5.946, P = 0.001), increased postoperative cervical physiological curvature (F = 82.424, P = 0.024), increased intervertebral space height (F = 43.427, P = 0.021), increased JOA score (F = 16.024, P = 0.016) and decreased NDI index (F = 21.439, P = 0.024). The difference between the physiological curvature of cervical spine (F = 70.247, P = 0.000), intervertebral space height (F = 35.312, P = 0.000), JOA score (F = 13.420, P = 0.000) and NDI index (F = 19.523, P = 0.000) before and after surgery in 2 groups was statistically significant at 1, 3, 6 and 12 months of follow-up, the measured data of cervical physiological curvature (P = 0.001, for all) and intervertebral space height (P = 0.001, for all) were higher than those before surgery, the JOA score increased (P = 0.001, for all) and the NDI index decreased (P = 0.001, for all). There was no significant difference in the incidence of dysphagia one week after surgery [48.21% (27/56) vs. 33.33% (20/60); χ^2 = 2.661, P = 0.103]. The incidence of dysphagia in the titanium plate group was higher than that in the ROI-C group at 12 months after surgery [16.07% (9/56) vs. 0 (0/60); χ^2 = 6.779, P = 0.009]. In addition, no incision infection, respiratory tract, oesophagal injury, oesophagal fistula, internal fixation rejection and other related complications occurred during the 12-month follow-up period. One case of CBF leakage during single-segment ACDF surgery with ROI-C. Hematoma and upper adjacent vertebral segment degeneration occurred in one patient in each group. **Conclusions** ACDF surgery with ROI-C has good efficacy and safety, it is suitable for treating patients with cervical degenerative diseases with single-segment or continuous double-segment lesions.

【**Key words**】 Cervical vertebrae; Diskectomy; Spinal fusion; Postoperative complications

This study was supported by Tianjin Key Medical Discipline (Specialty) Construction Project (No. TJYXZDXK-064B).

Conflicts of interest: none declared

颈椎前路椎间盘切除椎间融合术(ACDF)治疗颈椎退行性病变已有60余年历史,目前已成为标准术式。但传统融合器联合钛板内固定技术可造成螺钉或钛板移位、颈前软组织损伤、食管穿孔、血肿形成、相邻椎体节段退行性变或吞咽困难等手术相关并发症[1]。2011年,国家食品药品监督管理局批准新型零切迹自锁式椎间融合系统(ROI-C,法国LDR公司)应用于临床[2-3],以弥补传统融合器联合钛板内固定技术的不足。本研究以天津市人民医院近年诊断与治疗的116例颈椎退行性病变患者为研究对象,对比分析ROI-C与传统融合器联合钛板内固定治疗颈椎单节段或连续双节段病变的有效性和安全性,以为制定个体化手术方案提供参考。

对象与方法

一、研究对象

1.纳入标准 (1)颈椎MRI或CT提示颈椎间盘突出或椎体后缘骨化致颈椎单节段或连续双节段退行性变。(2)临床表现为典型的神经根或脊髓受压导致的根性或髓性症状。(3)均行颈椎前路椎间盘切除椎间融合术,且依从性良好,临床资料完整。(4)患者或其家属对手术过程及风险知情,并签署知情同意书。

2.排除标准 (1)发育性椎管狭窄或≥3个节段颈椎间盘突出或退行性变。(2)连续性或混合性后纵韧带骨化或强直性脊柱炎。(3)发育性或外伤所致脊柱畸形。(4)合并肿瘤或严重内科疾病,以及躁狂症、抑郁症或双相情感障碍等精神疾病。

3.一般资料 选择2017年3月至2019年3月在我院脊柱外科行颈椎前路椎间盘切除椎间融合术的颈椎退行性病变患者共116例,男性61例,女性55例;年龄42~71岁,平均为(58.82±11.58)岁;病程为2~30个月,平均为(9.72±3.61)个月。术中采用ROI-C者60例(ROI-C组),单节段病变33例[责

任病灶分别为C_{3-4}(4例)、C_{4-5}(6例)、C_{5-6}(14例)和C_{6-7}(9例)],双节段病变27例[包括C_{3-5}(6例)、C_{4-6}(9例)和C_{5-7}(12例)];采用传统融合器联合钛板内固定者56例(钛板组),单节段病变29例[包括C_{3-4}(3例)、C_{4-5}(5例)、C_{5-6}(12例)和C_{6-7}(9例)],双节段病变为27例[包括C_{3-5}(4例)、C_{4-6}(6例)和C_{5-7}(17例)]。两组患者临床资料比较,差异无统计学意义(均$P>0.05$,表1),均衡可比。

二、治疗方法

1.颈椎前路椎间盘切除椎间融合术　患者平卧于可行X线透视的手术床上,气管插管复合静脉吸入全身麻醉,肩背部稍垫高,头稍向后仰、偏向左侧,充分显露手术区域;做右侧颈前横切口,离断颈阔肌并分离筋膜,于胸锁乳突肌内侧分离气管前筋膜与颈动脉鞘间隙,触及颈动脉鞘后将其牵拉至外侧,并将食管、呼吸道、甲状腺等结构牵至内侧,分离颈动脉鞘与内脏鞘间隙,并由此间隙进入并显露椎前筋膜,分离显露椎体前方;采用英国Philips公司生产的C型臂X线成像系统辅助定位责任间隙,置入Caspar撑开器(瑞士Mathys公司)并适当撑开椎间隙,切开责任间隙前纵韧带,切除突出的纤维环和髓核,刮匙刮除上下软骨终板,注意避免破坏骨性终板,剔除椎体上下缘增生的骨赘,切除后纵韧带,再次探查脊髓前方有无受压,分别行ROI-C融合或传统融合器联合钛板内固定。(1)ROI-C组:椎管减压后,根据个体解剖形态和相邻椎间隙高度选择长度和高度适宜的椎间融合器植入椎间隙,并在融合器内预先植入同种异体骨,于C型臂X线透视下确定植入位置满意后松开Caspar撑开器并适当加压至椎间融合器无明显活动,再将2枚钛制嵌片分别自上下椎体植入融合器并各自通过相邻终板进入椎体内;双节段病变患者采用相同方法进行下一节段手术。(2)钛板组:单节段和双节段病变均于椎管减压后在椎间隙内植入传统椎间融合器,经X线透视确定植入位置满意,于融合器上下椎体前方植入长度和宽度适宜的钛板(美国Stryker公司),经X线透视确定钛板位置满意、螺钉内固定,彻底止血并逐层关闭切口,皮内缝合,结束手术。(3)术后护理:术后常规应用神经营养药、脱水降压药以改善神经水肿,并连续予以小剂量(5 mg)地塞米松治疗3 d以减轻神经炎症症状;卧床24 h后即可佩戴颈托下床行走,共佩戴6周。

2.预后评价　(1)记录手术时间和术中出血量。

表1　ROI-C组与钛板组患者临床资料的比较

Table 1.　Comparison of clinical data between ROI-C group and titanium plate group

观察指标	钛板组(n=56)	ROI-C组(n=60)	χ^2或t值	P值
性别[例(%)]			0.042	0.837
男性	30(53.57)	31(51.67)		
女性	26(46.43)	29(48.33)		
年龄($\bar{x}\pm s$,岁)	59.21±9.46	58.26±8.32	0.575	0.566
病程($\bar{x}\pm s$,月)	10.02±3.52	9.42±2.61	1.047	0.297
病变节段[例(%)]			0.120	0.729
单节段	29(51.79)	33(55.00)		
双节段	27(48.21)	27(45.00)		
单节段病灶[例(%)]	29	33	0.130	0.988
C_{3-4}	3(10.34)	4(12.12)		
C_{4-5}	5(17.24)	6(18.18)		
C_{5-6}	12(41.38)	14(42.42)		
C_{6-7}	9(31.03)	9(27.27)		
双节段病灶[例(%)]	27	27	1.862	0.394
C_{3-5}	4(14.81)	6(22.22)		
C_{4-6}	6(22.22)	9(33.33)		
C_{5-7}	17(62.96)	12(44.44)		

Two-independent-sample t test for comparison of age and duration, and χ^2 test for comparison of others,年龄和病程的比较行两独立样本的t检验,其余指标的比较行χ^2检验

(2)分别于术前,以及术后1、3、6和12个月行颈椎X线和CT扫描,对比分析颈椎生理曲度(C_{2-7} Cobb角,即C_2下终板平行线的垂线与C_7下终板平行线的垂线夹角)、颈椎椎间隙高度(于椎间隙上位椎体下终板和下位椎体上终板做横线,确定上下终板中点,两点之间的垂直距离即为椎间隙高度[4])改善情况。(3)神经功能评价:于术前以及术后1、3、6和12个月行神经功能评价。其中,日本骨科协会评分(JOA)用于评价上肢运动功能、下肢运动功能、感觉功能和膀胱功能,总评分为17分,评分越低、功能越差;颈椎功能障碍指数(NDI)主要用于评价术后日常生活质量,包括颈痛及相关症状(疼痛强度、头痛、集中注意力和睡眠),以及日常生活活动能力(个人护理、提重物、阅读、工作、驾驶和娱乐)两部分共10项内容,每项内容有6道题(0~5分),总评分为100分,评分越高、生活质量受限越严重;Bazaz吞咽困难分级,共分为4级,包括从未发生吞咽困难(无)、偶发吞咽困难(轻度)、吞食较硬食物时出现吞咽困难而吞咽软质食物不受影响(中度)和吞咽困难至无法进食(重度),分级越高、吞咽困难越严

表2 ROI-C组与钛板组患者手术时间和术中出血量的比较($\bar{x} \pm s$)

Table 2. Comparison of surgical time and intraoperative blood loss between ROI-C group and titanium plate group ($\bar{x} \pm s$)

组别	单节段病变			双节段病变		
	例数	手术时间(min)	术中出血量(ml)	例数	手术时间(min)	术中出血量(ml)
钛板组	29	75.72±21.45	45.81±17.30	27	128.62±42.21	76.49±27.76
ROI-C组	33	55.23±17.76	24.18±13.71	27	105.43±38.09	50.32±19.13
t值		5.619	7.488		3.110	5.946
P值		0.001	0.001		0.002	0.001

重。(4)手术安全性评价:术后12个月复查颈椎X线和CT,观察是否发生融合器沉降、假关节形成等植骨融合失败现象和相邻椎体节段退行性变,以及呼吸道、食管损伤或食管瘘,脑脊液漏,内固定排异反应,伤口感染或术后血肿等并发症。

3.统计分析方法 采用SPSS 23.0统计软件进行数据处理与分析。计数资料以相对数构成比(%)或率(%)表示,采用χ^2检验。Kolmogorov-Smirnova检验进行数据正态性检验,呈正态分布的计量资料以均数±标准差($\bar{x} \pm s$)表示,采用两独立样本的t检验或重复测量设计的方差分析,两两比较行LSD-t检验。以$P \leqslant 0.05$为差异具有统计学意义。

结 果

两组患者手术相关指标比较,与钛板组相比,ROI-C组无论单节段或双节段病变者手术时间缩短(P = 0.001, 0.002)、术中出血量减少(P = 0.001, 0.001;表2)。

两组患者影像学指标比较,ROI-C组患者颈椎生理曲度增大程度(P=0.024)和椎间隙高度增高程度(P=0.021)均优于钛板组(表3,4);两组手术前后不同观察时间点颈椎生理曲度(P=0.000)和椎间隙高度(P=0.000)差异亦有统计学意义(表3,4),术后1、3、6和12个月时颈椎生理曲度(均P=0.001)和椎间隙高度(均P=0.001)测量数据均高于术前,而术后各时间点差异无统计学意义(均P>0.05,表5)。表明无论是传统融合器联合钛板内固定还是ROI-C均可使颈椎生理曲度增大、椎间隙高度增高且可持续至术后12个月,尤以ROI-C效果更佳。

两组患者神经功能比较,ROI-C组患者JOA评分高于(P=0.016)、NDI指数低于(P=0.024)钛板组(表6,7);两组手术前后不同观察时间点JOA评分(P=0.000)和NDI指数(P=0.000)差异亦有统计学意义(表6,7),术后1、3、6和12个月时JOA评分高于(均P=0.001)、NDI指数低于(均P=0.001)术前(表6,7),而术后各时间点差异无统计学意义(均P>0.05,表8)。表明无论是传统融合器联合钛板内固定还是ROI-C均可使患者神经功能和生活质量受限得以改善且可持续至术后12个月,尤以ROI-C效果更佳。

根据Bazaz吞咽困难分级,术后1周共计47例发生吞咽困难,钛板组27例(轻度24例、中度3例),发生率为48.21%,其中10例(17.86%)术后3个月症状完全缓解、8例(14.29%)至术后6个月完全缓解,余9例(16.07%)至术后12个月时仍遗留轻度吞咽困难;ROI-C组共20例(轻度19例、中度1例),发生率约33.33%,均于术后3个月症状完全缓解。两组患者术后1周吞咽困难发生率差异无统计学意义(χ^2=2.661,P=0.103),但随访至12个月时钛板组吞咽困难发生率高于ROI-C组且差异具有统计学意义(χ^2=6.779,P=0.009)。

术后12个月随访时,颈椎X线和CT显示椎间植骨融合良好(图1,2),无一例发生融合器沉降、假关节形成等融合失败现象;ROI-C组行单节段手术患者无一例发生相邻椎体节段退行性变,1例双节段手术患者发生上位椎体节段退行性变,总体发生率为1.67%(1/60);钛板组行单节段手术患者均未发生相邻椎体节段退行性变,1例双节段手术患者发生上位椎体节段退行性变,总体发生率为1.78%(1/57);两组相邻椎体节段退行性变发生率差异无统计学意义(χ^2=0.002,P=0.961)。本研究所纳入病例无一例出现呼吸道、食管损伤或食管瘘,以及内固定排异、切口感染等手术相关并发症;ROI-C组有1例单节段手术患者术中发生脑脊液漏,经脊髓保护膜修补并肌肉填充后低颅压症状得以控制,两组脑脊液漏发生率差异无统计学意义(χ^2=1.081,

表3 ROI-C组与钛板组患者手术前后颈椎生理曲度和椎间隙高度的比较($\bar{x} \pm s$)

Table 3. Comparison of physiological curvature and intervertebral space height of cervical vertebrae before and after surgery between ROI-C group and titanium plate group ($\bar{x} \pm s$)

组别	例数	术前(1)	术后			
			1个月(2)	3个月(3)	6个月(4)	12个月(5)
颈椎生理曲度(°)						
钛板组	56	11.69±6.75	19.10±6.48	19.83±6.93	21.26±7.28	20.96±7.31
ROI-C组	60	12.26±7.10	19.62±6.53	20.38±7.55	21.60±7.23	21.45±6.81
椎间隙高度(mm)						
钛板组	56	4.55±0.82	6.38±1.17	6.40±1.31	6.36±1.58	6.33±1.16
ROI-C组	60	4.53±0.94	6.45±1.01	6.45±1.28	6.39±1.52	6.31±1.26

表4 ROI-C组与钛板组患者手术前后颈椎生理曲度和椎间隙高度的重复测量设计的方差分析表

Table 4. ANOVA for repeated measurement design analysis of physiological curvature and intervertebral space height of cervical vertebrae before and after surgery between ROI-C group and titanium plate group

变异来源	*SS*	df	*MS*	*F*值	*P*值	变异来源	*SS*	df	*MS*	*F*值	*P*值
颈椎生理曲度						椎间隙高度					
处理因素	16.239	1	16.329	82.424	0.024	处理因素	8.231	1	8.231	43.427	0.021
测量时间	250.940	4	62.735	70.247	0.000	测量时间	140.992	4	35.248	35.312	0.000
处理因素×测量时间	209.404	4	52.351	38.425	0.000	处理因素×测量时间	151.372	4	37.843	10.396	0.000
组间误差	3.215	1	3.215			组间误差	2.639	1	2.639		
组内误差	1.648	4	0.412			组内误差	1.528	4	0.382		

表5 同一处理组患者不同观察时间点颈椎生理曲度和椎间隙高度的两两比较

Table 5. Pairwise comparison of cervical vertebrae physiological curvature and intervertebral space height of cervical vertebrae at different observation time in the same treatment group

组内两两比	颈椎生理曲度		椎间隙高度		组内两两比	颈椎生理曲度		椎间隙高度	
	*t*值	*P*值	*t*值	*P*值		*t*值	*P*值	*t*值	*P*值
钛板组					ROI-C组				
(1):(2)	9.585	0.001	5.927	0.001	(1):(2)	10.780	0.001	5.910	0.001
(1):(3)	8.958	0.001	6.297	0.001	(1):(3)	8.984	0.001	6.069	0.001
(1):(4)	7.609	0.001	7.214	0.001	(1):(4)	8.062	0.001	7.140	0.001
(1):(5)	9.377	0.001	6.972	0.001	(1):(5)	8.771	0.001	7.236	0.001
(2):(3)	0.085	0.932	0.566	0.566	(2):(3)	0.026	0.998	0.589	0.556
(2):(4)	0.076	0.939	1.658	0.100	(2):(4)	0.255	0.799	1.574	0.118
(2):(5)	0.227	0.820	1.425	0.157	(2):(5)	0.672	0.503	1.502	0.135
(3):(4)	0.145	0.884	1.065	0.289	(3):(4)	0.234	0.816	0.904	0.368
(3):(5)	0.229	0.765	0.839	0.403	(3):(5)	0.547	0.604	0.815	0.417
(4):(5)	0.174	0.909	0.218	0.828	(4):(5)	0.314	0.254	0.117	0.907

$P=0.299$);两组各有1例双节段手术患者于术后当日出现手术切口局部血肿,经开放切口、清除血肿、冲洗引流后症状缓解,两组术后血肿发生率差异亦无统计学意义($\chi^2=0.002$,$P=0.961$)。

讨　论

目前,传统融合器联合钛板内固定技术已在全球范围内广泛应用,但存在内固定螺钉松动、断裂、退钉,内固定钛板断裂、松动、异物反应,以及钛板占据椎体与食管之间空间致长期吞咽困难等诸多并发症[1]。多个颈椎间盘突出行传统融合器联合钛板内固定患者,过长的钛板使术中显露范围扩大,操作难度增加,术中稍有不慎即可导致术野周围重要组织结构损伤,如食管、呼吸道损伤甚至食管漏,喉返神经受损可引起声音嘶哑、饮水呛咳[5];特别是对于不相邻节段椎间盘突出者需牺牲病变之间的

表6 ROI-C组与钛板组患者手术前后JOA评分和NDI指数的比较($\bar{x}\pm s$,评分)

Table 6. Comparison of JOA score and NDI score before and after surgery between ROI-C group and titanium plate group ($\bar{x}\pm s$, score)

组别	例数	术前(1)	术后			
			1个月(2)	3个月(3)	6个月(4)	12个月(5)
JOA评分						
钛板组	56	11.28±2.90	14.93±3.85	15.32±4.77	15.70±4.61	15.76±4.02
ROI-C组	60	11.62±3.56	15.28±4.14	15.57±5.11	15.80±5.28	15.92±4.26
NDI指数						
钛板组	56	35.61±5.98	14.97±3.81	15.06±4.40	15.01±3.47	15.69±4.33
ROI-C组	60	36.23±3.82	15.53±4.89	14.90±5.13	15.16±4.62	14.91±4.81

JOA,Japan Orthopedic Association Scores,日本骨科协会评分;NDI,Neck Disability Index,颈椎功能障碍指数。The same for Table 7, 8

表7 ROI-C组与钛板组患者手术前后JOA评分和NDI指数的重复测量设计的方差分析表

Table 7. ANOVA for repeated measurement design of JOA score and NDI score before and after surgery between ROI-C group and titanium plate group

变异来源	*SS*	df	*MS*	*F*值	*P*值	变异来源	*SS*	df	*MS*	*F*值	*P*值
JOA评分						NDI指数					
处理因素	563.579	1	563.579	16.024	0.016	处理因素	394.528	1	394.528	21.439	0.024
测量时间	2010.540	4	502.635	13.420	0.000	测量时间	1391.356	4	347.839	19.523	0.000
处理因素×测量时间	1969.456	4	492.364	3.563	0.000	处理因素×测量时间	1353.172	4	338.293	8.736	0.000
组间误差	42.593	1	42.593			组间误差	49.235	1	49.235		
组内误差	5.868	4	1.467			组内误差	10.732	4	2.683		

表8 同一处理组患者不同观察时间点JOA评分和NDI指数的两两比较

Table 8. Pairwise comparison of JOA score and NDI score at different observation time in the same treatment group

组内两两比	JOA评分		NDI指数		组内两两比	JOA评分		NDI指数	
	*t*值	*P*值	*t*值	*P*值		*t*值	*P*值	*t*值	*P*值
钛板组					ROI-C组				
(1):(2)	5.667	0.001	21.782	0.001	(1):(2)	5.192	0.001	25.843	0.001
(1):(3)	5.416	0.001	20.714	0.001	(1):(3)	4.913	0.001	25.838	0.001
(1):(4)	6.073	0.001	22.301	0.001	(1):(4)	5.084	0.001	27.233	0.001
(1):(5)	6.763	0.001	20.195	0.001	(1):(5)	6.000	0.001	26.892	0.001
(2):(3)	0.476	0.635	0.116	0.908	(2):(3)	0.733	0.342	0.689	0.493
(2):(4)	0.959	0.340	0.058	0.934	(2):(4)	0.600	0.549	0.426	0.671
(2):(5)	1.116	0.227	0.934	0.352	(2):(5)	0.835	0.406	0.700	0.485
(3):(4)	0.429	0.669	0.067	0.947	(3):(4)	0.243	0.809	0.299	0.765
(3):(5)	0.528	0.599	0.764	0.447	(3):(5)	0.406	0.684	0.011	0.991
(4):(5)	0.942	0.073	0.917	0.361	(4):(5)	0.137	0.891	0.290	0.772

正常椎体,使手术相关并发症发生风险明显增加。ROI-C恰好可以弥补上述缺陷,通过植入上下相邻椎体的两个钛制嵌片将融合器牢固地固定于椎间隙,从而使椎间融合器移动或退钉风险显著降低,且ROI-C植入后无椎前突出物,能够真正达到"零切迹",不仅使手术步骤简化、椎间软组织显露范围缩小,而且可避免植入钛板引起的相关并发症[3-7]。对本研究钛板组和ROI-C组患者手术相关指标的比较表明,无论是单节段手术还是双节段手术,ROI-C组手术时间和术中出血量均少于钛板组,主要得益于ROI-C简化的手术步骤,固定的钛制嵌片通过融合器直接植入椎体而无需额外显露固定钛板的术野;关于影像学指标比较,两组患者术后均可见颈椎生理曲度增大、椎间隙高度增高且疗效可持续至术后

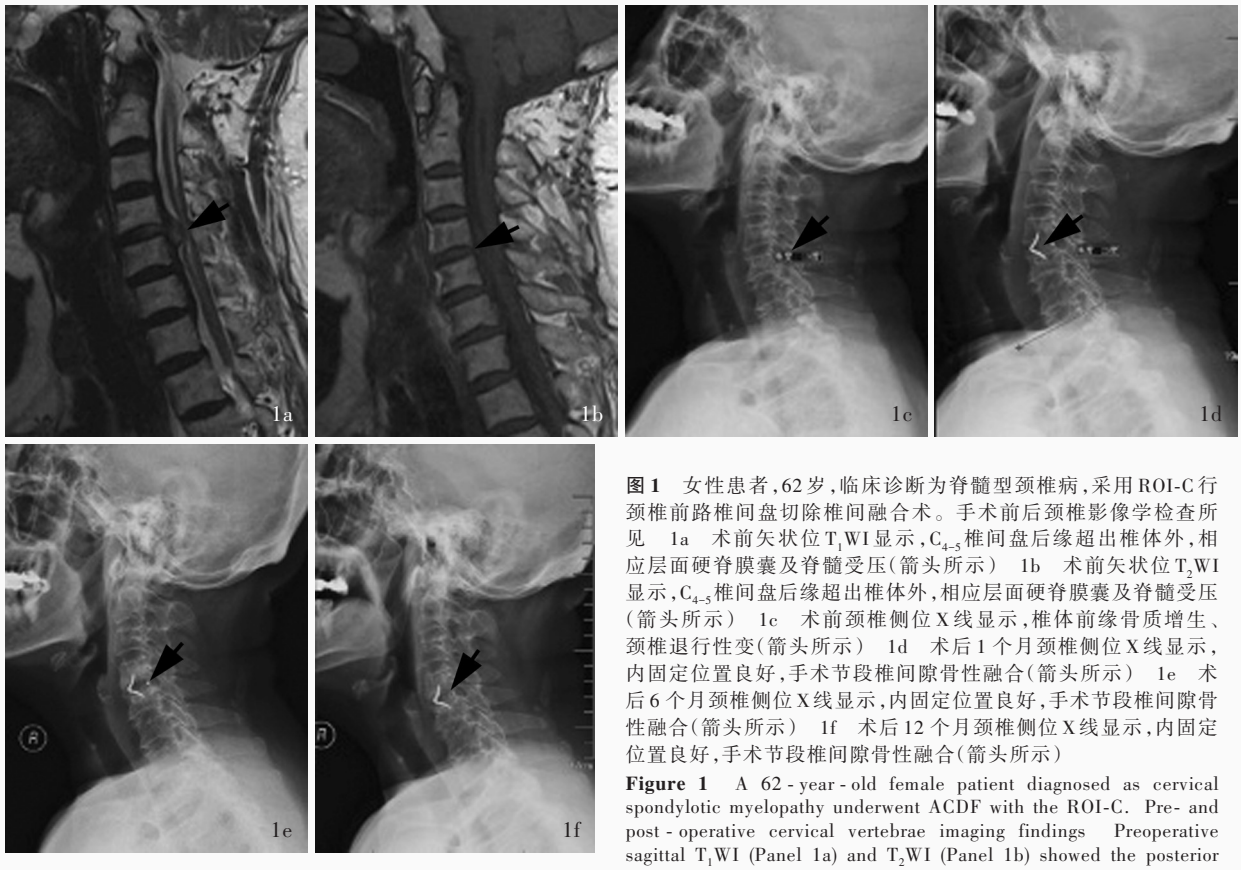

图1 女性患者，62岁，临床诊断为脊髓型颈椎病，采用ROI-C行颈椎前路椎间盘切除椎间融合术。手术前后颈椎影像学检查所见 1a 术前矢状位T_1WI显示，C_{4-5}椎间盘后缘超出椎体外，相应层面硬脊膜囊及脊髓受压（箭头所示） 1b 术前矢状位T_2WI显示，C_{4-5}椎间盘后缘超出椎体外，相应层面硬脊膜囊及脊髓受压（箭头所示） 1c 术前颈椎侧位X线显示，椎体前缘骨质增生、颈椎退行性变（箭头所示） 1d 术后1个月颈椎侧位X线显示，内固定位置良好，手术节段椎间隙骨性融合（箭头所示） 1e 术后6个月颈椎侧位X线显示，内固定位置良好，手术节段椎间隙骨性融合（箭头所示） 1f 术后12个月颈椎侧位X线显示，内固定位置良好，手术节段椎间隙骨性融合（箭头所示）

Figure 1 A 62-year-old female patient diagnosed as cervical spondylotic myelopathy underwent ACDF with the ROI-C. Pre- and post-operative cervical vertebrae imaging findings Preoperative sagittal T_1WI (Panel 1a) and T_2WI (Panel 1b) showed the posterior edge of the C_{4-5} intervertebral disc was beyond the vertebra, and the dural sac and spinal cord were compressed at the corresponding level (arrows indicate). Preoperative lateral X-ray showed bone hyperplasia at the anterior edge of vertebra, and a degenerative change in the cervical vertebrae (arrow indicates, Panel 1c). Postoperative lateral X-ray of the cervical spine at one month (Panel 1d), 6 months (Panel 1e) and 12 months (Panel 1f) good internal fixation position, and osseous fusion of the intervertebral space in the surgical segment (arrows indicate).

12个月，尤以ROI-C组效果更佳，提示无论是传统融合器联合钛板内固定还是ROI-C均可有效重建并维持颈椎生理曲度和椎间隙高度，但ROI-C各项测量数据均明显优于传统融合器联合钛板内固定技术；对术后神经功能评价显示，两组患者神经功能恢复良好，JOA评分增加、NDI指数减少，随访至术后12个月时各项神经功能与日常生活质量仍持续向好，尤以ROI-C组患者更明显，表明无论是传统融合器联合钛板内固定还是ROI-C均可使患者神经功能和生活质量改善并持续较长时间，以ROI-C效果更佳。

传统融合器联合钛板内固定后的常见并发症为吞咽困难[8]，术后早期吞咽困难发生率为2%～67%[9-10]，术后3个月为12%～35%[11-12]。术后发生吞咽困难的原因较多，Bazaz等[13]的研究显示，钛板厚度可能是影响术后吞咽功能的主要原因，应用较厚（>7 mm）钛板者术后吞咽困难发生率高于应用较薄（3～7 mm）或表面相对较光滑钛板者；手术时间也是术后发生吞咽困难的影响因素[14]，手术时间越长，食管、呼吸道、颈长肌等组织因牵拉造成的损伤程度越严重，术后出现局部组织肿胀、炎症反应的可能性越大，发生术后吞咽困难的概率越高；此外，病变椎体节段越多、术中显露范围越大，周围组织被剥离和牵拉得越明显，导致术后周围软组织明显肿胀，进而引起吞咽困难[6,15]。本研究ROI-C组与钛板组术后1周吞咽困难发生率无明显差异[33.33%（20/60）对48.21%（27/56），$P=0.103$]，但钛板组患者症状完全缓解时间较长，术后12个月时吞咽困难发生率高于ROI-C组[16.07%（9/56）对0（0/60），$P=0.009$]，推测与ROI-C术中操作步骤少、时间短，对颈前软组织的牵拉损伤较小有关，在一定程度上反映了术后短期内出现吞咽困难的原因主要为椎前软组织水肿[2,16-17]。相邻椎体节段退行性变是术后远期并发症，尽管有学者认为，相邻椎体

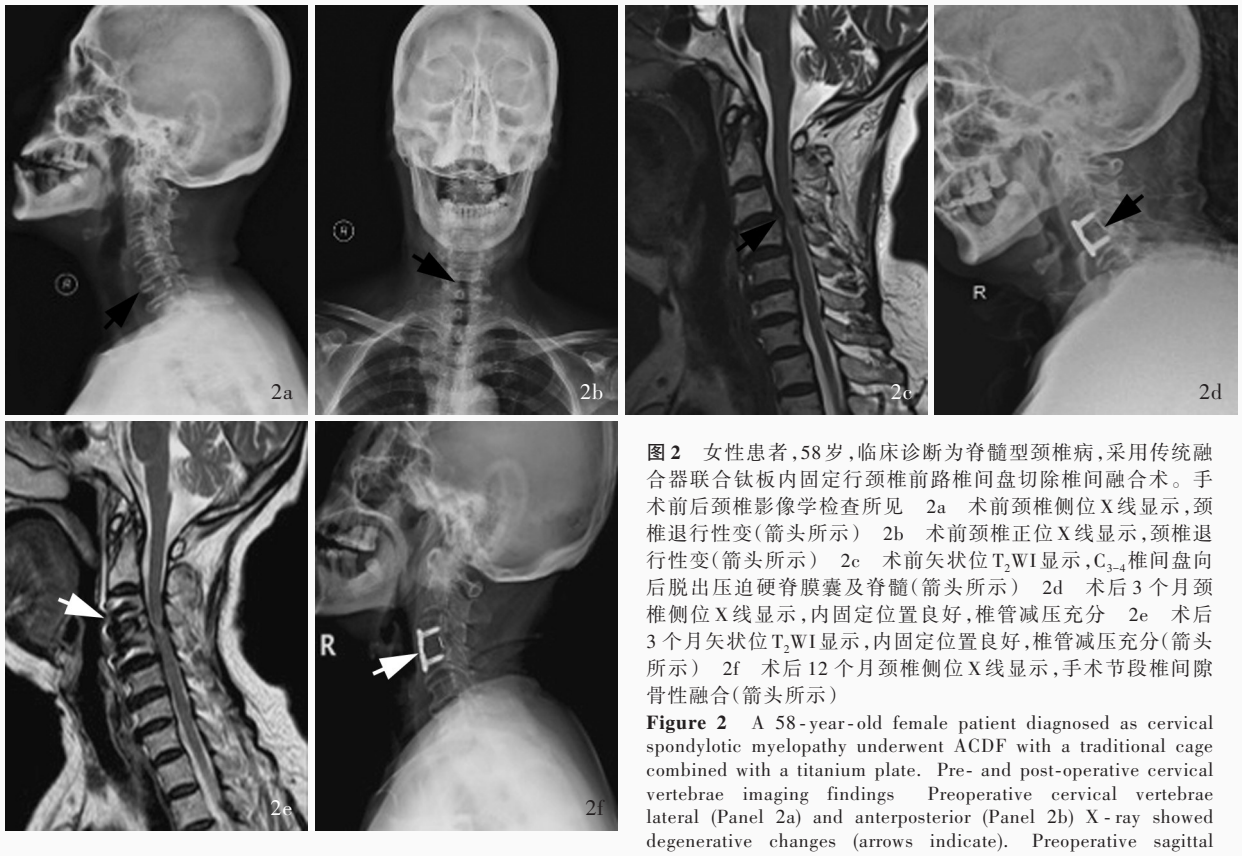

图2 女性患者，58岁，临床诊断为脊髓型颈椎病，采用传统融合器联合钛板内固定行颈椎前路椎间盘切除椎间融合术。手术前后颈椎影像学检查所见 2a 术前颈椎侧位X线显示，颈椎退行性变（箭头所示） 2b 术前颈椎正位X线显示，颈椎退行性变（箭头所示） 2c 术前矢状位T_2WI显示，C_{3-4}椎间盘向后脱出压迫硬脊膜囊及脊髓（箭头所示） 2d 术后3个月颈椎侧位X线显示，内固定位置良好，椎管减压充分 2e 术后3个月矢状位T_2WI显示，内固定位置良好，椎管减压充分（箭头所示） 2f 术后12个月颈椎侧位X线显示，手术节段椎间隙骨性融合（箭头所示）

Figure 2 A 58-year-old female patient diagnosed as cervical spondylotic myelopathy underwent ACDF with a traditional cage combined with a titanium plate. Pre- and post-operative cervical vertebrae imaging findings Preoperative cervical vertebrae lateral (Panel 2a) and anterposterior (Panel 2b) X-ray showed degenerative changes (arrows indicate). Preoperative sagittal T_2WI showed the C_{3-4} intervertebral disc prolapsed backward compressing the dural sac and spinal cord (arrow indicates, Panel 2c). Postoperative lateral X-ray (Panel 2d) and sagittal T_2WI (Panel 2e) of the cervical vertebrae at 3 months showed the internal fixation position was good, and the spinal canal was adequately decompressed (arrows indicate). Postoperative lateral X-ray of the cervical vertebrae at 12 months showed bony fusion in surgical intervertebral space (arrow indicates, Panel 2f).

节段退行性变是增龄性颈椎退行性病变的自然生理进程[18]。但生物力学研究显示，钛板固定使相邻椎体节段代偿性活动增加，导致椎间盘负荷增加和应力分布变化[19]；固定的钛板对相邻椎体节段的纤维环和前纵韧带是一种慢性不良刺激，具有一定损伤，可加速椎体间结缔组织的退行性变[20]。一项针对颈椎前路椎间盘切除椎间融合术患者进行的长达9.8年的随访研究显示，50%（21/42）患者可出现相邻椎体节段退行性变，38.10%（8/21）因颈椎曲度改变而致神经系统症状恶化[21]。亦有研究显示，颈椎前路椎间盘切除椎间融合术中应用钛板的患者相邻椎体节段退行性变发生率显著高于不应用钛板者[22]。然而，目前关于ROI-C是否引起相邻椎体节段退行性变及其危险因素的研究较少，本研究ROI-C组无论单节段手术还是双节段手术后12个月内均未发生相邻椎体节段退行性变，钛板组仅有1例双节段手术患者发生相邻椎体节段退行性变，但两组发生率并未达到统计学差异。

综上所述，ROI-C可以缩短颈椎前路椎间盘切除椎间融合术手术时间、减少术中出血量、恢复颈椎生理曲度和椎间隙高度、改善神经功能和生活质量，并可降低术后吞咽困难发生率，该项手术技术步骤简便，对软组织损伤较小，具备临床推广价值。本研究病例数较少，且作为回顾性研究其结果可能存在一定偏倚，未来有待扩大样本量、延长随访时间、开展多中心随机对照试验以进一步验证其临床疗效。

利益冲突 无

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（收稿日期：2022-08-20）
（本文编辑：彭一帆）

下期内容预告 本刊2022年第9期报道专题为神经系统免疫性疾病，重点内容包括：视神经脊髓炎谱系疾病神经再生研究进展；免疫检查点抑制剂相关神经系统不良反应；晚发型及极晚发型视神经脊髓炎谱系疾病临床特点分析；视神经脊髓炎谱系疾病静脉注射甲泼尼龙后肝损伤危险因素分析；视神经炎合并慢性乙型肝炎病毒感染临床分析；抗γ-氨基丁酸B型受体抗体相关脑炎临床特点分析；自身免疫性脑炎复发影响因素分析；表现为孤立性皮质病变的抗髓鞘少突胶质细胞糖蛋白免疫球蛋白G抗体相关疾病合并桥本甲状腺炎和干燥综合征一例；抗胶质纤维酸性蛋白抗体阳性的复发性短节段脊髓炎一例