临床论著

单节段 Discover 人工颈椎间盘置换术与颈前路减压融合术治疗颈椎病的长期疗效对比

雷润博[1,2],李 盼[1],甘 璐[1],杨雪蕊[3],魏 彬[1],曹雄飞[1],李 沫[1],罗卓荆[1]
(1 空军军医大学西京医院骨科 710004 西安市;2 解放军 95960 部队 710000 西安市;
3 空军军医大学唐都医院临床技能中心 710038 西安市)

【摘要】目的:比较单节段 Discover 人工颈椎间盘置换术(artificial cervical disc replacement,ACDR)与颈前路椎间盘切除减压融合术(anterior cervical discectomy and fusion,ACDF)治疗颈椎病的长期临床疗效。**方法**:回顾性分析 2009 年 1 月~2011 年 12 月在西京医院行单节段 ACDR 和 ACDF 治疗的颈椎病患者的临床资料。ACDR 组(n=21 例)男性 15 例,女性 6 例,年龄 33~58 岁(44.0±7.5 岁);采用 Discover 假体,C4/5 2 例,C5/6 17 例,C6/7 2 例。ACDF 组(n=25 例)男性 20 例,女性 5 例,年龄 33~63 岁(48.2±8.5 岁);C3/4 1 例,C4/5 3 例,C5/6 18 例,C6/7 3 例。采用日本矫形外科学会(Japanese Orthopedic Association,JOA)评分法、疼痛视觉模拟评分法(visual analogue scale,VAS)和颈椎功能障碍指数(neck disability index,NDI)对两组患者术前/术后 3 个月、1 年、2 年、5 年及末次随访时的神经功能和临床疗效进行评估;利用 X 线、CT 及 MRI 影像学资料测量和评估 ACDR 组手术节段活动度(range of motion,ROM)、末次随访时的异位骨化(heterotopic ossification,HO)以及末次随访时两组患者手术邻近节段退变(adjacent segment degeneration,ASD)情况,并进行统计学分析。**结果**:ACDR 组随访时间 138.9±12.0 个月,ACDF 组随访时间 136.9±10.8 个月,两组无统计学差异(P>0.05)。两组患者术后各随访时间点 JOA 评分、上肢痛 VAS 评分、颈痛 VAS 评分和 NDI 均较术前显著性改善,与同组术前比较均有统计学差异(P<0.05),末次随访与术后 2 年比较均无统计学差异(P>0.05);两组同时间点比较均无统计学差异(P>0.05)。ACDR 组术后 3 个月、1 年、2 年时手术节段 ROM 与术前比较显著性增加(P<0.05),术后 5 年和末次随访时与术前比较均无统计学差异(P>0.05)。ACDR 组末次随访时 13 例(61.9%)手术节段发生 HO,其中 McAfee 分级Ⅰ级 1 例,Ⅱ级 3 例,Ⅲ级 6 例,Ⅳ级 3 例。ACDR 组 17 个(40.5%)邻近节段发生退变,ACDF 组 34个(68.0%)邻近节段发生退变,两组 ASD 发生率有统计学差异(P<0.05)。末次随访时 ACDR 组无二次手术患者,ACDF 组 2 例因 ASD 导致二次手术。两组二次手术率有统计学差异(0 vs 8%,P<0.05)。**结论**:与 ACDF 术式相比,单节段 ACDR 治疗颈椎病能够获得一致的、良好的长期临床疗效,并在减少 ASD 发生方面具有优势。然而,随时间延长 ACDR 手术节段 HO 发生率较高,造成手术节段活动度降低。

【关键词】颈椎病;人工颈椎间盘置换术;颈前路减压融合术;长期随访;临床疗效
doi:10.3969/j.issn.1004-406X.2022.08.03
中图分类号:R681.5,R687.3 **文献标识码**:A **文章编号**:1004-406X(2022)-08-0688-08

Comparison of the long-term clinical effects between single-level Discover artificial cervical disc replacement and anterior cervical decompression and fusion in the treatment of cervical spondylosis/LEI Runbo, LI Pan, GAN Lu, et al//Chinese Journal of Spine and Spinal Cord, 2022, 32(8): 688-695

【Abstract】Objectives: To evaluate the long-term clinical efficacies of single-level Discover artificial cervical disc replacement(ACDR) and anterior cervical discectomy and fusion(ACDF) in the treatment of cervical spondylosis. **Methods:** The clinical data of patients with cervical spondylosis who underwent single-level ACDR or ACDF in Xijing Hospital from January 2009 to December 2011 were reviewed. ACDR group consisted of 21 patients(15 males and 6 females), aged 44.0±7.5(33-58) years old and treated with Discover prosthesis, involving C4/5 in 2 cases, C5/6 in 17 cases, and C6/7 in 2 cases. ACDF group consisted of 25 patients(20 males and 5 females), aged 48.2±8.5(33-63) years old, involving C3/4 in 1 case, C4/5 in 3 cases, C5/6 in 18 cases, and C6/7 in 3 cases. Japanese Orthopedic Association(JOA) score, visual analogue scale(VAS) and

第一作者简介:男(1994-),住院医师,硕士研究生,研究方向:颈腰椎退行性疾病
电话:(029)84775298 E-mail:609691269@qq.com
通讯作者:罗卓荆 E-mail:zjluo@fmmu.edu.cn; 李沫 E-mail:limo0729@hotmail.com

neck disability index(NDI) were used to assess the patients′ neurological functions and the clinical effects before surgery, at 3 months after surgery, and 1, 2, and 5 years after surgery, as well as the last follow-up. The range of motion(ROM) at the index level of ACDR group and final follow-up heterotopic ossification(HO) of ACDR group and adjacent segments degeneration(ASD) conditions of both groups were measured and evaluated with cervical spinal radiographs, CT scan and MRI, and statistical analyses were performed. **Results:** The mean follow-up time was 138.9±12.0 months in ACDR group and 136.9±10.8 months in ACDF group, and there was no statistical difference between the two groups (P>0.05). The postoperative follow-up JOA, VAS-Arm, and VAS-Neck scores and NDI of the two groups were all significantly improved compared with those before operation(P<0.05), respectively, there was no statistical difference between the scores at the last follow-up and 2 years after surgery in the same group (P>0.05), and there was no statistical difference between the two groups at the same time point(P>0.05). In the ACDR group, the range of motion(ROM) at the index level at the 3 month, 1 year and 2 years after surgery was significantly improved compared with that before surgery (P<0.05), and which at postoperative 5 years and final follow-up was not statistically different from that before operation(P>0.05). At the final follow-up, 13 cases(61.9%) in ACDR group occurred HO at the operated level, of which 1 case was of grade Ⅰ, 3 cases of grade Ⅱ, 6 cases of grade Ⅱ, and 3 cases of grade Ⅳ according to McAfee′s classification. The ASD rate in ACDR group(17/42, 40.5%) and ACDF group(34/50, 68.0%) was statistically different(P<0.05). At the last follow-up, there were 0 case of secondary operation in ACDR group and 2 cases in ACDF group caused by ASD were in need of secondary operations. The secondary operation rate between groups was statistically different (0 vs 8%, P<0.05). **Conclusions:** Single-level ACDR has the same and good long-term clinical efficacy comparing with ACDF, which also superiors in reducing the incidence of ASD in the treatment of cervical spondylosis. However, the incidence of HO at the index level may gradually increase over time, resulting in the reduction of the ROM at the index level.

【Key words】 Cervical spondylosis; Artificial cervical disc replacement; Anterior cervical discectomy and fusion; Long-term follow-up; Clinical efficacy

【Author′s address】 1. Department of Orthopaedics, Xijing Hospital, Air Force Medical University, Xi′an, 710004, China; 2. The Unit 95960 of the PLA, Xi′an, 710000, China

颈前路椎间盘切除减压融合内固定术(anterior cervical discectomy and fusion,ACDF) 是目前治疗颈椎病的标准术式之一[1]。然而,ACDF 患者术后手术邻近的非融合节段活动度增加, 加速退变,导致邻近节段椎间盘突出和椎管狭窄,甚至造成颈脊髓或神经根压迫,出现邻椎病[2,3]。人工颈椎间盘置换 (artificial cervical disc replacement,ACDR)的设计初衷是保留颈椎手术节段活动度,减缓邻近节段退变(adjacent segment degeneration,ASD)的发生,20 世纪 60 年代由 Fernstorm 等[4]首次报道,经过多年的发展,目前临床上应用的人工颈椎间盘假体类型有多种。Bryan 假体作为第一代人工颈椎间盘, 其长期随访临床研究相对较多, 但有关其在长期随访的临床疗效是否优于 ACDF 仍存在争议 [5,6]。Discover(Depuy Spine)假体作为第二代人工颈椎间盘,其短期随访临床疗效已得到验证[7,8];我们也曾报道过 Discover 人工颈椎间盘置换的短期随访疗效[9],患者术后神经功能得到了有效改善, 并保留了手术节段活动度(range of motion,ROM),未出现异位骨化(heterotopic ossification,HO)。目前,国内外关于 Discover 假体的长期随访临床研究少, 我们回顾性分析 2009 年 1 月~2011 年 12 月在西京医院行单节段 ACDR 治疗的 21 例颈椎病患者长期随访临床资料, 与同期行 ACDF 手术患者的临床资料进行对比。

1 资料和方法

1.1 一般资料

病例纳入标准:①临床诊断为颈椎病(C3~C7 神经根型、脊髓型或混合型颈椎病);②行单节段颈椎 ACDR 或 ACDF;③随访时间>10 年,随访资料齐全。排除标准:①既往有颈椎手术史;②存在颈椎先天发育畸形、外伤、感染、强直性脊柱炎;③后纵韧带骨化; ④行多节段 ACDR 或 ACDF 者。所有患者均同意并签署知情同意书。

2009 年 1 月~2011 年 12 月进行单节段 ACDR 且获得长期随访患者共 21 例(ACDR 组);进行单节段 ACDF 且获得长期随访患者共 25 例(ACDF 组)。ACDR 组采用的人工颈椎间盘为 Discover 假体,ACDF 组采用椎间自体植骨融合、Zephir 钢板内固定。两组患者年龄、性别、颈椎病类型、手术节段和随访时间见表 1,两组间比较均无统计学差异(P>0.05)。

1.2 临床疗效评估

术前、术后 3 个月、1 年、2 年、5 年及末次随访时采用日本矫形外科学会(Japanese Orthopedic Association,JOA)、疼痛视觉模拟(visual analogue scale,VAS)评分法和颈椎功能障碍指数(neck disability index,NDI)量表对患者进行评估,并计算末次随访时 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 Bazaz 方法[10]评估术后吞咽困难发生情况:无,没有吞咽困难;轻,极少数情况下出现吞咽困难,但不影响日常生活;中,在吞咽面包或牛排等特殊食物时偶发吞咽困难;重,频繁出现吞咽困难。

1.3 影像学评估

(1)在术前、术后 3 个月、1 年、2 年、5 年及末次随访时的颈椎过伸、过屈位 X 线片上测量 ACDR 组手术节段的 ROM。(2)在末次随访的颈椎 X 线片和三维 CT 上评估 ACDR 组手术节段 HO(采用 McAfee 分级法[11],0 级,没有骨化现象;Ⅰ级,有骨化形成,未侵及椎间隙;Ⅱ级,骨化侵及椎间隙;Ⅲ级,骨化影响椎间隙活动;Ⅳ级,假体融合,已经形成骨桥,节段活动度<2°)。(3)末次随访时通过颈椎侧位 X 线片和 MRI(Miyazaki 分级[12]:Ⅰ级,髓核高信号、白色且结构均匀,髓核和纤维环界限清晰,椎间盘高度正常;Ⅱ级,髓核高信号、结构不均匀且有水平条带,髓核和纤维环界限清晰,椎间盘高度正常;Ⅲ级,髓核中信号、灰黑色且结构不均匀,髓核和纤维环界限不清楚,椎间盘高度降低;Ⅳ级,髓核低信号、灰黑色且结构不均匀,髓核和纤维环界限消失,椎间盘高度降低;Ⅴ级,髓核低信号、灰黑色且结构不均匀,髓核和纤维环界限消失,椎间盘高度丢失)综合评估两组 ASD 发生情况:①在颈椎侧位 X 线片上有新生骨赘或原有骨赘增大,椎间隙高度较术前降低超过 10%,前纵韧带钙化;②在颈椎 MRI T2W1 矢状位上 Miyazaki 分级邻近节段椎间盘退变程度增加 1 级或以上。①和/或②即诊断为 ASD。

表 1 两组患者一般资料

Table 1 General information of patients

	ACDR组(n=21) ACDR group	ACDF组(n=25) ACDF group
性别(男/女) Gender(Male/Female)	15/6	20/5
年龄(岁) Age(years)	44.0±7.5	48.2±8.5
颈椎病类型(例) Type of cervical spondylosis(cases)		
脊髓型颈椎病 Myelopathy	12	15
神经根型颈椎病 Radiculopathy	0	2
混合型颈椎病 Mixed cervical spondylopathy	9	8
手术节段 Operated level		
C3/4	0	1
C4/5	2	3
C5/6	17	18
C6/7	2	3
随访时间(月) Follow-up period(months)	138.9±12.0 (121~155)	136.9±10.8 (122~153)

1.4 统计学方法

采用 SPSS 19.0 软件进行统计学分析。计量资料数据以均数±标准差表示,组内比较采用配对 t 检验,组间比较采用独立样本 t 检验。计数资料采用卡方检验或 Fisher 精确概率检验。P<0.05 为有统计学差异。

2 结果

两组术前和术后各随访时间点的 JOA 评分、颈痛和上肢痛 VAS 评分、NDI 见表 2。两组术后各时间点均获得了良好的神经功能改善,评分均较术前有明显改善(P<0.05)。末次随访与术后 2 年评分比较无明显变化(P>0.05)。两组同时间点比较均无统计学差异(P>0.05)。

ACDR 组术前手术节段 ROM 为 6.55°±3.70°,术后 3 个月为 8.87°±3.97°,术后 1 年为 9.39°±3.28°,术后 2 年为 9.80°±2.99°,术后 5 年为 7.71°±2.70°,末次随访时为 5.60°±3.05°。术后 3 个月、1 年和 2 年时与术前相比显著性增加(P<0.05),术后 5 年和末次随访时与术前比较无统计学差异(图 1,P>0.05)。

随访期间 ACDR 组患者未发生人工椎间盘沉降和移位,ACDF 组患者未出现钢板松动、移位和断裂。ACDR 组 1 例(4.76%)术后出现轻度吞咽困难,但在术后 1 个月随访时症状缓解;ACDF 组 2 例(8.00%)术后出现轻度吞咽困难,1 例

(4.00%)出现中度吞咽困难,2 例在术后 1 月随访时症状缓解,1 例轻度吞咽困难症状持续到了末次随访。末次随访时 ACDR 组 13 例(61.90%)手术节段发生 HO，其中 McAfee 分级Ⅰ级 1 例,Ⅱ级 3 例,Ⅲ级 6 例,Ⅳ级 3 例,Ⅳ级患者手术节段 ROM 基本丧失(图 2)。末次随访时对患者进行颈椎侧位 X 线和 MRI(Miyazaki)综合评估后发现，ACDR 组 17 个邻近节段发生 ASD，发生率为 40.47%(17/42);ACDF 组 34 个邻近节段发生 ASD(图 3),发生率为 68%(34/50)。两组 ASD 发生率比较有统计学差异(P<0.05)。ACDR 组没有患者出现压迫神经相应临床症状，无二次手术患者;ACDF 组有 6 例(24%)出现压迫神经相应临床症状,其中 4 例患者经保守治疗症状缓解,2 例(8%)患者因保守治疗无效进行二次手术。两组二次手术率比较有统计学差异(0 vs 8%,P<0.05)。

表 2 两组患者术前和术后不同时间点的临床疗效评分

Table 2 Clinical efficacy scores of the two groups at different time points before and after surgery

	ACDR组 ACDR group	ACDF组 ACDF group
JOA评分(分) JOA score		
术前 Preoperation	7.38±2.33	7.40±2.72
术后 3 个月 3m po.	14.76±4.74①	14.32±3.33①
术后 1 年 1y po.	14.43±4.63①	14.92±3.01①
术后 2 年 2y po.	14.62±4.46①	15.08±3.15①
术后 5 年 5y po.	15.05±4.04①	15.48±2.47①
末次随访 Final follow-up	14.95±3.94①	15.04±2.13①
颈椎功能障碍指数(分) NDI		
术前 Preoperation	50.24±18.91	48.80±18.18
术后 3 个月 3m po.	19.81±12.02①	17.68±10.77①
术后 1 年 1y po.	20.14±12.06①	17.60±10.17①
术后 2 年 2y po.	20.71±14.54①	16.48±11.03①
术后 5 年 5y po.	20.14±10.37①	18.24±10.74①
末次随访 Final follow-up	19.76±13.38①	18.32±9.98①
上肢痛 VAS 评分(分) VAS-Arm pain score		
术前 Preoperative	7.67±1.91	7.52±1.12
术后 3 个月 3m po.	2.81±1.25①	2.64±2.06①
术后 1 年 1y po.	2.52±1.12①	2.48±1.61①
术后 2 年 2y po.	2.19±1.17①	2.24±1.39①
术后 5 年 5y po.	2.00±1.05①	2.04±1.14①
末次随访 Final follow-up	2.05±1.24①	2.12±1.42①
颈痛 VAS 评分(分) VAS-Neck pain score		
术前 Preoperative	7.62±1.43	7.56±1.36
术后 3 个月 3m po.	2.33±1.35①	2.40±1.00①
术后 1 年 1y po.	2.33±1.24①	2.48±0.92①
术后 2 年 2y po.	2.14±1.15①	2.24±1.16①
术后 5 年 5y po.	2.10±0.99①	2.08±0.81①
末次随访 Final follow-up	2.00±1.00①	1.92±1.04①

注:①与同组术前比较 P<0.05

Note: ①Compared with preoperation, P<0.05

3 讨论

ACDF 在临床上应用广泛，通过直接去除压迫,缓解神经压迫症状,改善神经功能。但 ACDF 影响颈椎正常生物力学结构，手术节段的融合会增加邻近节段额外应力,导致邻近节段退变加速。为了解决上述问题,ACDR 被广泛接受和应用,在临床上取得了较为满意的疗效。本研究采用的 Discover 假体属于第二代人工颈椎间盘，不需要开槽、置钉,安装简便;与其他假体相比有 7°脊柱前凸角的设计优势。有关 Discover 假体的术后短期随访也表明了其临床疗效良好[7,8],但目前关于应用 Discover 假体进行 ACDR 的长期随访研究较少，本研究对进行单节段 Discover 人工颈椎间盘置换术与 ACDF 患者术后长达 10 年的临床随访疗效进行了研究对比。

ACDR 的短期随访相关报道证明了 ACDR 具有良好的神经功能恢复,临床疗效佳 [8,13]。在我院 ACDR 术后的短期随访研究中也发现 [9],25 例患者在术后平均 15.3 个月随访时 NDI、JOA 评分、VAS 评分较术前都有明显的改善，临床疗效显著,结果令人满意。有关 ACDR 长期随访的部分报道显示临床疗效和神经功能恢复结果满意[5,14]。本研究结果表明,ACDR 与 ACDF 术后长期随访均保持了良好神经功能恢复，两组在末次随访时的 JOA 评分、上肢痛 VAS 评分(VAS-Arm)、颈痛(VAS-Neck)VAS 评以及 NDI 比较无统计学差异(P>0.05)；末次随访时临床疗效评分较术前均有明显改善(P<0.05),而末次随访与术后 2 年短期随访评分相比较无统计学差异(P>0.05),体现了 ACDR 术后临床疗效的良好保持。Wahood 等[14]对多种 ACDR 术后临床疗效进行了 Meta 分析,发现不同假体术后临床疗效存在细小差别。Bryan 假体术后随访时 NDI、VAS-Arm、VAS-Neck 等评分与术前比较差别更大,神经功能改善更好。但其他假体(Prestige-LP、Mobi-C、Discover 等)术后神经功能也均获得良好改善，仅评分之间差别略小于 Bryan 假体。说明假体类型对术后临床疗效影响并不大。

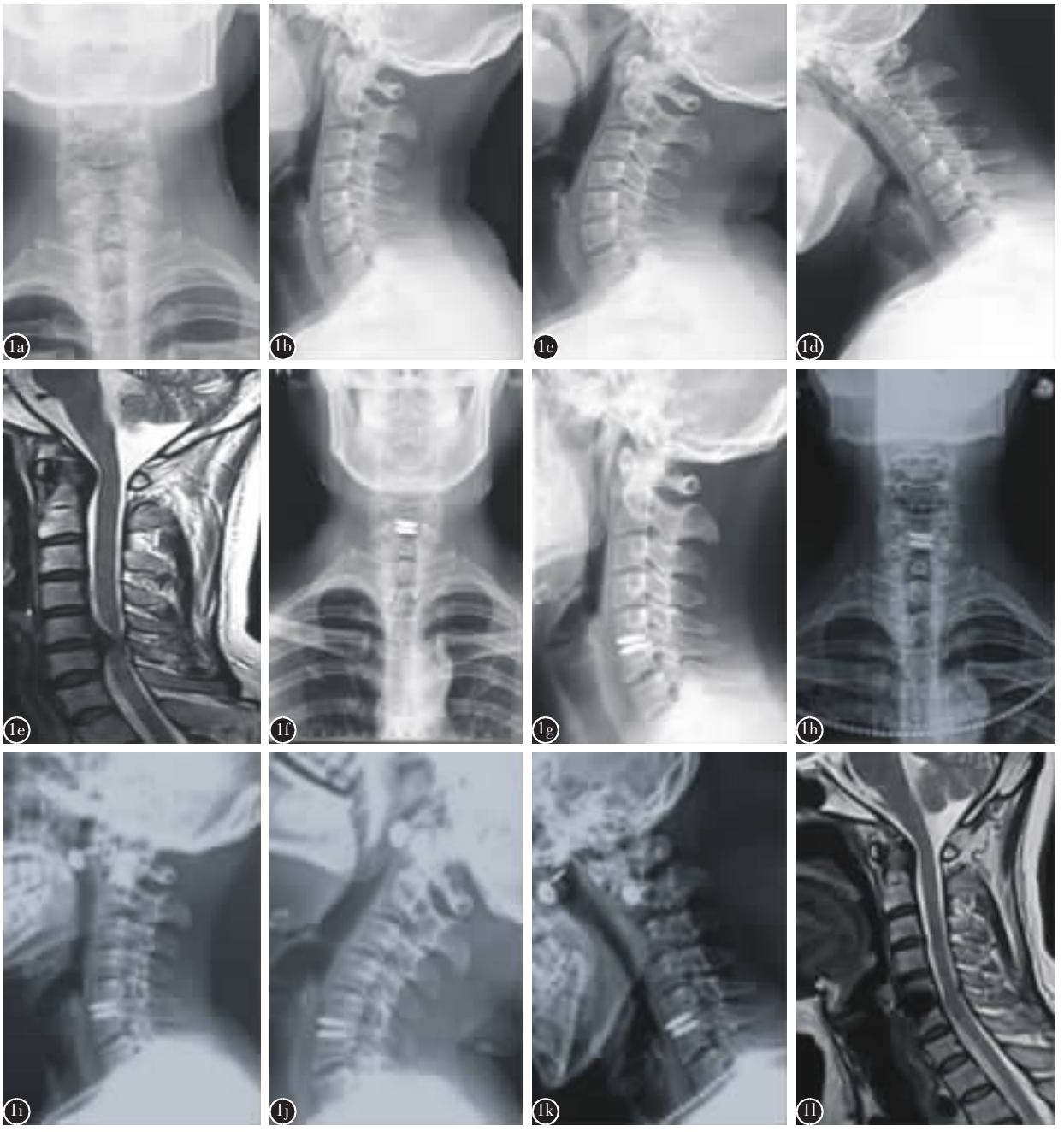

图 1 患者女性,34 岁,脊髓型颈椎病(C5/6) **a、b** 术前颈椎正侧位 X 线片示颈椎生理曲度良好 **c、d** 术前颈椎过伸过屈位 X 线片示颈椎无失稳表现,C5/6 活动度 9.5° **e** 术前 MRI 示 C5/6 椎间盘突出 **f、g** ACDR 术后颈椎正侧位 X 线片示假体位置良好 **h、i** ACDR 术后 10 年随访颈椎正侧位 X 线片示假体位置良好 **j、k** ACDR 术后 10 年随访颈椎过伸过屈位 X 线片示置换节段活动度为 7.9° **l** ACDR 术后 10 年随访 MRI 示邻近节段椎间盘无明显退变

Figure 1 A 34-year-old female patient with cervical spondylotic myelopathy (C5/6) **a, b** Preoperative cervical X-rays showed good physiological curvature **c, d** Preoperative cervical X-rays in extension and flexion showed no instability, C5/6 range of motion was 9.5° **e** Preoperative MRI showed C5/6 disc herniation **f, g** After ACDR, cervical X-rays showed that the prosthesis was in good position **h, i** At 10-year follow-up after ACDR, cervical X-rays showed that the prosthesis was in good position **j, k** In the follow-up at the end of 10 years after ACDR, cervical X-rays in extension and flexion showed the ROM of the replacement segment was 7.9° **l** At 10-year follow up after ACDR, MRI showed no obvious degeneration of adjacent segment

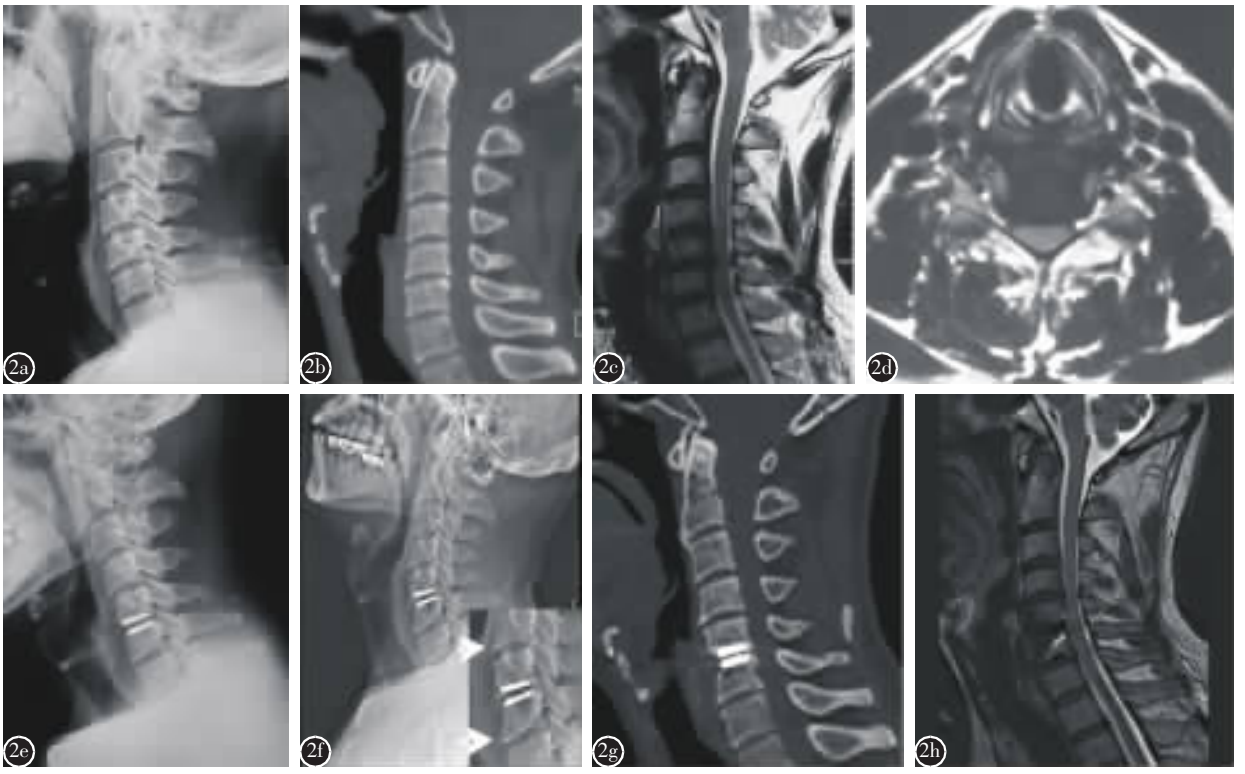

图 2 患者男性,43 岁,脊髓型颈椎病(C5/6) **a** 术前颈椎 X 线片示颈椎生理曲度良好,无失稳表现 **b~d** 术前 CT、MRI 示 C5/6 椎间盘突出无钙化 **e** ACDR 术后颈椎 X 线片示假体位置良好 **f** ACDR 术后 10 年随访颈椎 X 线片示假体周围见异位骨化形成(Ⅳ级) **g**、**h** ACDR 术后 10 年随访 CT、MRI 示邻近节段椎间盘无突出钙化

Figure 2 A 43-year-old male patient with cervical spondylotic myelopathy(C5/6) **a** Preoperative cervical X-rays showed good physiological curvature without instability **b-d** Preoperative CT and MRI showed C5/6 disc herniation without calcification **e** After ACDR, cervical X-rays showed that the prosthesis was in good position **f** At 10-year follow-up after ACDR, cervical X-rays showed heterotopic ossification in the front and back of the prosthesis (grade Ⅳ) **g, h** At 10-year follow-up after ACDR, CT and MRI showed no herniation or calcification in adjacent segments

从设计理念上来说,ACDR 可维持颈椎曲度,保留手术节段 ROM,改善颈椎整体 ROM。Lavelle 等[6]对 ACDR 和 ACDF 术后 10 年长期随访研究对比显示,158 例 ACDR 患者术后末次随访时置换节段 ROM 维持良好,较术前以及术后其他随访时间都有明显增加,手术节段 ROM 由术前的平均 6.45°增加至 2 年随访时的 8.08°,10 年随访时增加至 8.69°;104 例 ACDF 患者术后由于手术节段的融合,手术节段 ROM 由术前平均 8.3°减少至末次随访的 0.6°。而 Genitiempo 等 [5] 在关于 ACDR 的 18 年随访研究里指出,57 例接受单节段 ACDR 术患者的置换节段 ROM 从术前的 10.1°下降到术后 6 个月的 9.5°,最后降低至末次随访时的 6.1°,手术节段 ROM 出现了明显的下降。我们的研究结果显示,ACDR 组术后短期随访时置换节段与术前 ROM 相比有所增加,但在末次随访时,手术节段 ROM 出现了明显下降,降低到 5.60°±3.05°。这可能与假体的合适度、颈椎的退变和 HO 有关。

ACDR 置换术后手术节段 HO 会影响手术节段 ROM。一旦 HO 达到 McAfee 分级Ⅳ级,手术节段会基本丧失活动度,这样 ACDR 手术也就违背了设计初衷。因此,HO 是 ACDR 置换术后随访需关注的重点。我们团队前期研究[9]发现,在 ACDR 术后短期随访时患者手术节段未出现 HO。本研究结果显示,末次随访时 HO 发生率上升至 61.90%,McAfee 分级Ⅲ级增加至 6 例;Ⅳ级增加至 3 例,同时手术节段 ROM 也存在不同程度的下降,但 HO 的发生和严重程度的增加并没有使患者的临床症状反弹。Zhou 等[15]的 ACDR 长期随访研究显示,10 年以上随访患者的 HO 发生率达 68.2%。术前责任节段退变程度与术后异位骨化

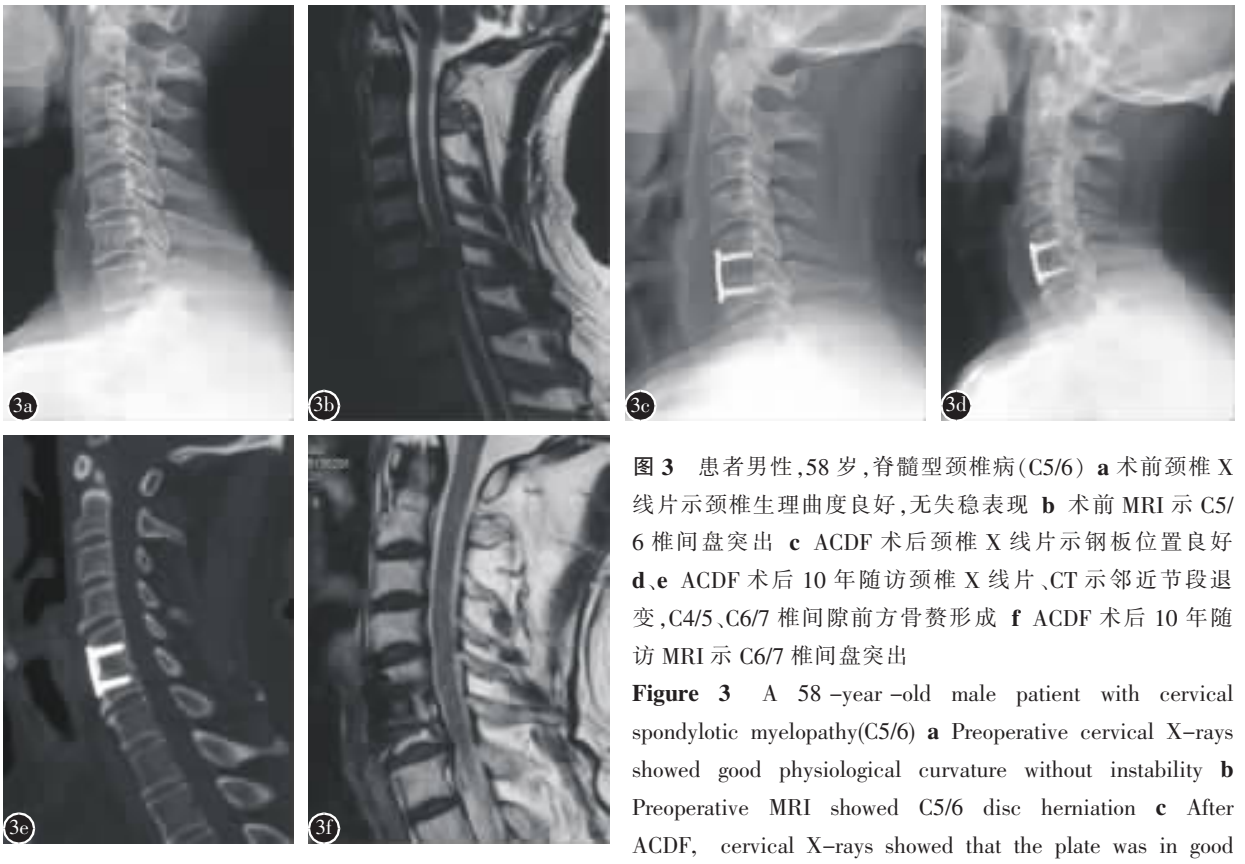

图 3 患者男性,58 岁,脊髓型颈椎病(C5/6) **a** 术前颈椎 X 线片示颈椎生理曲度良好,无失稳表现 **b** 术前 MRI 示 C5/6 椎间盘突出 **c** ACDF 术后颈椎 X 线片示钢板位置良好 **d**、**e** ACDF 术后 10 年随访颈椎 X 线片、CT 示邻近节段退变,C4/5、C6/7 椎间隙前方骨赘形成 **f** ACDF 术后 10 年随访 MRI 示 C6/7 椎间盘突出

Figure 3 A 58-year-old male patient with cervical spondylotic myelopathy(C5/6) **a** Preoperative cervical X-rays showed good physiological curvature without instability **b** Preoperative MRI showed C5/6 disc herniation **c** After ACDF, cervical X-rays showed that the plate was in good position **d, e** At 10-year follow-up after ACDF, cervical X-rays and CT showed degeneration occurred in adjacent segment and osteophytes formation in front of C4/5 and C6/7 **f** At 10-year follow-up after ACDF, MRI showed C6/7 disc herniation

严重程度呈正相关。通过量化术前颈椎病严重程度的相关因素发现责任间隙高度丢失是相关度最高的危险因素,其次是前骨赘的存在和终板硬化。Wu 等[16]也报道了严重颈椎退行性变患者的 HO 发生率较高。Chung 等[17]认为,术前钩椎关节肥大也是 HO 发生的危险因素之一。Qi 等[18]的研究认为术前脊髓内存在高信号、假体不匹配、手术节段数量多与 ACDR 术后 HO 有关。除术前潜在的危险因素外,HO 高发生率与手术过程中对终板的处理、置入假体时对皮质骨的处理相关[19,20]。术后早期使用非甾体消炎药可以有效抑制骨化[21]。我们分析 HO 出现原因可能有以下几点:(1)10 年前对人工颈椎间盘置换手术指征把握程度不一样,针对患者的选择没有严格统一的标准;(2)术者对置入假体的类型选择不一样,术中对椎间隙处理程度标准不统一,假体与间隙的匹配度不一致;(3)术后未常规使用非甾体消炎药。

ACDR 置换术后 ASD 同样是术后需要关注的重点。目前,尚无统一的 MRI 评估方法对 ASD 进行评估,本研究中患者术前邻近节段椎间盘 Miyazaki 分级均在Ⅰ、Ⅱ级,通过将 MRI 邻近节段椎间盘退变(Miyazaki 分级,椎间盘退变至Ⅲ、Ⅳ、Ⅴ级)和颈椎侧位 X 线片评估方法综合后分析 ASD 发生率。本研究显示,末次随访 ACDR 组 ASD 发生率为 40.47%,显著低于 ACDF 组的 68%。随访期间,ACDR 组未出现严重邻近节段退变导致的相应神经根压迫,无二次手术病例,体现了 ACDR 的优势。目前对于 ACDR 是否能有效降低 ASD 并未达成共识。Yang 等[22]关于 ACDR 与 ACDF 的 10 年随访对比显示,虽然 ACDF 组 ASD 发生率高于 ACDR 组(35.2% vs 33.3%),但两组发生率无统计学差异(P>0.05)。Lei 等[23]的 Bryan 假体 ACDR 与 ACDF 术后 8 年随访对比研究显示,末次随访时 ACDR 组与 ACDF 组发生 ASD 分别为 28.6% 和 58.6%(P<0.05),ACDR 明显优于 ACDF。导致出现不同结论甚至相反结论的因素很多,术前手术节段 ROM 显著下降[24]、邻近节段的自然退变等都会不同程度影响甚至加速 ACDR

术后 ASD。因此,严把手术适应证是必要的。

综上,单节段 ACDR 与 ACDF 治疗颈椎病均可取得良好的临床疗效和满意的神经功能恢复;与 ACDF 相比,ACDR 能有效降低 ASD 发生率,但手术节段 HO 程度增加和 ROM 降低现象较普遍,需要严把手术适应证,选择合适的椎间盘假体,做好围手术期处理。另外,本研究为单中心、小样本量回顾性研究,存在一定局限性。后续还需要多中心随机对照研究来进一步探讨验证 ACDR 术后长期随访疗效。

4 参考文献

1. Samartzis D, Shen FH, Goldberg EJ, et al. Is autograft the gold standard in achieving radiographic fusion in one-level anterior cervical discectomy and fusion with rigid anterior plate fixation[J]. Spine, 2005, 30(15): 1756-1761.
2. DePalma AF, Rothman RH, Lewinnek GE, et al. Anterior interbody fusion for severe cervical disc degeneration [J]. Surg Gynecol Obstet, 1972, 134(5): 755-758.
3. Baba H, Furusawa N, Imura S, et al. Late radiographic findings after anterior cervical fusion for spondylotic myeloradiculopathy[J]. Spine, 1993, 18(15): 2167-2173.
4. Fernström U. Arthroplasty with intercorporal endoprothesis in herniated disc and in painful disc[J]. Acta Chir Scand Suppl, 1966, 357: 154-159.
5. Genitiempo M, Perna A, Santagada DA, et al. Single-level Bryan cervical disc arthroplasty: evaluation of radiological and clinical outcomes after 18 years of follow-up[J]. Eur Spine J, 2020, 29(11): 2823-2830.
6. Lavelle WF, Riew KD, Levi AD, et al. Ten-year outcomes of cervical disc replacement with the bryan cervical disc [J]. Spine, 2019, 44(9): 601-608.
7. Miao J, Shen Y, Li C, et al. Cervical artificial disc replacement with discover prosthesis does not reduce the midterm risk of heterotopic ossification: results of a cohort study [J]. Clin Spine Surg, 2018, 31(3): E204-E208.
8. Shi S, Zheng S, Li XF, et al. Comparison of 2 Zero-profile implants in the treatment of single-level cervical spondylotic myelopathy: a preliminary clinical study of cervical disc arthroplasty versus fusion[J]. PLoS One, 2016, 11(7): e159761.
9. Du J, Li M, Liu H, et al. Early follow-up outcomes after treatment of degenerative disc disease with the discover cervical disc prosthesis[J]. Spine J, 2011, 11(4): 281-289.
10. 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.
11. McAfee PC, Cunningham BW, Devine J, et al. Classification of heterotopic ossification(HO) in artificial disk replacement [J]. J Spinal Disord Tech, 2003, 16(4): 384-389.
12. Miyazaki M, Hong SW, Yoon SH, et al. Kinematic analysis of the relationship between the grade of disc degeneration and motion unit of the cervical spine [J]. Spine (Phila Pa 1976), 2008, 33(2): 187-193.
13. Li J, Liang L, Ye X, et al. Cervical arthroplasty with discover prosthesis: clinical outcomes and analysis of factors that may influence postoperative range of motion [J]. Eur Spine J, 2013, 22(10): 2303-2309.
14. Wahood W, Yolcu YU, Kerezoudis P, et al. Artificial discs in cervical disc replacement: a meta-analysis for comparison of long-term outcomes[J]. World Neurosurgery, 2020, 134: 598-613.
15. Zhou F, Li S, Zhao Y, et al. Quantitative analysis of the correlation between preoperative cervical degeneration and postoperative heterotopic ossification after cervical disc replacement: minimum 10-year follow-up data[J]. J Neurosurg: Spine, 2020, 33(5): 674-679.
16. Wu J, Huang W, Tu T, et al. Differences between soft-disc herniation and spondylosis in cervical arthroplasty: CT-documented heterotopic ossification with minimum 2 years of follow-up[J]. J Neurosurg: Spine, 2012, 16(2): 163.
17. Chung S, Muradov JM, Lee S, et al. Uncovertebral hypertrophy is a significant risk factor for the occurrence of heterotopic ossification after cervical disc replacement: survivorship analysis of Bryan disc for single-level cervical arthroplasty [J]. Acta Neurochir(Wien), 2012, 154(6): 1017-1022.
18. Qi M, Chen H, Cao P, et al. Incidence and risk factors analysis of heterotopic ossification after cervical disc replacement[J]. Chin Med J(Engl), 2014, 127(22): 3871-3875.
19. Tu TH, Wu JC, Huang WC, et al. The effects of carpentry on heterotopic ossification and mobility in cervical arthroplasty: determination by computed tomography with a minimum 2-year follow-up: clinical article[J]. J Neurosurg Spine, 2012, 16(6): 601-609.
20. Yi S, Shin DA, Kim KN, et al. The predisposing factors for the heterotopic ossification after cervical artificial disc replacement[J]. Spine J, 2013, 13(9): 1048-1054.
21. Mehren C, Suchomel P, Grochulla F, et al. Heterotopic ossification in total cervical artificial disc replacement[J]. Spine (Phila Pa 1976), 2006, 31(24): 2802-2806.
22. Yang S, Zhu Y, Yan S, et al. Anterior cervical discectomy and fusion surgery versus total disc replacement: a comparative study with minimum of 10-year follow-up[J]. Sci Rep, 2017, 7(1): 16443.
23. Lei T, Liu Y, Wang H, et al. Clinical and radiological analysis of Bryan cervical disc arthroplasty: eight-year follow-up results compared with anterior cervical discectomy and fusion [J]. Int Orthop, 2016, 40(6): 1197-1203.
24. Mehren C, Heider F, Siepe CJ, et al. Clinical and radiological outcome at 10 years of follow-up after total cervical disc replacement[J]. Eur Spine J, 2017, 26(9): 2441-2449.

(收稿日期:2022-01-13 末次修回日期:2022-06-28)

(英文编审 谭 啸)

(本文编辑 卢庆霞)