临床论著

# 人工颈椎间盘置换术治疗颈椎病的临床疗效分析

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**【摘要】 目的:**评价人工颈椎间盘置换术(ACDR)治疗颈椎病的临床疗效,并与同期行颈前路减压融合术(ACDF)的患者进行比较。**方法:**对 2009 年 7 月~2015 年 4 月收治的 21 例行 ACDR 的颈椎病患者进行回顾性分析(ACDR 组),男 17 例,女 4 例,年龄 20~49 岁(39.1±6.8 岁);C3/4 4 例,C4/5 6 例,C5/6 9 例,C6/7 2 例。同时收集同期行 ACDF 的 21 例颈椎病患者(ACDF 组)进行对比,男 16 例,女 5 例,年龄 23~53 岁(39.5±6.3 岁);C3/4 4 例,C4/5 7 例,C5/6 8 例,C6/7 2 例。术后随访时拍摄颈椎 X 线片,测量颈椎曲度、手术节段活动度(ROM),观察椎间盘假体有无松动移位及异位骨化、椎间融合器有无出现松动移位及植骨融合等情况;按照 JOA 评分、疼痛视觉模拟量表评分(VAS)、颈椎功能障碍指数(NDI)和 Odom′s 分级评估临床疗效。**结果:**两组病例术后随访 4~9 年(5.7±1.2 年),两组随访时间无统计学差异($P$>0.05)。末次随访时无椎间盘假体和椎间融合器的松动和移位。ACDR 组出现 1 例异位骨化,未出现明显邻近节段退变的病例;术前与末次随访时的颈椎曲度和手术节段 ROM 差异无统计学意义($P$>0.05)。ACDF 组 X 线片显示手术节段全部骨性融合,5 例出现明显邻近节段退变(ASD),其中 3 例无临床症状,2 例临床症状较重再次行手术治疗;末次随访时颈椎曲度和手术节段 ROM 与术前比较有统计学差异($P$<0.05)。两组末次随访时 JOA 评分、VAS 评分和 NDI 与同组术前比较差异均有统计学意义($P$<0.05),两组间同时间点比较差异均无统计学意义($P$>0.05)。末次随访时 ACDR 组 Odom′s 分级优良率为 90.5%,ACDF 组为 85.7%,两组比较差异有统计学意义($P$<0.05)。两组 ASD 发生率有统计学意义(ACDR 0 vs ACDF 23.8%,$P$<0.05)。**结论:**ACDR 治疗颈椎病可取得较好的中长期效果,能够保留置换节段 ROM 和颈椎生理曲度,减少 ASD 发生。

**【关键词】**颈椎病;人工颈椎间盘置换术;颈前路减压融合术;临床疗效
**doi:**10.3969/j.issn.1004-406X.2020.12.06
**中图分类号:**R681.5,R318.17 **文献标识码:**A **文章编号:**1004-406X(2020)-12-1088-09

**Clinical outcomes of artificial cervical disc replacement in cervical spondylosis/LI Chuang, WU Bin, WU Yongchao, et al//Chinese Journal of Spine and Spinal Cord, 2020, 30(12): 1088-1096**

**【Abstract】 Objectives:** To observe and analyze the clinical effect of artificial cervical disc replacement(ACDR) in cervical spondylosis, and to compare the effect with that of anterior cervical decompression and fusion (ACDF) in the same period. **Methods:** A retrospective analysis was performed on 21 patients with cervical spondylopathy who were treated with ACDR from July 2009 to April 2015. The ACDR group included 17 males and 4 females, aged from 20 to 49 years with an average age of 39.1±6.8 years. There were 4 cases of C3/4, 6 cases of C4/5, 9 cases of C5/6, and 2 cases of C6/7. 21 cases of cervical spondylopathy patients received ACDF in the same period were collected for comparison. The ACDF group included 16 males and 5 females, aged 23-53 years with an average age of 39.5±6.3 years. There were 4 cases of C3/4, 7 cases of C4/5, 8 cases of C5/6, and 2 cases of C6/7. Postoperative follow-up included: X-ray film, cervical curvature, range of motion(ROM) in surgical segment, disc prosthesis loosing and displacement, ectopic ossification, intervertebral fusion device loosing and displacement, and bone graft fusion. JOA score, visual analogue scale of pain score(VAS), neck disability index (NDI) and Odom′s grading were used to evaluate the clinical outcomes. **Results:** The patients in the two groups were followed up for 4-9 years, with an average of 5.7±1.2 years. There was no significant difference between the two groups in the follow-up time. No loosening or displace ment of disc prosthesis or intervertebral fusion device was observed at the last follow-up. ACDR group pre-

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sented 1 case of ectopic ossification without obvious adjacent segment degeneration. There was no significant difference of cervical curvature and surgical segment ROM between preoperation and the last follow-up ($P$>0.05). X-ray in ACDF group showed osseous fusion of all surgical segments. There were 5 cases with obvious adjacent segment degeneration(ASD) in X-ray, among which 3 cases had no clinical symptoms, and 2 cases had severe clinical symptoms and underwent surgical treatment again. The cervical curvature and surgical segment ROM at preoperation and the last follow-up were with significant differences($P$<0.05). There were significant differences in the JOA, VAS and NDI scores in both groups at preoperation and the last follow-up ($P$<0.05), but there was no statistically significant difference of the scores between the two groups ($P$>0.05). The excellent and good rate of Odom′s classification at the last follow-up in ACDR group was 90.5%, and that in ACDF group was 85.7%, with significant difference between the groups($P$<0.05). The incidence of ASD between the groups had statistically significant difference (ACDR 0 vs ACDF 23.8%, $P$<0.05). **Conclusions:** ACDR has satisfactory outcomes in mid- and long-term follow-up for cervical spondylosis, which can retain the motion range of the replacement segment, reconstruct the maximum possible cervical curvature, and reduce the degeneration of adjacent segments.

**【Key words】** Cervical spondylosis; Artificial cervical disc replacement; Anterior cervical decompression and fusion; Clinical effect

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自 20 世纪 50 年代以来,Smith-Robinson 和 Cloward 等提出[1,2]的颈前路减压融合手术(anterior cervical decompression and fusion,ACDF)在临床上广泛应用,已成为治疗颈椎病的经典术式[3]。融合手术虽然可以解除压迫同时稳定颈椎[4],但是破坏了颈椎正常活动和生理功能,节段融合后使颈椎的生物力学特性发生改变,邻近节段所产生的轴性应力显著增加,以致邻近节段颈椎过度活动,最终导致退行性变加速和机械性不稳,同时颈椎的整体活动度明显受限。人工颈椎间盘置换(artificial cervical disc replacement,ACDR)的理论基础是其能保留颈椎的生理活动及生物力学环境,进而减少邻近节段退变(adjacent segment degeneration,ASD)的发生,避免融合术后相关的并发症[5]。我院从 2009 年 7 月开始对部分颈椎病患者进行了 ProDisc 人工颈椎间盘置换术,获得了良好的中长期临床疗效,在保留手术节段活动度的同时减少了 ASD 的发生,总结如下。

## 1 资料与方法

### 1.1 病例纳入与排除标准

纳入标准:①明确诊断为颈椎病(脊髓型或神经根型或二者兼有),经至少 3 个月保守治疗无效;②影像学证实颈椎间盘退变突出,病变节段为 C3~C7,颈脊髓或神经根受压明显,病变节段无明显骨化;③年龄 20~55 岁;④手术操作由同一位术者主刀完成。

排除标准:①伴严重骨质疏松症及代谢性骨病;②颈椎后纵韧带或黄韧带钙化所致的广泛颈椎管狭窄;③炎症性疾病(强直性脊柱炎、类风湿性关节炎等);④颈椎间隙狭窄≥50%甚至融合、颈椎明显不稳(过屈过伸位手术节段矢状面平移>3mm 或矢状面成角>11°);⑤颈椎滑脱骨折、肿瘤、颈椎感染等。

### 1.2 一般资料

2009 年 7 月~2015 年 4 月共有 21 例行 ACDR 的患者纳入本研究(ACDR 组)。收集同期行 ACDF 的 21 例颈椎病患者进行对比(ACDF 组)。两组患者的一般资料见表 1。两组患者的年龄、性别、手术节段、疾病类型、术后随访时间均无统计学差异($P$>0.05)。术前常规行颈椎正侧位和动力位 X 线片、CT 和 MRI 检查。ACDR 组行颈椎过伸过屈 X 线显示病变节段均无失稳表现,CT 提示病变节段后纵韧带及突出椎间盘均无骨化,MRI 提示椎间盘突出或脱出进入椎管,相应节段颈髓或神经根受压明显。42 例患者均无明显广泛椎管狭窄或显示后方压迫。ACDR 组采用的人工颈椎间盘均为 ProDisc 假体,其中 ProDisc-C 14 例,ProDisc-Vivo 7 例,均为单节段置换。ACDF 组采用的椎间融合器均为 Synthes 高分子材料融合器。

### 1.3 手术方法

ACDR组：采取全身麻醉，仰卧中立位，确保颈部在矢状位中立位。采用颈椎标准的前入路，标记手术节段，显露拟置换椎间盘以及邻近椎体。经C型臂X线机透视证实置换椎间隙后，按照ProDisc人工颈椎间盘假体的标准操作。首先摘除准备置换节段的椎间盘，摘除范围尽量到达两侧钩突关节部位，中间深部尽量到达椎体后缘部位。应用合适大小的椎体撑开器撑开椎间隙，椎体固定螺钉应与手术节段椎间盘的上下终板相平行。最大限度切除椎间盘组织，以利于椎体撑开器的尖端置于椎间隙的后方。小心处理软骨终板，将所有软组织都应从终板上清除，同时注意避免损伤破坏骨性终板。继续进行椎管和椎间孔区的减压，并切开后纵韧带。在彻底进行椎间盘切除和减压后，使用试模测量合适的椎间高度和宽度。选择合适大小的试模，小心打入椎间隙，在此过程中经C型臂X线机透视使试模前端的限深器到达椎体前缘合适位置。取出试模，将合适型号的ProDisc椎间盘假体小心置入，直至与椎体前缘充分吻合。置入过程中假体与椎体中线始终保持一致。置入完成后用C型臂X线透视机拍摄颈椎正侧位X线片，确认置入假体位置理想后充分止血，负压引流管置入后，逐层缝合伤口。

ACDF组：麻醉满意后，体位及手术入路同ACDR组。切除目标椎间盘，切开后纵韧带，探查颈髓及神经根无受压，用撑开器撑开目标椎间隙，选取合适的含骨粒的高分子材料椎间融合器（Synthes，GmbH）置入目标椎间隙，安装钛板固定，经透视位置满意后置入负压引流管，逐层缝合伤口。

**表 1 两组患者的一般资料**

**Table 1** General information of two groups of patients

| | ACDR组（*n*=21）<br>ACDR group | ACDF组（*n*=21）<br>ACDF group | *P*值<br>*P* value |
|---|---|---|---|
| 性别（男/女）<br>Gender（M/F） | 17/4 | 16/5 | >0.05 |
| 年龄（岁）<br>Age(yrs) | 39.1±6.8<br>(20~49) | 39.5±6.3<br>(23~53) | >0.05 |
| 颈椎病类型<br>Type of cervical spondylosis | | | >0.05 |
| 神经根型<br>Radiculopathy | 6 | 5 | |
| 脊髓型<br>Myelopathy | 14 | 15 | |
| 混合型<br>Mixed symptoms | 1 | 1 | |
| 手术节段<br>Operated level | | | >0.05 |
| C3/4 | 4 | 4 | |
| C4/5 | 6 | 7 | |
| C5/6 | 9 | 8 | |
| C6/7 | 2 | 2 | |
| 随访时间（年）<br>F/U period(year) | 5.76±1.27<br>(4~9) | 5.72±1.18<br>(4~9) | >0.05 |

## 1.4 效果评价

**1.4.1** 影像学测量 （1）颈椎曲度：应用Cobb角测量法，在颈椎侧位X线片上测量C2下终板与C7下终板的夹角。（2）手术节段活动度（range of motion，ROM）：在过屈位与过伸位X线片测量上位椎体后缘连线和下位椎体后缘连线的夹角，过伸和过屈位夹角之和即为ROM。（3）颈椎ASD：X线片上邻近节段椎体前缘新骨赘形成或原有骨赘增大、椎间隙狭窄（>30%）甚至塌陷、前纵韧带增生骨化[6]。

**1.4.2** 临床疗效评价 术前和末次随访时采用JOA 17分法评估患者神经功能状况，计算JOA评分改善率[改善率=（术后评分−术前评分）/（17−术前评分）×100%]，改善率≥75%为优秀；50%~74%为良好；25%~49%为一般；<25%为差。采用疼痛视觉模拟量表（visual analogue scale，VAS）评分评价疼痛程度；采用颈椎功能障碍指数（neck disability index，NDI）评估颈椎功能障碍程度。末次随访时采用Odom′s 标准评价综合临床疗效：优，术前所有的症状消失，日常生活得以正常进行同时不影响颈椎功能；良，术前症状显著减轻，日常生活不受明显影响；中，术前症状部分缓解，日常生活受到明显限制；差，术前症状没有改善甚至加重。

**1.4.3** 术后并发症 观察两组术后有无血管和神经脊髓损伤、脑脊液漏、切口感染、置入材料过敏等。ACDR组术后有无假体松动、移位、异位骨化及活动度丧失、异位骨化（heterotopic ossification，HO），在术后颈椎侧位X线片上使用McAfee分级法[6]将椎体前缘或后缘HO分为5级：0级，无骨化出现；Ⅰ级，有骨化形成，但椎间隙未出现；Ⅱ级，椎间隙内有骨化出现，对假体的活动可能造成潜在的影响；Ⅲ级，骨化范围扩大甚至导致形成骨桥，假体活动已经受到影响；Ⅳ级，骨化严重使置换节段已经融合，假体活动度丧失。ACDF组观察椎间植骨是否融合（颈椎动力位X线融合节段ROM为0°提示骨性融合）。

## 1.5 统计学方法

应用 SPSS 19.0 统计软件进行统计学分析，计量资料应用平均数±标准差表示，颈椎曲度、手术节段 ROM、JOA 评分、VAS 评分、NDI 等指标的术前和末次随访的比较采用组间 $t$ 检验，计数资料比较采用卡方检验，$P$<0.05 为差异具有统计学意义。

## 2 结果

两组患者术后均未出现血管和神经损伤、脑脊液漏、切口感染、植入材料过敏等并发症。随访 4~9 年(5.7±1.2 年)，两组患者的临床和影像学评价结果见表 2。两组末次随访时的 JOA 评分、VAS 评分和 NDI 较术前均有显著性改善($P$<0.05)，两组同时间点比较差异均无显著性($P$>0.05)。末次随访时 Odom′s 分级：ACDR 组优 9 例，良 10 例，中 2 例，差 0 例，优良率 90.48%；ACDF 组优 9 例，良 9 例，中 1 例，差 2 例，优良率为 85.71%，两组优良率比较有显著性差异 ($P$<0.05)。末次随访 ACDR组颈椎曲度和手术节段 ROM 较术前无显著性差异($P$>0.05，图 1)，ACDF 组较术前有显著性降低($P$<0.05，图 2)；ACDF 组椎间植骨全部骨性融合，5 例 X 线片上出现明显邻近节段退变(ASD)，其中 3 例无临床症状，2 例临床症状较重再次行手术治疗，1 例行 ACDR，另 1 例行颈椎后路椎管扩大椎板成形术(图 3、4)。两组患者 ASD 的发生率有显著性差异(ACDR 组 0 vs ACDF 组 23.8%，$P$<0.05)。

## 3 讨论

近 50 年来，ACDF 治疗颈椎病在临床上广泛应用。然而，随着临床随访时间的延长，发现病变节段融合后改变了颈椎的生物力学特性。该手术在达到良好减压效果和获得神经功能恢复的同时，并没有完成颈椎的生理功能的重建。同时，手术造成融合邻近节段所受应力显著增加，加剧邻近节段椎间盘的退行性改变[7]。Hilibrand 等[8,9]通过对 374 例 ACDF 患者的临床资料进行回顾性研究分析发现，患者融合节段中每年出现伴有相关症状的邻近节段退变的概率有 2.9%，而 10 年的累积发生率高达 25%左右。经前路减压后，置入有生理功能的人工椎间盘假体，从而恢复颈椎的活动度，同时具有缓冲震荡的功能，可以更好地重建颈椎的生理功能。ProDisc 人工颈椎间盘的设计正是符合这一要求。

本研究中，ACDR 组 21 例患者共置换 21 个人工颈椎间盘，术后随访 4~9 年，末次随访无假体松动、移位及异位骨化，中长期随访临床效果满意。评估人工颈椎间盘临床效果的重要指标是椎间盘假体的 ROM。本研究中，行 ACDR 的患者术后仍保留了平均 8.0°的 ROM，充分显示了人工颈椎间盘能保留置换节段的 ROM，同时也保持了良好的颈椎曲度。而 ACDF 组患者术后颈椎曲度及置换节段活动度均明显降低。Tian 等 [10] 报道 ACDR 术后 ROM 较好的患者，其原因主要是患者术前置换节段 ROM 较好(>3°且<11°)、年龄较小

**表 2 两组患者术前和末次随访时的颈椎生理曲度、手术节段活动度和功能评定**

**Table 2** The cervical spine physiology curvature, operative segment mobility and functional assessment of the two groups of patients before and at final follow-up

| | ACDR组($n$=21) Group ACDR | | ACDF组($n$=21) Group ACDF | |
|---|---|---|---|---|
| | 术前 Preoperation | 末次随访 Final follow-up | 术前 Preoperation | 末次随访 Final follow-up |
| 生理曲度(°) Physiological curvature | 20.75±3.15 | 19.00±3.28① | 20.08±1.9 | 13.12±3.06② |
| 手术节段活动度(°) Operation section ROM | 7.50±1.90 | 8.00±1.70① | 7.36±1.32 | 0② |
| JOA评分(分) JOA score | 11.64±2.97 | 15.84±1.36② | 11.28±2.24 | 15.56±1.34②③ |
| VAS评分(分) VAS score | 3.57±1.05 | 0.71±0.45② | 3.52±1.10 | 0.72±0.44②③ |
| 颈椎功能障碍指数(分) NDI | 22.00±2.41 | 3.00±1.49② | 21.84±2.36 | 3.64±1.29②③ |

注：①与同组术前比较 $P$>0.05；②与同组术前比较 $P$<0.05；③与同时间点 ACDR 组比较 $P$>0.05

Note: ①Compared with the same group before operation, $P$>0.05; ②Compared with the same group before operation, $P$<0.05; ③Compared with group ACDR at the same time point, $P$>0.05

(<55 岁,尤其 40 岁以下)、术中椎间盘假体插入角度较好(假体尽量与目标椎间隙平行,假体插入角为-2°~2°之间)、插入深度较好(假体的后缘与椎体后缘尽量接近)。ACDR 成功的关键包括严格

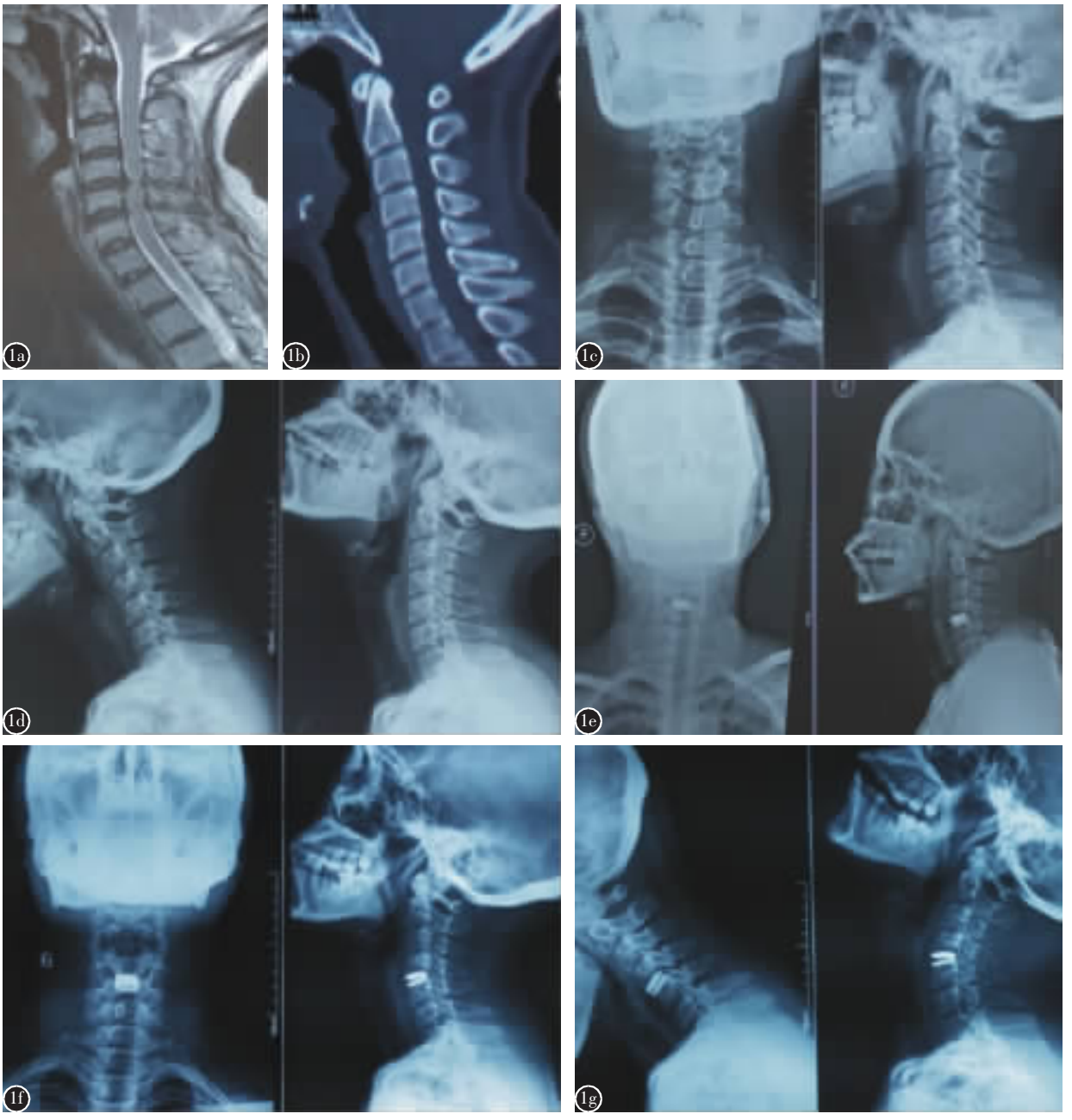


**图 1** 患者女,35 岁, 脊髓型颈椎病 **a** 术前 MRI 示 C4/5 椎间盘突出 **b** 术前 CT 示 C4/5 椎间盘突出无骨化 **c** 术前颈椎正侧位 X 线片示颈椎生理曲度良好 **d** 术前颈椎过伸过屈位 X 线片示颈椎无失稳表现 **e** ACDR 术后 1 周颈椎正侧位 X 线片示假体位置良好 **f** ACDR 术后 5 年随访正侧位 X 线片示假体位置良好 **g** ACDR 术后 5 年过伸过屈位 X 线片示置换节段仍保持一定的活动度

**Figure 1** A 35-year-old female with cervical spondylotic myelopathy **a** Preoperative MRI showing C4/5 disc herniation **b** Preoperative CT showing no ossification of C4/5 disc herniation **c** The X-ray of the cervical spine before surgery showing that the cervical spine has good physiological curvature **d** Preoperative X-ray of cervical spine in overextension and flexion showing no instability **e** One week after ACDR, X-ray film showing the prosthesis in good position **f** 5 years after ACDR, X-ray film showing prosthesis in good position **g** 5 years after ACDR, X-ray showing the replacement segment still maintaining a certain degree of motion

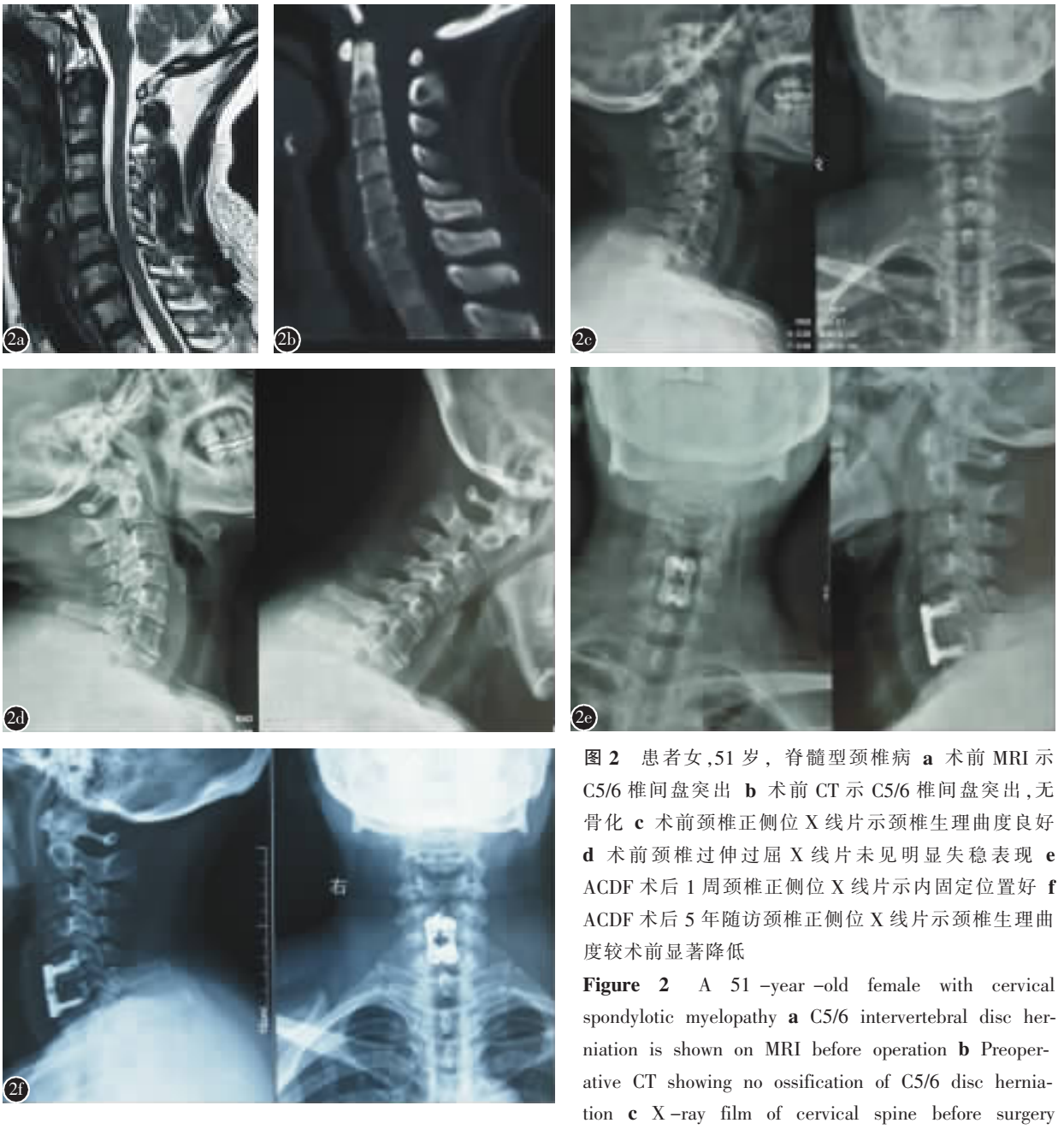


**图 2** 患者女,51 岁, 脊髓型颈椎病 **a** 术前 MRI 示 C5/6 椎间盘突出 **b** 术前 CT 示 C5/6 椎间盘突出,无骨化 **c** 术前颈椎正侧位 X 线片示颈椎生理曲度良好 **d** 术前颈椎过伸过屈 X 线片未见明显失稳表现 **e** ACDF 术后 1 周颈椎正侧位 X 线片示内固定位置好 **f** ACDF 术后 5 年随访颈椎正侧位 X 线片示颈椎生理曲度较术前显著降低

**Figure 2** A 51 -year -old female with cervical spondylotic myelopathy **a** C5/6 intervertebral disc herniation is shown on MRI before operation **b** Preoperative CT showing no ossification of C5/6 disc herniation **c** X -ray film of cervical spine before surgery showing good cervical spine physiology **d** Preoperative X-ray of cervical spine hyperextension and hyperflexion showing no obvious instability **e** Anterior and lateral X-ray of cervical spine one week after ACDF showing good internal fixation position **f** Anterior and lateral X ray of cervical spine 5 years after ACDF surgery shows that the physiological curvature of cervical spine is significantly reduced compared with that before surgery

筛选患者并把握手术适应证,彻底减压,精密准确的设备和选取合适的椎间盘假体[11]。

本研究中,ACDR 组 21 例患者末次随访时颈椎 X 线侧位片显示未见明显的邻近节段椎体前缘骨质增生和骨赘形成、椎间隙狭窄(>30%)和前纵韧带骨化等 ASD 的影像学表现;而 ACDF 组有 5 例出现 ASD,其中 3 例无临床症状,2 例出现临床症状需再次手术治疗。两组 ASD 发生率有显著性差异 ($P$<0.05)。2 例再次手术者其中 1 例为 ACDF 术后 5 年邻近节段退变椎间盘脱出压迫颈髓导致不全瘫的 29 岁男性患者,在严格把控手术适应证的基础上,我们在邻近节段行 ACDR,术后 5 年随访, 人工椎间盘假体无松动移位及异位骨化,神经功能基本恢复正常,同时颈椎保持良好的

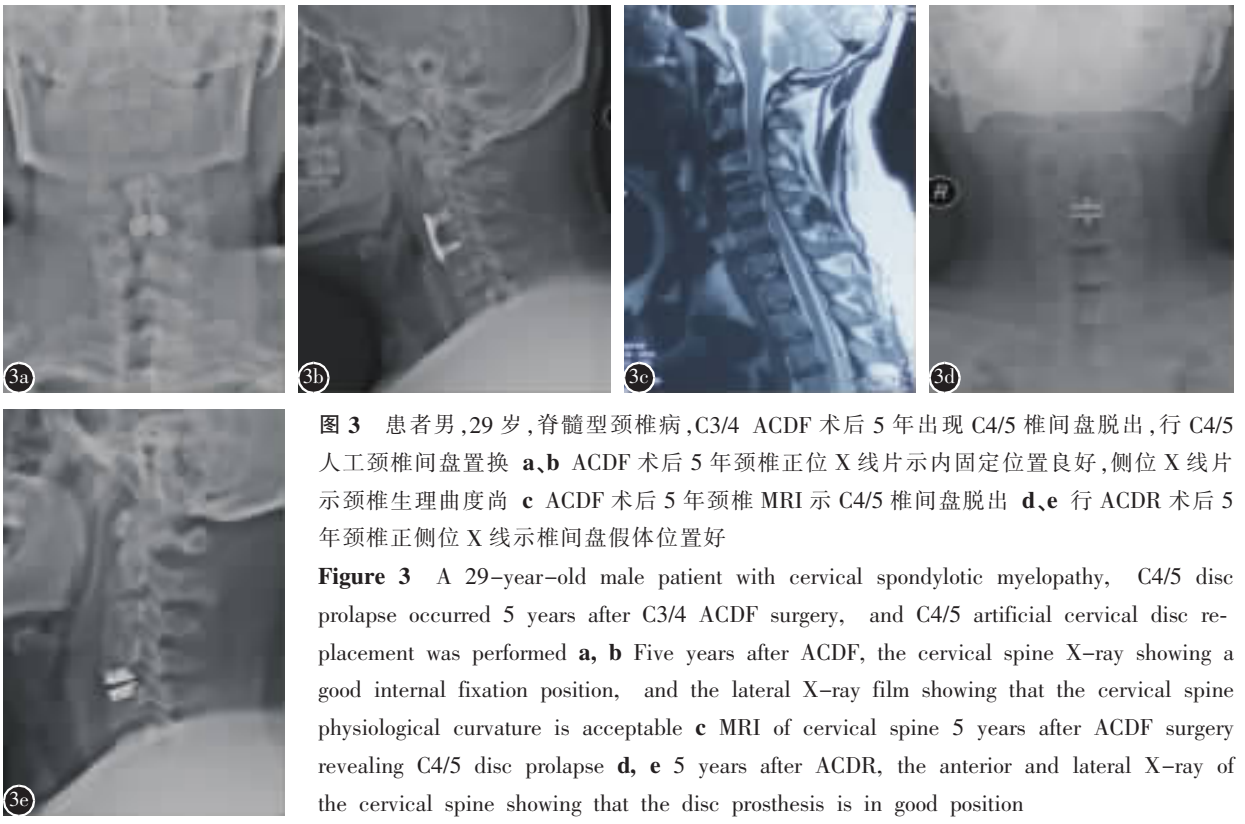

**图 3** 患者男,29 岁,脊髓型颈椎病,C3/4 ACDF 术后 5 年出现 C4/5 椎间盘脱出,行 C4/5 人工颈椎间盘置换 **a**、**b** ACDF 术后 5 年颈椎正位 X 线片示内固定位置良好,侧位 X 线片示颈椎生理曲度尚 **c** ACDF 术后 5 年颈椎 MRI 示 C4/5 椎间盘脱出 **d**、**e** 行 ACDR 术后 5 年颈椎正侧位 X 线示椎间盘假体位置好

**Figure 3** A 29-year-old male patient with cervical spondylotic myelopathy, C4/5 disc prolapse occurred 5 years after C3/4 ACDF surgery, and C4/5 artificial cervical disc replacement was performed **a, b** Five years after ACDF, the cervical spine X-ray showing a good internal fixation position, and the lateral X-ray film showing that the cervical spine physiological curvature is acceptable **c** MRI of cervical spine 5 years after ACDF surgery revealing C4/5 disc prolapse **d, e** 5 years after ACDR, the anterior and lateral X-ray of the cervical spine showing that the disc prosthesis is in good position

曲度。但仍需长时间随访以评价其远期疗效。Sheng 等[12]报道 ACDR 相对于 ACDF 对邻近节段的关节突间压力影响更小。ACDF 术后 ASD 的原因可能是手术节段融合时间的延长，邻近节段终板及关节突的应力增加所致。人工椎间盘假体可以模拟正常椎间盘的生理功能，有效地将椎间盘压力维持在正常范围内，这可以用来解释 ACDR 减少 ASD 的发生。ACDR 是 ACDF 术后邻近节段退变有效的治疗方法，可保持置换节段及相邻节段的颈椎活动度。另一例为 ACDF 术后 5 年出现 ASD 的 53 岁男性患者,邻近上下节段均累及,并出现较重的临床症状，行颈椎后路椎板成形术。Wu 等[13]对 38149 例 ACDF 患者进行了长达 16 年的跟踪研究,2.9%的患者在平均 4.7 年后因 ASD 而进行了二次手术治疗；年轻患者行 ACDF 术后发生 ASD 再次手术的风险更高。大量的生物力学实验研究已经证实,ACDR 可以保留颈椎正常的生物力学环境,减少 ASD 发生[14]。但关于 ACDR 能否减少 ASD 目前并未达成共识。Lei 等[15]报道 ACDF 术后 8 年末次随访时融合组 ASD 发生率(58.6%)明显高于置换组(28.6%)；而 Nunley 等[16]的临床研究通过术后随访 38 个月比较 ACDR 与 ACDF,颈椎 ASD 发生率无明显统计学意义。不同研究者的临床研究得出的结论有差异，甚至得出相反的结论。我们分析存在差异有以下原因：(1) ACDR 临床应用时间不长，手术适应证把控不严格,术中操作也不太规范,置换假体大小跟实际病例不太匹配等都会导致置换节段活动度降低甚至丢失。(2)导致 ASD 的原因很多,包括邻近节段的自身退变程度及 ROM，手术节段的 ROM 和颈椎本身生理曲度等，由于多种因素的共同影响而且各个因素对结果的影响占有不同的比例，使得出的结论有不同程度的偏倚，甚至出现完全相反的结论。

ACDF 可以直接解除前方致压物对颈髓的压迫,减压效果好,患者术后临床症状改善明显[17]。本研究中 ACDR 组 21 例患者与同期 ACDF 的患者对比，其在临床症状的改善和神经功能的恢复上无显著差异。我们认为,患者神经功能的改善主要通过彻底解除对神经和脊髓压迫来完成，椎间盘假体只具有稳定颈椎和保留节段活动度的功能,对神经功能的恢复影响不大。

综上所述,对比 ACDF,在严格把握手术适应证、选择合适的椎间盘假体的情况下,ACDR 能够

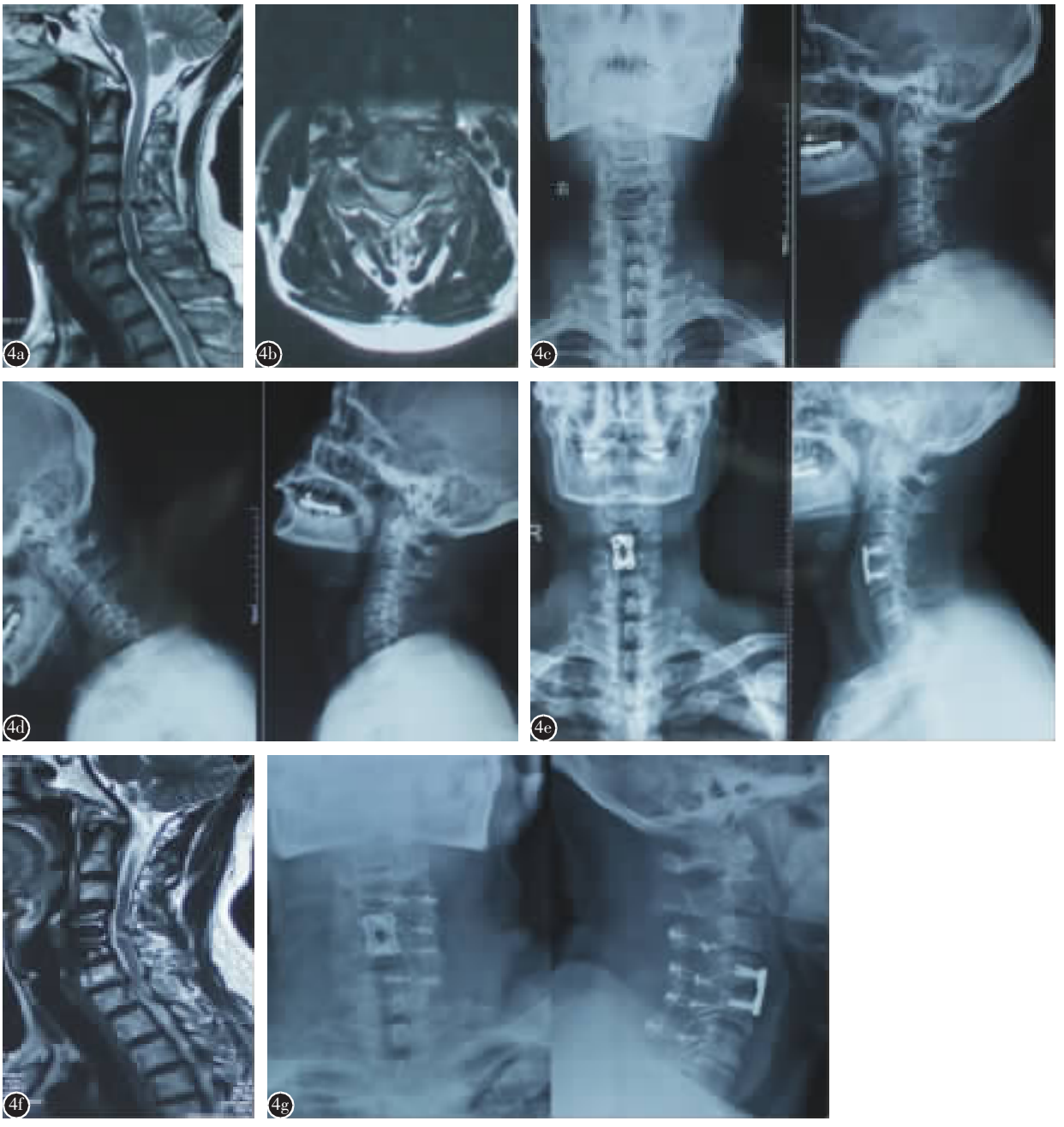


**图 4** 患者男,53 岁,脊髓型颈椎病,ACDF 术后 5 年出现 ASD,二次手术行 C3~C6 椎管扩大椎板成形术 **a** 术前颈椎 MRI 示 C4/5 椎间盘突出 **b** 术前颈椎侧位 X 线片示颈椎生理曲度尚可 **c** 术前颈椎过伸过屈位 X 线片示无明显失稳表现 **d** 术后 5 年颈椎正侧位 X 线片示内固定位置良好 **e** 术后 5 年颈椎 MRI 示 C3/4、C6/7 椎间盘突出 **f** 行 C3~C6 椎管扩大椎板成形术术后颈椎正侧位 X 线片示内固定位置良好,颈椎生理曲度得以维持

**Figure 4** A 53-year-old male patient with cervical spondylotic myelopathy, ASD appeared 5 years after ACDF, secondary operation for laminoplasty **a** Preoperative MRI of the cervical spine revealing C4/5 disc herniation **b** X-ray of cervical spine before surgery showing acceptable cervical spine physiology **c** Preoperative cervical spine hyperextension and flexion X-ray showing no obvious instability **d** Anterior and lateral X-ray of cervical spine 5 years after operation **e** 5 years after surgery, MRI of cervical spine showing C3/4 and C6/7 disc herniation **f** The X-ray film of the cervical spine after the second operation of C3-C6 laminoplasty showing that the internal fixation position is good, and the cervical spine physiological curvature is maintained

保留置换节段的 ROM 及颈椎生理曲度，降低 ASD 的发生率，中长期随访的临床疗效和影像学表现基本满意，能更好地保留颈椎的生理活动及生物力学环境。

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（收稿日期：2020–01–08 末次修回日期：2020–07–19）

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