
[Abstract] Objectives: To evaluate the radiographic and clinical outcomes of Bryan cervical disc arthroplasty at 10 years follow-up. Methods: Sixty patients with complete clinical and radiographic data were included in this study. The mean follow-up period was 124.0±8.3 months (117–150 months). 47 patients underwent single-level arthroplasty and 12 underwent arthroplasty at two levels. 1 patient underwent arthroplasty at three levels. 15 of the 60 patients presented with radiculopathy and 41 patients with myelopathy, 4 patients were with combined radiculopathy and myelopathy. Clinical evaluations included mJOA score, VAS score, etiology and surgical strategy of reoperations. Radiographic evaluations included heterotopic ossification according to McAfee’s classification and the range of motion on dynamic X-rays at baseline and at final follow-up. Results: The mJOA score of the patients with myelopathy was 13.4±2.2 at baseline and 15.8±1.1 (P<0.05) at final follow-up. The arm VAS score of the patients with radiculopathy was 5.7±2.2 at baseline and 0.7±0.9 (P<0.05) at final follow-up. The neck VAS score of the patients with radiculopathy was 4.7±2.2 at baseline and 1.0±1.0 (P<0.05) at final follow-up. The mJOA score of the patients with combined radiculopathy and myelopathy was 13.3±3.6 at baseline and 15.4±1.1 at final follow-up. The arm VAS score was 4.3±2.6 at baseline and 1.0±1.4 at final follow-up. The VAS neck score was 2.8±1.5 at baseline and 2.5±1.9 at final
follow-up. 1 patient received reoperation due to adjacent segment disease. 6 patients received revision surgeries at the index level for recurrent radiculopathy or myelopathy caused by heterotopic ossification (The initial surgeries included 1 cases of arthroplasty at two levels and 5 case of single-level arthroplasty; 3 levels were classified as grade III heterotopic ossification and 4 levels as grade IV before the reoperations). On X-ray examination, the range of motion at the operated level was 7.0°±2.9° at baseline and 4.6°±4.1° at final follow-up (P<0.05). Heterotopic ossification was observed in 53(71.6%) levels. According to McAfee’s classification, 5 levels were classified as grade II, 21 levels were classified as grade III and 27 levels as grade IV.

Conclusions: Cervical arthroplasty with Bryan cervical disc prosthesis resulted in fine clinical outcomes at long-term follow-up. The rate of heterotopic ossification was high after Bryan disc arthroplasty and heterotopic ossification accounted for most of the reoperations.

【Key words】Cervical spondylosis; Cervical disc arthroplasty; Long-term follow-up; Heterotopic ossification; Reoperation

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1 资料与方法
1.1 临床资料
Bryan 颈椎人工椎间盘置换术的适应证为脊髓型或/和神经根型颈椎病患者，保守治疗无效，既往无颈椎手术史，无明显的颈椎不稳定和严重骨质疏松症，手术节段无明显椎间隙狭窄，后纵韧带骨化症或感染。

纳入我院骨科行 Bryan 颈椎人工椎间盘置换术且随访 10 年的病例，其中临床和影像学资料均完整者共 60 例，男 29 例，女 31 例，年龄为 20-59 岁 (43.0±7.4 岁)。神经根型颈椎病为 15 例，脊髓型颈椎病为 41 例，混合型颈椎病 (脊髓型+神经根型)4 例。接受单节段 Bryan 颈椎人工椎间盘置换术 47 例，双节段置换术 12 例，3 节段置换术 1 例，累计手术节段为 74 个节段。74 个节段节段中，C3/4 6 个，C4/5 12 个，C5/6 45 个，C6/7 11 个，60 例患者的随访时间为 124.0±8.3 个月 (117-150 个月)。

1.2 临床评估
脊髓型颈椎病病例采用 mJOA 评分评估术前和末次随访时的神经功能情况；神经根型颈椎病病例采用 VAS 评分评估术前和末次随访时的神经功能情况。

1.3 影像学评估
影像学检查包括术前和末次随访时的颈椎正侧位和过伸过屈位 X 线片检查。过伸和过屈位 X 线片上采用 White 方法测量手术节段活动度；采用 McAfee 分级评估术后异位骨化情况。其中 I 级为局部骨化块不超过椎体终板水平线；II 级为局部骨化块超过椎体终板水平线，但不影响假体活动；III 级为局部骨化块超过椎体终板水平线并影响假体活动；IV 级为局部骨化块引起手术节段骨性融合，节段活动度<2°。

1.4 统计学分析
采用 SPSS 13.0 软件对临床疗效和节段活动度进行配对样本 t 检验，P<0.05 为差异有统计学意义。
13.3±3.6分,末次随访时为15.4±1.1分;术前上肢VAS评分为4.3±2.6分,末次随访时为1.0±1.4分;术前颈痛VAS评分为2.8±1.5分,末次随访时为2.5±1.9分。

7例患者接受了二次手术治疗,其中6例为手术节段异位骨化(包括初次手术单节段椎间盘置换手术例,2例,双节段置换手术;3例;二次手术时3个节段异位骨化分级为Ⅲ级,4个节段为Ⅳ级)导致的症状而行手术节段二次手术;1例为椎病行后路单侧椎管扩大成形术,手术间隔时间为137个月。没有因为假体移位,术后血肿或感染而接受二次手术治疗者。6例手术节段二次手术患者包括新发脊椎型颈椎病5例,新发脊椎型颈椎病2例(1例新发生脊椎型颈椎病,接受二次术后在脊椎型颈椎病);手术间隔时间为48-150个月,平均为98个月。对于新发脊椎型颈椎病患者,二次前路手术使用高速磨钻去除增生骨赘和异位骨化,人工椎间盘假体保持原位,5例患者的根性症状和麻木症状手术后好转。对于新发脊椎型颈椎病患者,二次前路手术使用超声骨刀去除增生骨赘和异位骨化,取出人工椎间盘假体,行钛网植骨钛板固定融合术。7例患者二次手术后症状均缓解。

2.2 影像学结果
末次随访时,74个手术节段中有53个(71.6%)节段出现异位骨化,根据McAfee异位骨化分级,其中5个节段为Ⅱ级,21个节段为Ⅲ级,27个节段为Ⅳ级(活动度<2°)。

74个手术节段的术前活动度为7.0°±2.9°,末次随访时活动度为4.6°±4.1°(P<0.05)。按照末次随访异位骨化情况,分为异位骨化组(53个节段)和无异位骨化组(21个节段),异位骨化组末次随访时的活动度为2.6°±2.7°,无异位骨化组为9.7°±2.5°。典型病例见图1,2。

3 讨论
3.1 Bryan颈椎人工椎间盘置换术的临床疗效
Sasso等报道Bryan颈椎人工椎间盘置换术后7年和10年随访均取得了较好的临床效果,临床疗效不亚于融合术。本研究中脊椎型颈椎病和神经型颈椎病患者末次随访时均获得了较好疗效。7例患者接受了二次手术治疗,其中6例为手术节段异位骨化导致的新症状而行手术节段二次手术;1例为椎病行后路单侧椎管扩大成形术。钩椎关节增生和异位骨化形成可以导致神经根管狭窄,5例患者因为神经根管狭窄而出现神

37岁女性患者,脊椎型颈椎病a,b术前颈椎过伸过屈位X线片显示无明显椎间隙狭窄c,d术后127个月随访X线片示C4-C6假体活动度良好(C4/5节段活动度为9°,C5/6节段活动度为10°),无异位骨化

Figure 1 A 37-year-old female patient with cervical spondylotic myelopathy a, b Preoperative dynamic X-ray showed no obvious narrowing of the disc space c, d Dynamic X-ray at 127-month follow-up showed an adequate range of motion (that the range of motions of C4–5 and C5–6 were 9° and 10° respectively), no heterotopic ossification
经根性症状。前路二次手术使用高速磨钻去除了增生的骨赘和异位骨化，Bryan 人工椎间盘假体保持原位，二次手术后神经根性症状得到明显缓解。Wenger 等报告采用后路“钥匙孔”入路治疗 Bryan 人工椎间盘置换术后新发的神经根管狭窄，也取得了较好的临床效果。严重的异位骨化也可以延伸到假体后方，导致新发脊髓型颈椎病，本研究中 2 例患者二次手术取出假体，行钛网植骨钛板固定融合术。

Robertson 等对 74 例 Bryan 人工椎间盘置换术和 158 例前路融合术病例进行 2 年随访对比分析，发现 X 线片上相邻节段退变发生率融合组显著高于椎间盘置换组。Hilibrand 等报道颈椎前路融合术后邻椎病的发生率每年 2.9%。本研究中人工椎间盘置换术后 10 年随访仅有 1 例病例出现邻椎病接受了二次手术治疗，人工椎间盘置换术通过保留节段活动度，可能避免融合术后邻椎节段加速退变。

3.2 Bryan 人工椎间盘置换术后的活动度

Bryan 人工椎间盘假体为耦合运动模式，能够部分模拟颈椎的生理运动。颈椎人工椎间盘置换术的手术目的是保留手术节段的活动度，中长期随访显示 Bryan 颈椎人工椎间盘置换术后假体活动度得到了保留。Goffin 等报道单节段 Bryan 人工椎间盘置换术后 4 年和 6 年随访时活动度均得到保留。Dejaegher 等报道 Bryan 人工椎间盘置换术后 10 年随访时活动度平均为 8.6°。本研究中，10 年随访时活动度较术前降低。邻椎骨化的形成可能是导致活动度降低的原因，Ⅲ级邻椎骨化会降低活动度，Ⅳ级邻椎骨化时局部活动度<2°。

3.3 Bryan 人工椎间盘置换术后邻椎骨化


Zhou F, Ju KL, Zhao Y. et al. Progressive bone formation...

（收稿日期：2018–10–20 修回日期：2018–12–03）
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（本文编辑 李伟霞）