

doi: 10.13241/j.cnki.pmb.2019.17.027

自体髂骨移植用于后路椎弓根钉棒系统矫形内固定术治疗脊柱侧凸的临床效果及对预后的影响*

卫宝宁¹ 刘伟^{1△} 赵奋伟¹ 刘鹏¹ 宋文慧² 赵胜² 张晶³ 马燕³ 刘烈东³

(1 陕西省榆林市第一医院 骨科 陕西 榆林 719000; 2 山西医科大学第二附属医院 脊柱外科 山西 太原 030000;

3 陕西省延安大学第二附属医院 骨科 陕西 榆林 719000)

摘要 目的:探讨自体髂骨移植用于后路椎弓根钉棒系统矫形内固定术治疗脊柱侧凸的临床效果及对患者预后的影响。**方法:**选取 2014 年 4 月至 2017 年 4 月 90 例在我院及山西医科大学进行手术治疗的退行性脊柱侧凸患者作为研究对象,按照随机法将患者分为两组,各组 45 例患者。对照组采用后路椎弓根钉棒系统矫形内固定术,观察组采用后路椎弓根钉棒系统矫形内固定结合自体髂骨移植术。比较两组患者围手术期情况,术前、术后 7 天及术后 12 个月腰椎后凸角度、Cobb 角、JOA 评分、ODI 评分的变化及术后并发症发生情况。**结果:**两组患者手术时间、术中出血量、体温恢复时间、WBC 恢复正常时间、引流管置管时间比较差异无统计学意义($P>0.05$)。两组患者术后腰椎前凸角度、Cobb 角较术前明显改善($P<0.05$);术后 12 个月,观察组患者腰椎前凸角度高于对照组,Cobb 角显著低于对照组($P<0.05$)。两组患者术后 JOA 评分高于术前,ODI 评分低于术前($P<0.05$);观察组患者术后 12 个月 JOA 评分高于对照组,ODI 评分低于对照组($P<0.05$)。观察组患者并发症发生率显著低于对照组($P<0.05$)。**结论:**自体髂骨移植应用于后路椎弓根钉棒系统矫形内固定术治疗退行性脊柱侧凸效果较好,不仅可纠正脊柱侧弯,同时可减轻患者疼痛感及不适感,安全性较高。

关键词:后路椎弓根钉棒系统;自体骨移植;退行性脊柱侧凸

中图分类号:R681.5 **文献标识码:**A **文章编号:**1673-6273(2019)17-3330-04

Effect of Autogenous Iliac Bone Graft for the Posterior Pedicle Screw Rod System Orthopedic Internal Fixation for Scoliosis*

WEI Bao-ning¹, LIU Wei^{1△}, ZHAO Fen-wei¹, LIU Peng¹, SONG Wen-hui², ZHAO Sheng², ZHANG Jing³, MA Yan³, LIU Lie-dong³

(1 Department of Orthopaedics, first Hospital of Yulin City, Yulin, Shaanxi, 719000, China;

2 Department of Spinal surgery, Second affiliated Hospital of Shanxi Medical University, Taiyuan, Shaanxi, 030000, China;

3 Department of orthopaedics, Second Affiliated Hospital of Yan'an University, Yulin, Shaanxi, 719000, China)

ABSTRACT Objective: To investigate the clinical effect of autologous iliac bone transplantation for posterior pedicle screw-rod system internal fixation in the treatment of scoliosis and its influence on the prognosis of patients. **Methods:** From April 2014 to April 2017, 90 cases of patients with degenerative scoliosis who underwent surgical treatment in our hospital and Shanxi Medical University were selected as the study subjects. The patients were divided into two groups according to random method, with 45 patients in each group. The control group was treated with posterior pedicle screw-rod system, while the observation group was treated with posterior pedicle screw-rod system combined with autologous iliac bone transplantation. The changes of lumbar kyphosis angle, Cobb angle, JOA score, ODI score and complications were compared between the two groups before operation, at 7 days after operation and at 12 months after operation. **Results:** There was no significant difference in the operation time, blood loss, temperature recovery time, WBC recovery time and drainage tube indwelling time between the two groups ($P>0.05$). The lumbar lordosis angle and Cobb angle of both groups were significantly improved after operation ($P<0.05$); at 12 months after operation, the lumbar lordosis angle of observation group was higher than that of the control group, and the Cobb angle was significantly lower than that of the control group ($P<0.05$). The JOA score of both groups was higher than that before operation, and the ODI score was lower than that before operation ($P<0.05$); the JOA score of observation group was higher than that of the control group at 12 months after operation, and the ODI score was lower than that of the control group ($P<0.05$). The incidence of complications in the observation group was significantly lower than that in the control group ($P<0.05$). **Conclusion:** Autologous iliac bone transplantation is effective in the treatment of degenerative scoliosis with posterior pedicle screw-rod system. It can not only correct the scoliosis, but also alleviate the pain and discomfort with high safety.

Key words: Posterior pedicle screw rod system; Autogenous bone graft; Degenerative scoliosis

Chinese Library Classification(CLC): R681.5 **Document code:** A

Article ID: 1673-6273(2019)17-3330-04

* 基金项目:陕西省自然科学基金项目(SJ08F32)

作者简介:卫宝宁(1986-),男,硕士研究生,主治医师,研究方向:骨脊柱、创伤骨科、骨折,电话:1592995154, E-mail: zjgaomengnai@163.com

△ 通讯作者:刘伟(1983-),男,硕士研究生,主治医师,研究方向:创伤骨科

(收稿日期:2019-01-20 接受日期:2019-02-16)

前言

退行性脊柱侧凸为一种严重退行性病变,好发于老年人,随着我国社会老龄化进程的加速,其发病人群数量在不断增加^[1]。脊柱侧凸是以脊柱在冠状面上偏离躯体中线,水平面上的椎体、附件的旋转及矢状面生理曲度增加,伴有腰痛、下肢痛、间歇跛行等,给患者带来诸多不便,严重影响生活质量^[2]。引起退行性脊柱侧凸的原因较多,如生物力学因素、神经肌肉因素及内分泌代谢因素。

目前,临床对于退行性脊柱侧凸的治疗分为保守治疗及矫形手术治疗,其中手术治疗策略包括椎管减压术、前后路融合术及后路内固定等,尽可能恢复患者解剖位置及脊柱功能^[3,4]。近年研究发现^[5],单纯采用后路椎弓根钉棒系统矫形内固定术,虽然短期效果较好,但是远期以出现椎体高度丢失或相邻椎体 Cobb 角增大,引起椎体后凸畸形,严重者可出现内固定断裂等严重并发症。因此,本研究主要探讨了后路椎弓根钉棒系统矫形内固定术用于自体髂骨移植治疗脊柱侧凸的临床效果及对预后影响,以期临床治疗该疾病提供参考证据。具体结果报

道如下。

1 材料与方法

1.1 临床资料

本次研究经我院及山西医科大学伦理道德委员会审核批准,获得患者及家属同意,均签订知情同意书。纳入标准:(1)X线检查示退行性脊柱侧弯明显;(2)经 CT 检查提示椎管不同程度狭窄;(3)伴有腰间下肢疼痛,行走及站立有不适感。排除标准:(1)伴有严重心、肾功能不全,不能耐受手术者;(2)不能进行随访者;(3)拒绝入组研究者。依据纳入排除标准,选取 2014 年 4 月至 2017 年 4 月期间 90 例在我院及山西医科大学进行手术治疗的退行性脊柱侧弯患者作为研究对象,按照简单随机法将患者分为 2 组,每组各 45 例患者。对照组采用后路椎弓根钉棒系统矫形内固定术,观察组采用后路椎弓根钉棒系统矫形内固定结合自体髂骨移植术。两组患者性别、年龄、体重指数、病程等一般情况比较均无明显差异($P>0.05$),具有可比性。具体数据见表 1。

表 1 两组患者一般情况的比较

Table 1 Comparison of the general data between two groups of patients

Index	Control group(n=45)	Observation group(n=45)	χ^2/t	P
Gender (male/female)	25/20	24/21	1.0254	0.1274
Average age age age (year)	56.45± 5.83	58.83± 6.35	1.6602	0.0863
Body mass index(kg/m ²)	23.44± 1.12	22.72± 2.17	0.9506	0.2426
Course of disease (year)	4.58± 1.47	4.49± 1.51	0.8710	0.3194

1.2 方法

1.2.1 术前准备 入组患者晚上站立位全脊柱正、侧位 X 线片,采用 Cobb 法测量畸形角度,在脊柱 X 线侧位片中了解脊柱的生理弧度及矢状面的平衡情况,确定中立椎、顶椎及上下终椎,以确定手术过程中置放钉子位置以及融合范围。患者术前 1 周注重肺活量的锻炼,提高肺活量;术前留置导尿管,避免术中出現膀胱充盈。

1.2.2 手术方法 (1)对照组:采用后路椎弓根钉棒系统矫形内固定术;患者全麻后,取俯卧位,在腰背位置的正中作切口,充分剥离椎旁组织及脊柱旁肌肉,暴露脊柱侧凸节段关节突、关节囊、双侧椎板及棘突等部位;确定病变椎体后,将椎弓根螺钉正确植入椎弓根内,实施矫形,然后经神经根管、全椎板、半椎板及椎间孔,对脊髓官腔进行减压;取预先准备好的自体骨植入受骨区,最后,依据脊柱生理曲度连接钛棒,详细检查减压情况后,用引流管对流体进行引流,缝合切口。(2)观察组:采用后路椎弓根钉棒系统矫形内固定结合自体髂骨移植术;后路椎弓根钉棒系统矫形内固定术同对照组,完成椎弓根钉植入后,按照所需骨量取自体髂骨,修剪后植入受骨区,再连接钛棒。两组患者术后给予患者常规抗感染药物进行抗感染治疗,同时常规引流;2 周后依据患者伤口愈合情况拆线,并定期进行复查。

1.3 观察指标

1.3.1 围手术期情况 手术时间、术中出血量、白细胞计数

(WBC)恢复正常时间、引流管置管时间。

1.3.2 功能评分 记录术前、术后 7 天及术后 12 个月,患者的腰椎前凸角度、Cobb 角、JOA 评分^[6]及 ODI 评分^[7]。其中,JOA 评分越高,表示患者的运动功能、感觉等恢复得越好;ODI 主要是通过了解患者旅游、社会生活、性生活、干扰睡眠、站立、坐位、步行、提物、生活自理、疼痛强度 10 个方面的情况,每个问题答案具有 6 个选项,5 分为最高得分,其记分方法为:实际得分/50×100%,分数越高则代表患者有较为严重的功能障碍。

1.3.3 并发症 de 发生情况 通过电话、门诊随访,记录两组患者术后 12 个月期间并发症发生情况,包括硬脊膜撕裂、下肢疼痛、断钉、侧凸进展。

1.4 统计学分析

本次研究数据用 SPSS20.0 软件处理,计量资料以($\bar{x} \pm s$)表示,组间比较采用 t 检验,计数资料以[例(%)]表示,组间比较采用 χ^2 检验,以 $P<0.05$ 表示差异具有统计学意义。

2 结果

2.1 两组患者围手术期情况的比较

两组患者手术时间、术中出血量、WBC 恢复正常时间、引流管置管时间比较差异均无统计学意义($P>0.05$),具体数据见表 2。

2.2 两组患者手术前后腰椎前凸及 Cobb 角度的变化

两组患者术后 7 天和术后 12 个月的腰椎前凸角度较手术前明显增加,而 Cobb 角较手术前明显降低($P<0.05$);术后 12 个月,观察组患者腰椎前凸角度显著高于对照组,Cobb 角明显低于对照组($P<0.05$)。具体数据见表 3。

表 2 两组患者围手术期情况的比较

Table 2 Comparison of perioperative conditions between two groups

Groups	Operation time (min)	Intraoperative bleeding volume (mL)	WBC recovery time (d)	Drainage tube placement time (d)
Control group(n=45)	247.25± 18.20	652.74± 32.18	8.37± 1.22	2.48± 0.67
Observation group(n=45)	266.45± 16.73	701.29± 36.15	7.68± 1.31	2.42± 0.64
t	2.0254	2.6602	1.2426	0.9716
P	0.0774	0.0663	0.0994	0.1308

表 3 两组患者手术前后腰椎前凸及 Cobb 角度的变化比较[$\bar{x} \pm s$, n=45]

Table 3 Comparison of the changes of lumbar lordosis and Cobb angle before and after operation between two groups[$\bar{x} \pm s$, n=45]

Groups	Lumbar lordosis angle(°)			Cobb angle(°)		
	Before surgery	At 7 days after operation	At 12 months after operation	Before surgery	At 7 days after operation	At 12 months after operation
Control group	17.68± 1.54	27.48± 2.47 ¹	25.17± 2.86 ¹	37.44± 3.15	26.84± 2.23 ¹	26.07± 1.08 ¹
Observation group	17.35± 1.77	27.31± 2.53 ¹	26.96± 3.25 ¹	37.09± 3.06	26.38± 2.17 ¹	25.14± 1.79 ¹
t	0.8152	0.9438	4.6059	0.8711	0.8037	3.9406
P	0.3618	0.2417	0.0264	0.3348	0.3824	0.0385

Note: ¹ $P<0.05$, Compared with pre-operation.

2.3 两组患者手术前后 JOA 评分及 ODI 评分的比较

JOA 评分高于对照组,ODI 评分低于对照组($P<0.05$),具体数据见表 4。

两组患者术后 7 天和术后 12 个月的 JOA 评分高于手术前,ODI 评分低于手术前 ($P<0.05$); 观察组患者术后 12 个月

表 4 两组患者手术前后 JOA 评分及 ODI 评分的比较[$\bar{x} \pm s$, 分]

Table 4 Comparison of the JOA score and ODI score of patients before and after operation between two groups[$\bar{x} \pm s$, score]

Groups	JOA score			ODI score		
	Before surgery	At 7 days after operation	At 12 months after operation	Before surgery	At 7 days after operation	At 12 months after operation
Control group	10.33± 1.62	22.95± 2.47 ¹	25.48± 1.37 ¹	48.76± 3.25	23.49± 1.72 ¹	22.61± 1.05 ¹
Observation group	10.74± 1.78	23.34± 2.57 ¹	26.91± 2.92 ¹	49.59± 3.47	23.37± 1.81 ¹	21.55± 1.34 ¹
t	0.8305	1.2509	5.4018	1.1406	0.9244	4.3488
P	0.3502	0.0833	0.0021	0.0968	0.2167	0.0052

Note: ¹ $P<0.05$, Compared with pre-operation.

2.4 两组患者并发症发生情况的比较

17.78%,观察组患者并发症的发生率为 6.67%,观察组患者并发症的发生率显著低于对照组($P<0.05$),具体数据见表 5。

术后对患者随访 12 个月,对照组患者并发症的发生率为

表 5 两组患者并发症发生情况比较[例(%)]

Table 5 Comparisons of the incidence of complications between two groups[n(%)]

Groups	Dural tear	Lower limb pain	Nail breaking	Progress in scoliosis	Total
Control group(n=45)	2(4.44)	4(8.89)	1(2.22)	1(2.22)	8(17.78)
Observation group (n=45)	1(2.22)	2(4.44)	0(0.00)	0(0.00)	3(6.67)
χ^2					4.0318
P					0.0215

3 讨论

脊柱侧凸为一种临床常见的肌肉骨骼系统疾病,可继发于腰椎间盘突出及腰椎关节退变的成人脊柱侧凸,而非原有脊柱侧凸进展引起,或者继发于脊柱椎体器质性病变,如骨折、肿瘤等^[8-12]。研究表明^[13]退行性脊柱侧凸少见于40岁以前,多发生于50岁以上中老年人,男女发病无明显差异。退行性脊柱侧凸常由椎间盘及椎间小关节退变引起,好发于腰段及胸腰段,可有椎间盘变性、突出、椎体滑脱及椎管狭窄等多种病变,以多节段的退行性病变为主,目前对于该疾病的治疗多以充分减压和重建腰椎矢状面序列为目的^[14-18]。临床研究显示^[19-22]退行性脊柱侧凸可先有因椎间盘退变而引起以腰背痛为主要临床表现,当病变程度加重时,可因椎间盘向椎管突出压迫神经,出现下肢放射性疼痛。

临床上多采用矫形手术及内固定进行治疗,解除神经压迫,改善临床症状。研究表明^[23-26]后路椎弓根螺钉系统手术可用于椎管受压程度较重者其可降低椎管压力,解除神经根压迫程度,不仅可改善临床症状,同时可进行脊柱侧凸的矫正。退行性脊柱侧凸者因存在矢状面及冠状面的弯曲畸形,多数伴有不同程度的神经根压迫和椎管狭窄,而椎管内压缩对脊髓及神经根的损伤风险相对较小,通过凸侧的压缩进行侧弯矫正,可获得较好的治疗效果,若矫正效果不理想,可在允许范围内进行凹侧节段性撑开,达到接触压迫目的^[27,28]。该手术短期效果较好,但远期要想维持矫形的稳定常需要脊柱坚强、持久的骨性融合^[29]。研究显示^[30]自体骨移植不仅能够实现良好的骨性融合,同时具有较好的生物相容性,降低排斥风险发生。

本研究结果显示采用后路椎弓根钉棒系统矫形内固定术组患者与后路椎弓根钉棒系统矫形内固定术结合自体骨移植组患者的围手术期指标比较无统计学差异,说明在常规手术基础上采用自体髂骨移植不增加手术时间,术中出血量未明显增加。本次研究对两组患者随访12个月,结果发现两组患者术后腰椎前凸角度、Cobb角、JOA评分、ODI评分较术前明显改善,而观察组患者腰椎前凸角度高于对照组,Cobb角低于对照组,JOA评分高于对照组,ODI评分低于对照组,说明两种治疗方式对脊柱侧凸均能达到良好的短期治疗目的,而采用自体髂骨移植组患者随访12个月,患者术后脊柱曲度、神经功能优于对照组,说明自体髂骨移植能够促进骨性融合,缓解患者疼痛感,维持脊柱稳定性,改善脊柱功能。此外,本次研究结果显示观察组患者并发症发生率低于对照组,提示自体髂骨移植安全性较高。

综上所述,自体髂骨移植应用于后路椎弓根钉棒系统矫形内固定术治疗退行性脊柱侧凸效果较好,不仅可纠正脊柱侧弯,同时可减轻患者疼痛感及不适感,安全性较高。

参考文献(References)

[1] Morozova N S, Kolbovsky D A, Kazmin A I, et al. The Use of Nitinol Rods in Surgical Treatment of Degenerative Scoliosis. 2.5-Year Follow-Up[J]. *Coluna/columna*, 2016, 15(1): 22-25
[2] Blizzard D J, Gallizzi M A, Sheets C, et al. Sagittal Balance Correction

in Lateral Interbody Fusion for Degenerative Scoliosis[J]. *International Journal of Spine Surgery*, 2016, 10(1): 29
[3] York P J, Kim H J. Degenerative Scoliosis [J]. *Current Reviews in Musculoskeletal Medicine*, 2017, 10(3): 1-12
[4] Kleinstueck F S, Fekete T F, Jeszenszky D, et al. Adult degenerative scoliosis: comparison of patient-rated outcome after three different surgical treatments [J]. *European Spine Journal*, 2016, 25 (8): 2649-2656
[5] Lamerain M, Bachy M, Dubory A, et al. All-Pedicle Screw Fixation With 6-mm-Diameter Cobalt-Chromium Rods Provides Optimized Sagittal Correction of Adolescent Idiopathic Scoliosis [J]. *Clin Spine Surg*, 2016, 30(7): E857
[6] Mohi E M M, Aldin H A S. Percutaneous Transpedicular Fixation: Technical tips and Pitfalls of Sextant and Pathfinder Systems [J]. *Asian Spine Journal*, 2016, 10(1): 111-122
[7] Hosseini P, Nnadi C, Rehak L, et al. Analysis of Segmental Mobility Following a Novel Posterior Apical Short-Segment Correction for Adolescent Idiopathic Scoliosis[J]. *Spine*, 2016, 41(20): E1223
[8] Fadzan M, Bettanysaltikov J A. Etiological Theories of Adolescent Idiopathic Scoliosis: Past and Present [J]. *Open Orthopaedics Journal*, 2017, 11(Suppl-9, M3): 1466-1489
[9] Zaydman A M, Strokova E L, Kiseleva E V, et al. A New Look at Etiological Factors of Idiopathic Scoliosis: Neural Crest Cells[J]. *International Journal of Medical Sciences*, 2018, 15(5): 436-446
[10] Latalski M, Danielewicz-Bromberek A, Fatyga M, et al. Current insights into the aetiology of adolescent idiopathic scoliosis [J]. *Archives of Orthopaedic & Trauma Surgery*, 2017, 137(10): 1327-1333
[11] Garcia-Cano E, Cosjo F A, Duong L, et al. Dynamic ensemble selection of learner-descriptor classifiers to assess curve types in adolescent idiopathic scoliosis [J]. *Medical & Biological Engineering & Computing*, 2018, 56(12): 2221-2231
[12] Theologis A A, Sing D C, Chekeni F, et al. National Trends in the Surgical Management of Adolescent Idiopathic Scoliosis: Analysis of a National Estimate of 60,108 Children From the National Inpatient Sample Over a 13-Year Time Period in the United States [J]. *Spine Deformity*, 2017, 5(1): 56-65
[13] Graham R B, Sugrue P A, Koski T R. Adult Degenerative Scoliosis [J]. *Clinical Spine Surgery*, 2016, 29(3): 95
[14] Wang G, Cui X, Jiang Z, et al. Evaluation and Surgical Management of Adult Degenerative Scoliosis Associated With Lumbar Stenosis[J]. *Medicine*, 2016, 95(15): e3394
[15] Hawasli A H, Chang J, Yarbrough C K, et al. Interpedicular height as a predictor of radicular pain in adult degenerative scoliosis [J]. *Spine Journal*, 2016, 16(9): 1070-1078
[16] Brodke D S, Annis P, Lawrence B D, et al. Reoperation and Revision Rates of Three Surgical Treatment Methods for Lumbar Stenosis Associated With Degenerative Scoliosis and Spondylolisthesis[J]. *Spine*, 2013, 38(26): 2287-2294
[17] Le H J, Cogniet A, Mazas S, et al. Lumbar scoliosis associated with spinal stenosis in idiopathic and degenerative cases [J]. *European Journal of Orthopaedic Surgery & Traumatology*, 2016, 26(7): 1-8

- [24] Oh SM, Park G, Lee SH, et al. Assessing the recovery from prerenal and renal acute kidney injury after treatment with single herbal medicine via activity of the biomarkers HMGB1, NGAL and KIM-1 in kidney proximal tubular cells treated by cisplatin with different doses and exposure times [J]. BMC Complement Altern Med, 2017, 17(1): 544-553
- [25] Chung E Y, Chen J, Roxburgh S. A Case Report of Henoch-Schönlein Purpura and IgA Nephropathy Associated With Rivaroxaban[J]. Nephrology, 2018, 23(3): 289-290
- [26] Shi X, Li W C, Mo L J, et al. Altered mean platelet volume in children with Henoch-Schönlein purpura and its association with disease activity [J]. Annals of Clinical Biochemistry, 2018, 55 (3): 4563217727015
- [27] Buscatti I M, Casella B B, Aikawa N E, et al. Henoch-Schönlein purpura nephritis: initial risk factors and outcomes in a Latin American tertiary center[J]. Clinical Rheumatology, 2018, 37(5): 1319-1324
- [28] Shim J O, Han K, Park S, et al. Ten-year Nationwide Population-based Survey on the Characteristics of Children with Henoch-Schönlein Purpura in Korea [J]. Journal of Korean Medical Science, 2018, 33(25): e174
- [29] Inagaki K, Kaihan A B, Hachiya A, et al. Clinical impact of endocapillary proliferation according to the Oxford classification among adults with Henoch-Schönlein purpura nephritis: a multicenter retrospective cohort study[J]. BMC Nephrology, 2018, 19(1): 208
- [30] Yang Y, Zhang Z, Zhuo L, et al. The Spectrum of Biopsy-Proven Glomerular Disease in China: A Systematic Review[J]. Chinese Medical Journal, 2018, 131(6): 731
- [31] Wang P, Tang L, Yao J, et al. The spectrum of biopsy-proven secondary glomerular diseases: A cross-sectional study in China[J]. Clinical Nephrology, 2017, 88(11): 270

(上接第 3333 页)

- [18] Faraj S S A, Haanstra T M, Martijn H, et al. Functional outcome of non-surgical and surgical management for de novo degenerative lumbar scoliosis: a mean follow-up of 10 years[J]. Scoliosis & Spinal Disorders, 2017, 12(1): 35
- [19] Phan K, Huo Y R, Hogan J A, et al. Minimally invasive surgery in adult degenerative scoliosis: a systematic review and meta-analysis of decompression, anterior/lateral and posterior lumbar approaches[J]. J Spine Surg, 2016, 2(2): 89-104
- [20] Hang-Bo Q U, Tong P J, Wei-Feng J I, et al. Percutaneous kyphoplasty for the treatment of osteoporotic vertebral compression fracture with degenerative scoliosis [J]. China Journal of Orthopaedics & Traumatology, 2016, 29(1): 38-40
- [21] Dangelmajer S, Zadnik P L, Rodriguez S T, et al. Minimally invasive spine surgery for adult degenerative lumbar scoliosis [J]. Neurosurgical Focus, 2014, 36(5): E7
- [22] Ledonio C G T, Polly D W, Crawford C H, et al. Adult Degenerative Scoliosis Surgical Outcomes: A Systematic Review and Meta-analysis [J]. Spine Deformity, 2013, 1(4): 248-258
- [23] Kemppainen J W, Morscher M A, Gothard M D, et al. Evaluation of Limited Screw Density Pedicle Screw Constructs in Posterior Fusions for Adolescent Idiopathic Scoliosis[J]. Spine Deformity, 2016, 4(1): 33
- [24] Floccari L V, Larson A N, Stans A A, et al. Delayed Dural Leak Following Posterior Spinal Fusion for Idiopathic Scoliosis Using All Posterior Pedicle Screw Technique [J]. Journal of Pediatric Orthopedics, 2017, 37(7): e415
- [25] Tsirikos A I, Mataliotakis G, Bounakis N. Posterior spinal fusion for adolescent idiopathic scoliosis using a convex pedicle screw technique: a novel concept of deformity correction[J]. Bone & Joint Journal, 2017, 99-B(8): 1080
- [26] Namikawa T, Matsumura A, Kato M, et al. Radiological assessment of shoulder balance following posterior spinal fusion for thoracic adolescent idiopathic scoliosis[J]. Scoliosis, 2015, 10(Suppl 2): S18-S18
- [27] Wang G, Hu J, Liu X, et al. Surgical treatments for degenerative lumbar scoliosis: a meta analysis[J]. European Spine Journal, 2015, 24(8): 1792-1799
- [28] Yang Y, Jie Z, Lou S. Medium to long-term curative effects of long-segmental fixation and fusion on degenerative scoliosis [J]. Int J Clin Exp Med, 2015, 8(5): 8129-8134
- [29] Du J, Tang X, Li N, et al. Limited long-segment fusion for degenerative lower lumbar scoliosis: a special kind of scoliosis[J]. International Orthopaedics, 2016, 40(6): 1227-1231
- [30] Khojasteh A, Sadeghi N. Application of buccal fat pad-derived stem cells in combination with autogenous iliac bone graft in the treatment of maxillomandibular atrophy: a preliminary human study[J]. Int J Oral Maxillofac Surg, 2016, 45(7): 864-871