

# 成人退变性腰椎侧凸可矫正程度与侧凸节段椎间盘退变程度的相关性分析

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**摘要** 目的:探讨成人退变性腰椎侧凸(degenerative lumbar scoliosis, DLS)可矫正程度与侧凸节段椎间盘退变程度的相关性。方法:以 2014 年 6 月至 2017 年 12 月收治的成人 DLS 患者为研究对象。在患者术前拍摄的站立位全脊柱正位 X 线片、侧屈位 X 线片及胸腰椎 MRI 上评定主弯区域的椎间盘退变程度和可矫正程度。评定范围包括主弯区域侧凸顶部节段(apical vertebrae, AV),侧凸顶部上、下一节段(AV+1、AV-1),侧凸顶部椎间盘上、下两节段(AV+2、AV-2)。分别在站立位全脊柱正位 X 线片和侧屈位 X 线片上测量主弯 Cobb 角和椎间角,并以此计算脊柱柔韧性,间接评估侧凸可矫正程度。根据患者的 MRI 评价主弯区椎间盘的退变程度,依据 Pfirrmann 椎间盘退变分级标准进行分级,并按照等级进行评分(I 级为 0 分,II 级为 1 分,III 级为 2 分,IV 级为 3 分,V 级为 4 分)。结果:研究共纳入 33 例患者,男 10 例,女 23 例;年龄 55~72 岁,中位数 64 岁。患者的站立位全脊柱正位 X 线片上的主弯 Cobb 角为  $30.4^{\circ} \pm 6.4^{\circ}$ ,侧屈位 X 线片上的主弯 Cobb 角为  $18.5^{\circ} \pm 5.1^{\circ}$ ,主弯整体柔韧性为  $(39.20 \pm 9.30)\%$ 。主弯各节段的椎间盘退变程度评分比较,差异有统计学意义[AV+2:  $(2.10 \pm 0.62)$  分,AV+1:  $(3.01 \pm 0.59)$  分,AV:  $(4.11 \pm 0.69)$  分,AV-1:  $(3.14 \pm 0.81)$  分,AV-2:  $(2.90 \pm 0.71)$  分,  $F=8.118, P=0.010$ ];AV 节段椎间盘退变程度评分高于其他节段( $P=0.001; P=0.012; P=0.001; P=0.017$ )。主弯各节段的柔韧性比较,差异有统计学意义[AV+2:  $(56.08 \pm 13.52)\%$ , AV+1:  $(40.61 \pm 10.63)\%$ , AV:  $(30.30 \pm 8.22)\%$ , AV-1:  $(45.11 \pm 11.17)\%$ , AV-2:  $(60.08 \pm 12.10)\%$ ,  $F=9.104, P=0.007$ ];AV 节段的柔韧性低于其他节段( $P=0.001; P=0.000; P=0.000; P=0.001$ )。主弯各节段的椎间盘退变评分与对应节段的柔韧性均呈负相关(AV+2:  $r=-0.713, P=0.001$ ; AV+1:  $r=-0.623, P=0.000$ ; AV:  $r=-0.899, P=0.000$ ; AV-1:  $r=-0.683, P=0.001$ ; AV-2:  $r=-0.603, P=0.002$ )。结论:成人 DLS 患者主弯各节段的椎间盘均存在不同程度的退行性改变,侧凸顶部椎间盘退变程度最高、可矫正程度最差,侧凸各节段的可矫正程度与相应节段的椎间盘退变程度均呈负相关。

**关键词** 脊柱侧凸;腰椎;椎间盘退行性变;矫形外科手术

## A correlation analysis of the relationship between corrigible degree of degenerative lumbar scoliosis and degeneration degree of intervertebral disc at scoliosis segments in adults

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**ABSTRACT** **Objective:** To explore the correlation between corrigible degree of degenerative lumbar scoliosis(DLS) and degeneration degree of intervertebral disc at scoliosis segments in adults. **Methods:** The adults with DLS recruited from June 2014 to December 2017 were selected as the subjects. The degeneration degree of intervertebral disc and corrigible degree of DLS of main bending section were evaluated using the whole spine anteroposterior X-ray films in standing position and lateral flexion position and thoracic-lumbar MRI that were taken before surgery. The evaluation scopes covered apical vertebrae(AV), AV+1, AV-1, AV+2 and AV-2 of main bending section. The Cobb angle and intervertebral angle of the main bending section were measured on the whole spine anteroposterior X-ray films in standing position and lateral flexion position respectively, and the spinal flexibility was evaluated according to the final measurement results, and the corrigible degree of scoliosis was assessed indirectly. The degeneration degree of intervertebral disc of main bending section was evaluated and classified according to patients' MRI and Pfirrmann grading standards for intervertebral disc degeneration respectively, and it was scored according to the grade(0 point for grade I, 1 point for grade II, 2 points for grade III, 3 points for grade IV and 4 points for grade V). **Results:** Thirty-three patients(10 males and 23 females) between the ages of 55 and 72(Median = 64 yrs) were included in the study. The Cobb angles of the main bending section on the whole spine anteroposterior X-ray films in standing position and lateral flexion position were

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30.4 $\pm$ 6.4 and 18.5 $\pm$ 5.1 degrees respectively, and the general flexibility of the main bending section was 39.20 $\pm$ 9.30%. There was statistical difference in the scores of degeneration degree of intervertebral disc between segments of main bending section (AV+2: 2.10 $\pm$ 0.62 points, AV+1: 3.01 $\pm$ 0.59 points, AV: 4.11 $\pm$ 0.69 points, AV-1: 3.14 $\pm$ 0.81 points, AV-2: 2.90 $\pm$ 0.71 points,  $F=8.118$ ,  $P=0.010$ ). The scores of degeneration degree of intervertebral disc were higher in AV segment compared to other segments ( $P=0.001$ ;  $P=0.012$ ;  $P=0.001$ ;  $P=0.017$ ). There was statistical difference in flexibility between segments of main bending section (AV+2: 56.08 $\pm$ 13.52%, AV+1: 40.61 $\pm$ 10.63%, AV: 30.30 $\pm$ 8.22%, AV-1: 45.11 $\pm$ 11.17%, AV-2: 60.08 $\pm$ 12.10%,  $F=9.104$ ,  $P=0.007$ ). The flexibility was poorer in AV segment compared to other segments ( $P=0.001$ ;  $P=0.000$ ;  $P=0.000$ ;  $P=0.001$ ). The scores of degeneration degree of intervertebral disc were negatively correlated with the flexibility in each segment of main bending section (AV+2:  $r=-0.713$ ,  $P=0.001$ ; AV+1:  $r=-0.623$ ,  $P=0.000$ ; AV:  $r=-0.899$ ,  $P=0.000$ ; AV-1:  $r=-0.683$ ,  $P=0.001$ ; AV-2:  $r=-0.603$ ,  $P=0.002$ ). **Conclusion:** The degenerative changes of intervertebral disc at different degrees exist at each segment of main bending section in adults with DLS. The degeneration degree of intervertebral disc is highest and the corrigible degree is the lowest in AV segment. The corrigible degree is negatively correlated with degeneration degree of intervertebral disc in each segment of DLS.

**Keywords** scoliosis; lumbar vertebrae; intervertebral disc degeneration; orthopedic procedures

通常认为退变性腰椎侧凸 (degenerative lumbar scoliosis, DLS) 是由于成年后脊椎各结构, 尤其是椎间盘不对称退变导致的脊柱畸形<sup>[1]</sup>。与青少年特发性脊柱侧凸不同, DLS 较为僵硬, 矫正效果有限, 临床治疗相对棘手。此类患者通常伴有相应节段不同程度的退变, 包括椎间盘退变、椎间隙塌陷、终板硬化、骨赘形成、关节突关节增生及椎体间旋转半脱位等, 这些因素均会不同程度地影响矫形效果。目前多数学者认为椎间盘退变是 DLS 发病与进展的主要始动因素<sup>[2-3]</sup>。椎间盘退变尤其是不对称性退变势必会影响脊柱稳定性, 引起终板硬化、关节突关节增生、骨赘形成等一系列代偿性改变, 从而影响脊柱柔韧性, 而脊柱柔韧性是手术可矫正程度的可靠参照指标。但目前鲜有 DLS 与椎体退变程度相关性的研究。为此, 本研究探讨了成人 DLS 可矫正程度与侧凸节段椎间盘退变程度的相关性, 现总结报告如下。

## 1 临床资料

**1.1 一般资料** 以 2014 年 6 月至 2017 年 12 月在湖州师范学院附属第一医院住院治疗的成人 DLS 患者为研究对象。试验方案经医院医学伦理委员会审查通过。

**1.2 纳入标准** ①确诊为 DLS; ②年龄 55~75 岁; ③脊柱侧凸类型为主胸腰弯或腰弯<sup>[4]</sup>, 侧凸 Cobb 角 $>10^\circ$ ; ④有完整的术前站立位全脊柱正位 X 线片、侧屈位 X 线片及胸腰椎 MRI。

**1.3 排除标准** ①既往有脊柱或髋关节手术史者; ②因脊柱肿瘤、结核、创伤及其他因素导致的腰椎侧

凸者; ③合并严重脊柱后凸畸形 (脊柱后凸 Cobb 角 $>40^\circ$ ) 或存在脊柱冠状面、矢状面严重失衡患者。

## 2 方法

**2.1 影像学检查** 所有患者均于术前拍摄站立位全脊柱正位 X 线片、侧屈位 X 线片及胸腰椎 MRI。侧屈位 X 线片拍摄体位如下: 患者仰卧于放射台, 双手上举过头顶并握住腰椎侧凸凸侧放射台边缘; 脊柱外科医师立于患者腰椎侧凸凸侧, 以一手握拳作为支点, 置于顶椎对应体表处, 另一只手置于对侧下肢或骨盆处, 以患者能忍受的压力对脊柱侧凸凸侧进行最大程度加压 (图 1); 患者身体垂直于 X 线<sup>[5]</sup>。

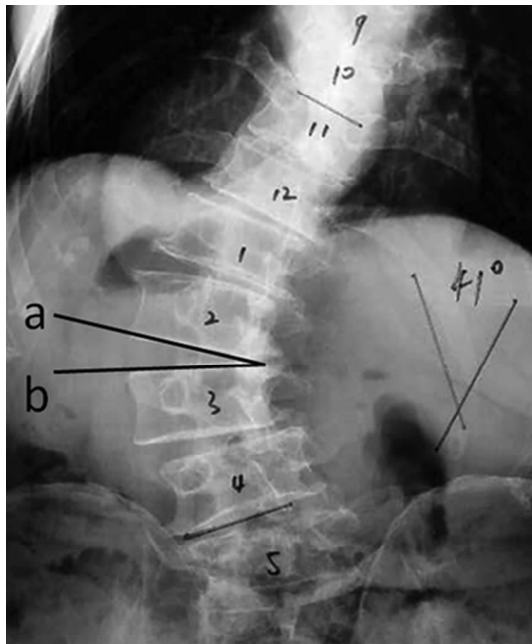


图 1 侧屈位 X 线片拍摄体位

## 2.2 影像学评价

**2.2.1 主弯侧凸可矫正程度评定** 分别在站立位全

脊柱正位 X 线片和侧屈位 X 线片上测量主弯 Cobb 角和椎间角。椎间角测量方法如下:分别通过主弯区上位椎体下终板和下位椎体上终板作直线,2 条线所成角即为该节段的椎间角(图 2)。通过计算脊柱柔韧性来间接评估侧凸可矫正程度。主弯整体柔韧性 = [(术前站立位 X 线片 Cobb 角 - 术前侧屈位 X 线片 Cobb 角) / 术前站立位 X 线片 Cobb 角] × 100%, 节段柔韧性 = [(术前站立位 X 线片椎间角 - 术前侧屈位 X 线片椎间角) / 术前站立位 X 线片椎间角] × 100%。



图中 a, b 分别为通过主弯区上位椎体下终板和下位椎体上终板的直线

图 2 椎间角测量方法

**2.2.2 主弯区椎间盘退变程度评定** 根据患者的 MRI 评价主弯区椎间盘的退变程度,依据 Pfirrmann

椎间盘退变分级标准<sup>[6]</sup>进行分级,并按照等级进行评分。Pfirrmann 椎间盘退变分级及评分标准见表 1。由两名脊柱外科医师在患者的胸腰椎 T2WI MRI 上进行评定,范围包括侧凸顶部节段(apical vertebrae, AV),侧凸顶部上、下一节段(AV + 1、AV - 1),侧凸顶部椎间盘上、下两节段(AV + 2、AV - 2)。如侧凸顶部为椎体,则将此椎体上下两个椎间盘评分的平均值记为该患者侧凸顶部节段椎间盘退变评分。若两名医生评定结果不一致,则与另一名高年资脊柱外科医师协商后确定。

**2.3 数据统计** 采用 SPSS18.0 软件进行数据统计学分析。各节段之间椎间盘退变程度、柔韧性的整体比较均采用单因素方差分析,各节段之间两两比较均采用 LSD - *t* 检验;主弯各节段椎间盘退变评分与对应节段柔韧性的相关性分析采用 Pearson 相关分析。检验水准  $\alpha = 0.05$ 。

### 3 结果

研究共纳入 33 例患者,男 10 例,女 23 例;年龄 55 ~ 72 岁,中位数 64 岁。患者的站立位全脊柱正位 X 线片上的主弯 Cobb 角为  $30.4^\circ \pm 6.4^\circ$ ,侧屈位 X 线片上的主弯 Cobb 角为  $18.5^\circ \pm 5.1^\circ$ ,主弯整体柔韧性为  $(39.20 \pm 9.30)\%$ 。主弯各节段椎间盘退变程度评分比较,差异有统计学意义;AV 节段椎间盘退变程度评分高于其他节段( $P = 0.001$ ;  $P = 0.012$ ;  $P = 0.001$ ;  $P = 0.017$ )。主弯各节段的柔韧性比较,差异有统计学意义;AV 节段的柔韧性低于其他节段( $P = 0.001$ ;  $P = 0.000$ ;  $P = 0.000$ ;  $P = 0.001$ )。主弯各节段的椎间盘退变评分与对应节段的柔韧性均呈负相关。见表 2。

表 1 Pfirrmann 椎间盘退变分级及评分标准

等级	MRI 表现				评分 (分)
	髓核结构	髓核与纤维环分界	髓核信号强度	椎间盘高度	
I 级	椎间盘髓核呈亮白色,信号均匀	清晰	信号强度不高,等同于脑脊液	正常	0
II 级	椎间盘髓核呈白色,信号不均匀	清晰	高强度信号,等同于脑脊液	正常	1
III 级	伴或不伴水平暗带,椎间盘髓核呈灰色	模糊	中等信号	正常至轻度降低	2
IV 级	椎间盘髓核呈灰色至黑色,信号不均匀	消失	中等信号至低信号	正常至中度降低	3
V 级	椎间盘髓核呈灰色,信号不均匀	消失	低信号	塌陷	4

表 2 33 例退变性腰椎侧凸患者主弯各节段退变程度评分及柔韧性

节段	样本量(个)	椎间盘退变评分( $\bar{x} \pm s$ , 分)	柔韧性( $\bar{x} \pm s$ )	r 值	P 值
AV + 2	33	2.10 ± 0.62	(56.08 ± 13.52)%	-0.713	0.001
AV + 1	33	3.01 ± 0.59	(40.61 ± 10.63)%	-0.623	0.000
AV	33	4.11 ± 0.69	(30.30 ± 8.22)%	-0.899	0.000
AV - 1	33	3.14 ± 0.81	(45.11 ± 11.17)%	-0.683	0.001
AV - 2	33	2.90 ± 0.71	(60.08 ± 12.10)%	-0.603	0.002
F 值		8.118	9.104		
P 值		0.010	0.007		

AV:侧凸顶部节段

#### 4 讨 论

DLS 是成年后由于椎体、椎间盘以及椎间关节等进行性退变而出现的腰椎冠状面 Cobb 角  $> 10^\circ$  的脊柱畸形,在老年人群的发病率各家报道不一(6% ~ 68%),且发病率随着年龄的增长呈上升趋势<sup>[7-8]</sup>。一般认为 DLS 是在脊柱退变并失稳的基础上逐渐发生的,但具体的发病机制尚不明确<sup>[9]</sup>。目前多数学者认为椎间盘退变是 DLS 发生与发展的主要因素<sup>[10-11]</sup>。Kobayashi 等<sup>[10]</sup>通过对 60 名无腰椎侧凸史的志愿者 12 年随访研究后认为,通过观察是否存在不对称的椎间盘退变可以预测 DLS 的发生。刘永胜等<sup>[11]</sup>也认为椎间盘退变是 DLS 发生的最初始过程,椎间盘的不对称退变把椎体的一部分负荷转移到椎弓根和关节突,从而引发关节突退变。Daffner 等<sup>[12]</sup>认为,脊柱椎间盘或关节突关节的不对称退变会导致脊柱相应节段的不对称性载荷,不对称性退变继续发展会产生全脊柱的不对称性负荷,而不对称负荷则会进一步加重脊柱相应节段的不对称退变,由此形成恶性循环,导致侧凸进行性发展。Murata 等<sup>[13]</sup>认为,腰椎任何节段的椎间盘退变均可以导致 DLS 的发生。然而目前对椎间盘退变与 DLS 关系的研究着重于 DLS 发病机制上,尚未见椎间盘退变程度与 DLS 柔韧性相关性的报道。本研究首次对 DLS 患者主弯各个椎间盘退变程度进行评估,并分析其与侧弯柔韧性即可矫正程度的相关性。

目前的研究显示, L<sub>4-5</sub> 椎间盘是退变发病率最高的节段<sup>[14]</sup>。但在腰椎侧凸情况下,侧凸顶部椎间盘受到旋转挤压、不对称载荷及剪切应力等综合因素影响,使得其退变最为严重,而由于脊柱的代偿作用使得侧凸顶部节段出现硬化、骨赘形成、骨桥连接等以对抗脊柱的不稳状态,从而导致侧凸顶部节段变得极度僵硬,使该节段获得部分动态稳定性<sup>[15-16]</sup>,但也会

影响手术的可矫正程度。目前关于腰椎侧凸柔韧性的评估多集中于青少年特发性脊柱侧凸,对于成人腰椎侧凸柔韧性的评估缺乏重视。侧屈位 X 线片是临床上评价腰椎侧凸柔韧性最常用的影像学手段。本研究对 33 例 DLS 患者脊柱柔韧性进行评估,得到 DLS 脊柱的平均柔韧性为 39.2%,这明显低于青少年特发性脊柱侧凸的柔韧性<sup>[14]</sup>,进一步说明了 DLS 患者脊柱僵硬、术后可矫正程度有限。

为了说明脊柱退变程度尤其是椎间盘退变程度与脊柱柔韧性的关系,本研究将患者脊柱的柔韧性同主弯区域内椎间盘退变程度进行相关性分析,发现二者呈负相关,说明椎间盘退变越严重, DLS 脊柱柔韧性越差。究其原因,考虑严重的椎间盘退变,会导致周围组织及关节突关节严重退变、增生,甚至骨桥形成,脊柱柔韧性变差。

本研究的结果提示,成人 DLS 患者主弯各节段的椎间盘均存在不同程度的退行性改变,侧凸顶部椎间盘退变程度最高、可矫正程度最差,侧凸各节段的可矫正程度与相应节段的椎间盘退变程度均呈负相关。

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