

临床论著

顶椎远端截骨治疗强直性脊柱炎胸腰椎后凸畸形

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【摘要】目的:探讨顶椎远端经椎弓根椎体截骨(pedicle subtraction osteotomy, PSO)治疗强直性脊柱炎(ankylosing spondylitis, AS)胸腰椎后凸畸形的适应证和疗效。方法:2001 年 1 月~2017 年 8 月采用顶椎远端 PSO 手术治疗 39 例 AS 胸腰椎后凸畸形患者,男 35 例,女 4 例;年龄 20~59 岁(38.2 ± 10.5 岁)。顶椎分布于 T9~L1 之间。9 例合并假关节,其中 5 例位于顶椎远端者伴神经功能损害,4 例位于顶椎者不伴神经功能损害。2 例术前已行双侧髋关节置换术;37 例术前伴一侧或双侧髋关节功能障碍,巴氏 AS 放射指数(BASRI)左侧为 2.56 ± 0.77 分,右侧为 2.42 ± 0.65 分,其中 24 例患者单侧或双侧髋关节间隙明显狭窄($\text{BASRI} \geq 3$ 分)。22 例术前腰椎前凸不足,1 例腰椎后凸。腰背痛 VAS 评分 4.83 ± 2.03 。记录患者的截骨节段和手术并发症;术前、术后及末次随访时摄站立位全脊柱正、侧位 X 线片,测量胸腰椎最大后凸角(global kyphosis, GK)、矢状面躯干偏移(sagittal vertical axis, SVA)、腰椎前凸角(lumbar lordosis, LL)、固定节段后凸角(angle of fused segments, AFS)和颌眉角(chin-brow vertical angle, CBVA)。结果:39 例患者均完成矫形手术,截骨节段:T12 2 例,L1 8 例,L2 16 例,L3 12 例,L5 1 例。1 例术中截骨椎脱位;1 例术中不良置钉;1 例术中硬脊膜破裂,术后脑脊液漏;无术中大血管损伤、术后无感染等并发症。术后所有患者后凸畸形及平视功能得到改善,腰背痛症状缓解。随访 14~144 个月(40.26 ± 28.52 个月),2 例内固定断裂,其中 1 例行翻修术,3 个月随访内固定在位,融合良好;1 例无症状,固定区域稳定,未处理。所有患者术后无假关节形成。术前 GK、LL、SVA、CBVA 分别为 $69.47^\circ \pm 14.37^\circ$ 、 $19.32^\circ \pm 19.19^\circ$ 、 $120.77 \pm 48.34\text{mm}$ 、 $23.00^\circ \pm 17.08^\circ$,术后分别为 $28.76^\circ \pm 12.83^\circ$ 、 $51.62^\circ \pm 16.08^\circ$ 、 $26.56 \pm 41.12\text{mm}$ 、 $4.19^\circ \pm 6.58^\circ$,末次随访时分别为 $30.53^\circ \pm 13.95^\circ$ 、 $49.32^\circ \pm 16.64^\circ$ 、 $32.56 \pm 35.14\text{mm}$ 、 $4.78^\circ \pm 6.22^\circ$,术后与术前比较均有显著性差异($P < 0.05$),末次随访时与术后比较均无统计学差异($P > 0.05$)。术后 AFS 平均为 $22.77^\circ \pm 10.86^\circ$,末次随访时为 $24.29^\circ \pm 10.99^\circ$,无统计学差异($P > 0.05$)。末次随访时 VAS 评分为 1.82 ± 1.64 ,与术前比较有显著性差异($P < 0.05$)。结论:AS 胸腰椎后凸畸形患者于顶椎远端行 PSO 手术可以明显改善矢状面平衡,对以矫正 SVA 为主要目的,术前顶椎区假关节不伴有神经损害、顶椎远端假关节伴有神经损害、术前髋关节功能受限、顶椎位置位于胸腰段以上、腰椎前凸不足或后凸且顶椎位置位于胸腰交界处的患者,于顶椎远端截骨可以取得满意手术疗效。

【关键词】强直性脊柱炎;胸腰椎后凸;经椎弓根椎体截骨;顶椎远端

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【Abstract】Objectives: To investigate the indications and efficacy of performing pedicle subtraction osteotomy (PSO) distal to the apex for thoracolumbar kyphosis caused by ankylosing spondylitis(AS). Methods: Between January 2001 and August 2017, 39 AS patients(35 males and 4 females) treated with osteotomy distal to apical region were retrospectively reviewed. The mean age was 38.2 ± 10.5 years(range, 20 to 59 years). The location of apex ranged from T9 to L1. Preoperative pseudarthrosis was found in 9 cases, involving 4 cases with pseudarthrosis located at apex but without neurologic deficit and 5 cases with the lesions located below apex with neurologic deficit. Bilateral total hip replacement(THR) was performed for 2 patients. Besides, 37 cases presented with unilateral or bilateral hip dysfunction before surgery. The mean BASRI-hip scores were 2.56 ± 0.77 for the left side and 2.42 ± 0.65 for the right side. Severe narrowing of unilateral or bilateral hip joint

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space(BASRI ≥ 3) was found in 24 out of 39 cases. Hypolordotic lumbar spine was found in 22 cases while kyphotic lumbar spine was identified in 1 case. Preoperative CBVA and VAS were $23.00^{\circ}\pm 17.08^{\circ}$ and 4.83 ± 2.63 , respectively. The osteotomy level, complications were assessed. Also, the radiographic parameters including global kyphosis(GK), sagittal vertical axis(SVA), lumbar lordosis(LL), angle of fused segments(AFS), and chin-brow vertical angle(CBVA) were evaluated. **Results:** All the 39 patients underwent correction surgery. The osteotomy level varied from T12 to L5(T12 2 cases, L1 8 cases, L2 16 cases, L3 12 cases and L5 1 case). Surgical complications included one case of intraoperative vertebral subluxation and one case of screw malposition. Intraoperative dural tears with cerebrospinal fluid leakage was observed in one case and was resolved at discharge. Also, no vascular complication, infection or postoperative nonunion was found. Kyphotic deformity, persistent back pain and impaired horizontal gaze were all resolved postoperatively. The average follow-up was 40.26 ± 28.52 months, ranging from 14 to 144 months. One patient underwent revision surgery for rod breakage and achieved solid bone union at 3-month follow-up. On the contrary, conservative treatment was performed for another case with stable fused region. The preoperative GK, LL, SVA and CBVA were $69.47^{\circ}\pm 14.37^{\circ}$, $19.32^{\circ}\pm 19.19^{\circ}$, 120.77 ± 48.34 mm and $23.00^{\circ}\pm 17.08^{\circ}$, respectively. The above-mentioned parameters were changed to $28.76^{\circ}\pm 12.83^{\circ}$, $51.62^{\circ}\pm 16.08^{\circ}$, 26.56 ± 41.12 mm and $4.19^{\circ}\pm 6.58^{\circ}$ after operation, respectively, and there was significant difference with that of preoperation($P<0.05$). At the final follow-up, the above-mentioned parameters were $30.53^{\circ}\pm 13.95^{\circ}$, $49.32^{\circ}\pm 16.64^{\circ}$, 32.56 ± 35.14 mm, $4.78^{\circ}\pm 6.22^{\circ}$, and there was no significant difference with that of postoperation ($P>0.05$). AFS was $22.77^{\circ}\pm 10.86^{\circ}$ of postoperation, and $24.29^{\circ}\pm 10.99^{\circ}$ at the final follow-up($P>0.05$). VAS was 1.82 ± 1.64 at the final follow-up, and there was significantly difference with that of preperation($P<0.05$). **Conclusions:** PSO distal to apex was a feasible and effective method to restore sagittal balance in AS-related kyphosis. Osteotomy distal to apex can be considered with the following criteria including primary surgical goal was to correct the SVA instead of GK, pseudarthrosis located at apex without neurologic deficit, pseudarthrosis located below apex with neurologic deficit, preoperative restricted hip function, apex located at middle thoracic spine, and flattening of the lumbar spine with apex at thoracolumbar junction.

[Key words] Ankylosing spondylitis; Thoracolumbar kyphosis; Pedicle subtraction osteotomy; Distal to apex

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强直性脊柱炎(ankylosing spondylitis, AS)主要累及脊柱及骶髂关节等中轴骨骼,随着疾病的进展,患者逐渐出现严重的矢状面失衡,表现为胸椎后凸的增大及腰椎前凸的减小^[1]。同时由于进行性的骨化和连续性骨赘的形成,最终发展成为僵硬的胸腰椎后凸畸形,致腰背部疼痛和平视功能的丢失,影响患者的个人自理能力和生活质量^[2,3]。既往的研究报道,对于 AS 后凸畸形的患者,采用经椎弓根椎体截骨(pedicle subtraction osteotomy, PSO)的方法可以明显改善患者的畸形并重建矢状面的平衡^[3-6]。关于截骨节段的选择,理论上应选择在顶椎区域,因为顶椎离表层皮肤的距离近容易暴露且椎体更易切除,同时在顶椎截骨后该区域弯棒的角度小更容易控制。但是,在顶椎区截骨可能增加术中神经损伤、硬膜撕裂的风险。相较而言,我们发现在顶椎远端截骨的部分 AS 患者中远期随访同样可以获得稳定的矫形效

果^[7]。目前,对 AS 胸腰椎后凸畸形患者顶椎远端截骨的疗效及适应证未见文献报道。现对我院采用顶椎远端 PSO 手术治疗的 AS 胸腰椎后凸畸形患者的临床资料进行回顾性分析,旨在评估 AS 胸腰椎后凸畸形患者在顶椎区域行远端截骨的临床疗效,分析 AS 患者顶椎远端行 PSO 手术的适应条件。

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 AS 胸腰椎后凸畸形;(2)胸腰椎最大后凸角(global kyphosis, GK) $\geq 40^{\circ}$;(3)随访时间 ≥ 12 个月;(4)有完整的临床及影像学资料,包括术前、术后及末次随访时站立位全脊柱正侧位 X 线片;(5)行单节段 PSO。排除合并脊柱骨折、脊柱肿瘤和翻修手术患者。

1.2 一般资料

2001 年 1 月~2017 年 8 月在我院确诊并治疗的 AS 胸腰椎后凸畸形患者 291 例,按上述纳入及排除标准,共有 39 例采用顶椎远端 PSO 手术治疗的纳入本研究,男 35 例,女 4 例;年龄 20~59 岁(38.2 ± 10.5 岁)。顶椎位置:T9 1 例,T10 5 例,T10/11 1 例,T11/12 3 例,T12/L1 1 例,T11 7 例,T12 13 例,L1 8 例。9 例合并假关节,其中 5 例位于顶椎远端者伴神经功能损害,4 例位于顶椎者不伴神经功能损害。2 例术前行双侧髋关节置换术;37 例术前伴一侧或双侧髋关节功能障碍,巴氏 AS 放射指数(BASRI)^[8]左侧为 2.56 ± 0.77 分,右侧为 2.42 ± 0.65 分,其中 24 例患者单侧或双侧髋关节间隙明显狭窄($\text{BASRI}\geq 3$ 分)。22 例术前腰椎前凸不足,1 例腰椎后凸。

1.3 手术方法

全身麻醉后,患者俯卧于弓形托架上,后正中皮肤切口,切开皮肤、皮下组织和腰背筋膜至棘突。自远及近行一侧骨膜下剥离,显露骨性结构,剥离后纱布填塞;同样方式暴露对侧。自动拉钩撑开软组织与肌肉。在既定节段置入椎弓根螺钉,在截骨椎上下邻近关节间行 V 形截骨,然后行截骨椎全椎板切除,暴露双侧椎弓根,单侧临时棒固定,防止截骨椎脱位及截骨面过早塌陷及闭合。用磨钻经椎弓根钻入,在椎体内开辟一个可以使髓核钳进出的隧道。超声骨刀去松质骨截骨,将两侧的骨性隧道打通,形成椎体内的楔形空腔,再用反向刮匙将椎体后壁推入截骨后形成的空腔。截骨完成后,松开临时固定的短棒,潜行修正上位椎板下缘和下位椎板上缘,避免矫形复位时对神经根造成机械性压迫。用两把持钉钳持住下位邻近椎体的椎弓根螺钉,以防止远端前脱位。缓慢调节弓形架进行复位矫形,直至截骨处 V 形底边缩短、消失,截骨面靠拢闭合。放置单侧预弯固定棒,以截骨椎椎体前臂为支点,利用悬梁臂技术进行加压使前柱中柱截骨面均闭合。放置另一侧固定棒,再从远端向近端依次拧紧螺帽。手术全程在体感诱发电位和运动诱发电位联合监护下完成。

1.4 疗效评估方法

统计所有患者截骨节段及术后并发症。在术前、术后及末次随访时站立位全脊柱正侧位 X 线片上测量以下矢状面影像学参数:(1)胸腰椎最大后凸角(global kyphosis,GK)^[1],胸腰椎最倾斜的上端椎的上终板和下端椎的下终板之间的夹角。

(2)腰椎前凸角(lumbar lordosis,LL)^[9],T12 下终板与骶骨上终板之间的角度(正值为腰椎前凸,负值为后凸)。(3)矢状面躯干偏移(sagittal vertical axis,SVA)^[10],经 C7 椎体中点的铅垂线与骶骨后上角之间的距离(正值表示铅垂线位于前方,负值表示铅垂线位于后方)。(4)固定节段后凸角(angle of fused segments,AFS)^[11],上融合椎上终板与下融合椎下终板之间的角度。(5)颌眉角(chin-brow vertical angle,CBVA)^[4]:颌眉线与躯干垂线的夹角。

1.5 统计学方法

计量资料均采用 $\bar{x}\pm s$ 表示,应用 SPSS 24.0 (SPSS 公司,美国)统计软件包对所有数据进行统计分析,采用配对 t 检验比较术前与术后、术后与末次随访时的矢状面测量参数之间的差异, $P<0.05$ 为差异有统计学意义。

2 结果

2.1 手术情况

患者均完成截骨手术,截骨节段:T12 2 例,L1 8 例,L2 16 例,L3 12 例,L5 1 例。术前伴有假关节的 9 例患者中,有神经损害的 5 例,且均位于顶椎远端(分布于 T11/12 与 L4/5 之间),采用经假关节 PSO 手术的方式;4 例患者假关节位于顶椎区且术前不伴有神经损害症状的患者采用跨越假关节固定并于远端行 PSO 的术式。术中 1 例患者出现截骨椎脱位;1 例出现术中腰椎不良置钉,患者无迟发神经损害症状;1 例经假关节截骨患者术中硬脊膜破裂,术后脑脊液漏,出院时愈合;术中无大血管或神经损伤,术后无感染及假关节形成。2 例术后出现内固定断裂,其中 1 例翻修后 3 个月随访内固定在位,融合良好;另 1 例未出现症状,随访过程中固定区域稳定,未予特殊处理。

2.2 脊柱矢状面参数

术后所有患者的后凸畸形及平视功能得到改善,腰背部疼痛症状均缓解。术前、术后和末次随访时的脊柱矢状面参数和 VAS 评分见表 1。术后 GK、LL、SVA 和 CBVA 与术前比较均有显著性差异($P<0.05$),末次随访时与术后比较均无显著性差异($P>0.05$);末次随访时 VAS 评分与术前比较显著性降低($P<0.05$),AFS 与术后比较无显著性变化($P>0.05$),矫正无明显丢失(图 1~4)。

3 讨论

3.1 AS 胸腰椎后凸患者顶椎远端截骨的疗效

AS 患者在疾病的中晚期常出现僵硬的胸腰椎后凸畸形,严重影响患者的平视功能及生活质量

表 1 AS 胸腰椎后凸畸形患者手术前后影像学参数和 VAS 评分 ($\bar{x}\pm s, n=39$)

Table 1 Radiographic assessment and VAS score of preoperative, postoperative and final follow-up

	术前 Preoperation	术后 Postoperation	末次随访 Final follow-up
GK(°)	69.47±14.37	28.76±12.83 ^①	30.53±13.95
LL(°)	19.32±19.19	51.62±16.08 ^①	49.32±16.64
SVA(mm)	120.77±48.34	26.56±41.12 ^①	32.56±35.14
CBVA(°)	23.00±17.08	4.19±6.58 ^①	4.78±6.22
AFS(°)	—	22.77±10.86	24.29±10.99
VAS	4.83±2.63	—	1.82±1.64 ^①

注:GK,胸腰椎最大后凸角;LL,腰椎前凸角;SVA,矢状面躯干偏移;AFS,固定节段后凸角;CBVA,颌眉角;①与术前比较 $P<0.05$

Note: GK, global kyphosis; LL, lumbar lordosis; SVA, sagittal vertical axis; AFS, angle of fused segments; CBVA, chin-brow vertical angle; ①Compared with preoperation, $P<0.05$

量。目前,后路 PSO 手术已成为 AS 后凸矫形的标准术式,而手术策略制定的首要环节便是截骨椎位置的确定。Chen 等^[7]曾对 78 例 AS 患者行顶椎区域截骨,取得了良好的矫形效果,平均每个截骨节段取得 34.5°的后凸矫正,并指出顶椎截骨更容易操作且可取得满意的弯棒角度。本组患者采用顶椎远端 PSO, GK 和 SVA 矫正度平均为 41°和 94mm,与经顶椎截骨矫形手术疗效相仿^[3,7],随访过程中也未见明显矫正丢失和矢状面失平衡。

本组患者术后及随访过程中共出现了 2 例内固定断裂(2.6%),发生率低于文献中曾经报道的成人脊柱畸形手术的发生率(15.8%~22.0%)。本研究采用 AFS 来评估固定区域的稳定性,末次随访与术后无明显差异,截骨部位无新发假关节形成,提示顶椎远端截骨的 AS 患者融合区内的力学环境也较为稳定、骨性愈合良好。

3.2 AS 胸腰椎后凸患者顶椎远端截骨的适应证

由于炎症及韧带骨化的影响,AS 胸腰椎后凸畸形结构极其僵硬,矫形需通过以截骨椎体前方

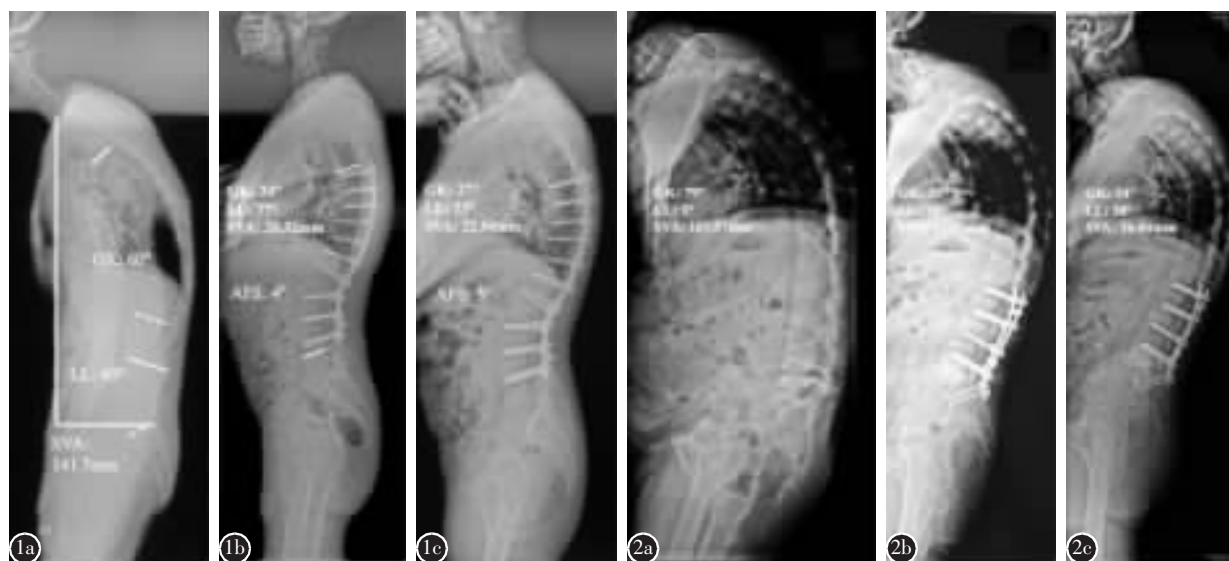


图 1 患者男,40 岁,AS 胸腰椎后凸畸形 a 术前 X 线片示 SVA 为 141.7mm, GK 为 60°, 顶椎为 T11 b 行顶椎远端 L1 椎体截骨,融合节段为 T6~L4,术后 GK 和 SVA 矫正至 24°和 20.32mm c 术后 24 个月随访无明显矫正丢失 图 2 患者男,54 岁,AS 胸腰椎后凸畸形伴神经损害 a 术前 X 线片示顶椎为 T12,顶椎远端 L4/5 假关节形成 b 行经假关节 PSO 手术,融合节段为 L1~S1 c 术后 24 个月随访无明显矫正丢失

Figure 1 A 40-year-old male with thoracolumbar kyphosis a Preoperation GK was 60° and the primary surgical goal was to correct the SVA, the apex was at T11 b PSO was performed at L1 with T6 to L4 posterior fixation. Postoperative GK and SVA were corrected to 24° and 20.32mm c No obvious correction loss was observed at the 24-month follow-up **Figure 2** A 54-year-old male with thoracolumbar kyphosis a Preoperation the apex was at T12 and pseudoarthrosis was found at L4/5 b PSO was performed via pseudoarthrosis with L1 to S1 fixation c No obvious correction loss was observed at the 24-month follow-up

骨皮质中点为铰链完成,截骨椎的位置越低,与躯干重心的距离越长,截骨闭合的过程中力臂越长,躯干的偏移越大,SVA 的恢复更多^[12,13]。因此,对于以 SVA 的矫正而不是后凸程度矫正为主要目的的 AS 患者,适合于在顶椎远端截骨。Van Royen 等^[14]也指出截骨椎的位置越低,对于 C2 SVA 及 C7 SVA 的影响越大。

由于 AS 多中心和非连续骨化的特点,常会残留单个节段的非骨化区,这个区域在承受异常应力和微动的情况下形成难以愈合的病损^[15]。如果没有及时处理,椎体终板破坏,椎体塌陷进而形成局部的后凸畸形,严重者累及三柱甚至压迫椎管造成神经损害。因此,术前假关节的评估对于截骨节段的选择尤为重要。本组中有 5 例患者术前顶椎远端的假关节引发了神经损害,均采用经假关节 PSO 手术的方法来完成减压和矫形的目的。Qian 等^[16]对 7 例 AS 伴假关节患者行经假关节 PSO 手术,末次随访时矫形效果稳定,无严重并发症。Zhang 等^[17]也对经假关节楔形截骨手术的可行性进行了分析,指出此术式可以获得满意的后凸

畸形矫正和神经减压,但是术中要避免损伤硬膜造成术后脑脊液漏的风险。另一方面,对于不伴有神经损害的顶椎区域的假关节,采用远端 PSO 手术并跨越假关节固定的方法同样可行。本研究中 4 例患者采用了此术式,术后及随访过程中无明显矫正丢失,假关节处也观察到连续骨皮质的形成,提示骨性愈合良好。可能原因包括三点:(1) AS 疾病自身较强的成骨能力;(2) 上半身躯干的力线转移到假关节处;(3) 假关节处的剪切应力转变为压缩应力有助于愈合^[3]。

本组中 9 例患者出现双侧髋关节关节间隙明显狭窄,功能受限,因此术前髋关节的功能也是截骨位置选择需要考量的因素之一。对于术前髋关节功能正常的患者,后凸畸形一部分通过髋关节的屈曲代偿,若在顶椎截骨且截骨量过大,GK 矫正过多,可以通过术后髋关节形态的重塑来保证正常的平视功能^[18]。但是对于髋关节功能受限甚至是完全僵直的患者,GK 的矫正完全靠截骨椎上方的闭合复位完成,截骨角度过大时容易出现躯干后倾而髋关节无法代偿,因此推荐在顶椎远



图 3 患者男,44 岁,AS 胸腰椎后凸畸形 **a** 术前 X 线片示顶椎区 T10/11 假关节形成 **b** 行顶椎远端 L1 椎体截骨,跨越假关节固定,融合节段为 T6~L4 **c** 术后 36 个月随访无明显矫正丢失 **图 4** 患者女,46 岁,AS 胸腰椎后凸畸形 **a** 术前 X 线片示顶椎为 T9,GK 为 98°,LL 为 24°,SVA 为 119.67mm **b** 行顶椎远端 L1 椎体 PSO 手术,融合节段为 T6~L4,术后 GK、LL 和 SVA 改善为 44°、56°和 41.56mm **c** 术后 14 个月随访无明显矫正丢失

Figure 3 A 44-year-old male with thoracolumbar kyphosis **a** Preoperative pseudoarthrosis was found at the apical region(T10/11) without neurologic deficit **b** PSO was performed at L1 with fixation across over the pseudarthrosis **c** No obvious correction loss and complication was observed at the 36-month follow-up **Figure 4** A 46-year-old female with thoracolumbar kyphosis **a** Preoperative, the apex was at T9, GK, LL and SVA were 98°, 24° and 119.67mm **b** PSO was performed at L1 with T6 to L4 posterior fixation. Postoperative GK, LL and SVA were corrected to 44°, 56° and 41.56mm **c** No obvious correction loss was observed at the 14-month follow-up

端截骨。

Diao 等^[19]曾对 AS 患者腰椎的形态学进行分类,分为后凸型和前凸型,而针对腰椎为后凸型的患者,在下腰椎进行截骨可以得到更多的腰椎前凸的矫正。因此,我们总结对于顶椎位置在胸腰段的患者,如果术前腰椎为后凸类型或者腰椎前凸不足,则推荐在顶椎远端截骨,既能获得比较大的 SVA 矫正,也能塑造比较自然的腰椎形态。

另外,顶椎的位置若位于胸腰段以上,由于肋骨的限制,在 T11 椎体及以上截骨限制了矫形的程度,因此对于顶椎位置较高的患者也应采用远端截骨的策略。本研究中顶椎位于 T9 的有 1 例、位于 T10 的有 3 例在腰椎行 PSO 手术,矫形效果满意。

3.3 AS 胸腰椎后凸患者顶椎远端截骨的优劣势

相对于在顶椎区截骨,下腰椎的椎管更为宽大,顶椎远端截骨时神经损伤、脊髓褶皱或神经根卡压的风险更小,手术更安全;其次,对于顶椎在胸腰段附近的患者,在远端截骨可以摆脱肋骨与胸腔的限制并取得更大的矫正;同时,在顶椎远端进行操作时,相同的截骨角度躯干的重心更容易后移,从而避免截骨后患者平卧时头部与背部距离过大,影响睡眠^[20,21];最后,在俯卧位时 L2/3 椎体作为应力集中点,更容易实现复位,减少脱位的风险^[7,22]。在顶椎远端截骨存在的缺点包括对后凸程度矫正不足,残存部分畸形或过度矫正 SVA 可能。

总之,AS 胸腰椎后凸畸形患者在顶椎远端行 PSO 手术可获得稳定的矫形效果且并发症发生率低。对于以矫正 SVA 而非纠正后凸程度为主、术前髋关节功能受限、顶椎位置位于胸腰段以上或顶椎位于胸腰段但腰椎前凸不足的患者,推荐在顶椎远端进行截骨。同时,对于顶椎区域假关节形成无神经损害或者顶椎远端假关节伴有神经损害的患者,采用顶椎远端截骨方式同样可行。但本研究为回顾性研究,且纳入的病例数较少,在顶椎区远端行 PSO 手术的远期疗效及更大范围的适应证还需要进一步扩大样本量,延长随访时间。另外,对于 AS 患者截骨节段的选择需要综合考虑顶椎位置、后凸程度、腰椎形态、假关节位置或髋关节功能等多种因素,依据个人情况制定合适的截骨方案。

4 参考文献

1. Qian BP, Wang XH, Qiu Y, et al. The influence of closing-opening wedge osteotomy on sagittal balance in thoracolumbar kyphosis secondary to ankylosing spondylitis: a comparison with closing wedge osteotomy[J]. Spine(Phila Pa 1976), 2012, 37(16): 1415-1423.
2. Van Tubergen A, Ramiro S, van der Heijde D, et al. Development of new syndesmophytes and bridges in ankylosing spondylitis and their predictors: a longitudinal study[J]. Ann Rheum Dis, 2012, 71(4): 518-523.
3. Chang KW, Chen YY, Lin CC, et al. Closing wedge osteotomy versus opening wedge osteotomy in ankylosing spondylitis with thoracolumbar kyphotic deformity [J]. Spine (Phila Pa 1976), 2005, 30(14): 1584-1593.
4. Kim KT, Suk KS, Cho YJ, et al. Clinical outcome results of pedicle subtraction osteotomy in ankylosing spondylitis with kyphotic deformity[J]. Spine, 2002, 27(6): 612-618.
5. Kim KT, Park DH, Lee SH, et al. Results of corrective osteotomy and treatment strategy for ankylosing spondylitis with kyphotic deformity[J]. Clin Orthop Surg, 2015, 7(3): 330-336.
6. Qian BP, Jiang J, Qiu Y, et al. Radiographical predictors for postoperative sagittal imbalance in patients with thoracolumbar kyphosis secondary to ankylosing spondylitis after lumbar pedicle subtraction osteotomy[J]. Spine(Phila Pa 1976), 2013, 38(26): E1669-1675.
7. Chen IH, Chien JT, Yu TC, et al. Transpedicular wedge osteotomy for correction of thoracolumbar kyphosis in ankylosing spondylitis[J]. Spine, 2001, 16(2): 354-360.
8. MacKay K, Brophy S, Mack C, et al. The development and validation of a radiographic grading system for the hip in ankylosing spondylitis: the bath ankylosing spondylitis radiology hip index[J]. J Rheumatol, 2000, 27(12): 2866-2872.
9. Min K, Hahn F, Leonardi M. Lumbar spinal osteotomy for kyphosis in ankylosing spondylitis: the significance of the whole body kyphosis angle[J]. J Spinal Disord Tech, 2007, 20(2): 149-153.
10. Qian BP, Jiang J, Qiu Y, et al. The presence of a negative sacral slope in patients with ankylosing spondylitis with severe thoracolumbar kyphosis[J]. J Bone Joint Surg Am, 2014, 96(22): e188.
11. Qiao M, Qian BP, Mao SH, et al. The patterns of loss of correction after posterior wedge osteotomy in ankylosing spondylitis-related thoracolumbar kyphosis: a minimum of five-year follow-up[J]. BMC Musculoskelet Dis, 2017, 18(1): 465.
12. Camargo FP, Corderio EN, Napoli MM. Corrective osteotomy of the spine in ankylosing spondylitis. Experience with 66 cases[J]. Clin Orthop Relat Res, 1986, 208: 157-167.
13. Koller H, Koller J, Mayer M, et al. Osteotomy in ankylosing spondylitis: where, how many, and how much[J]. Eur Spine

- J, 2018, 27(Suppl 1): S70-100.
14. Van Royen BJ, De Gast A, Smith TH. Deformity planning for sagittal plane corrective osteotomies of the spine in ankylosing spondylitis[J]. Eur Spine J, 2000, 9(6): 492-498.
15. Fang D, Leong JC, Ho EK, et al. Spinal pseudarthrosis in ankylosing spondylitis: clinicopathological correlation and the results of anterior spinal fusion [J]. J Bone Joint Surg Br, 1988, 70(3): 443-447.
16. Qian BP, Qiu Y, Wang B. Pedicle subtraction osteotomy through pseudarthrosis to correct thoracolumbar kyphotic deformity in advanced ankylosing spondylitis [J]. Eur Spine J, 2012, 21(4): 711-718.
17. Zhang X, Wang Y, Wu B, et al. Treatment of Andersson lesion-complicating ankylosing spondylitis via transpedicular subtraction and disc resection osteotomy: a retrospective study[J]. Eur Spine J, 2016, 25(8): 2587-2595.
18. Rousseau MA, Lazenec JY, Tassin JL, et al. Sagittal rebalancing of the pelvis and the thoracic spine after pedicle subtraction osteotomy at the lumbar level[J]. J Spinal Disord Tech, 2014, 27(3): 166-173.
19. Diao WY, Qian BP, Qiu Y, et al. Does the preoperative lumbar sagittal profile affect the selection of osteotomy level in pedicle subtraction osteotomy for thoracolumbar kyphosis secondary to ankylosing spondylitis[J]. Clin Neurol Neurosurg, 2018, 172: 39-45.
20. Liu ZJ, Qian BP, Qiu Y, et al. Does postoperative PI-LL mismatching affect surgical outcomes in thoracolumbar kyphosis associated with ankylosing spondylitis patients [J]. Clin Neurol Neurosurg, 2018, 169: 71-76.
21. Lazenec JY, Saillant G, Saidi K, et al. Surgery of the deformities in ankylosing spondylitis: our experience of lumbar osteotomies in 31 patients[J]. Eur Spine J, 1997, 6(4): 222-232.
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